MINISTRY OF PUBLIC
WORKS AND TRANSPORT

General Directorate of Techniques
Road Infrastructure Department

Guidelines for Repairing Defects of Roads

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Road Inventory and Maintenance Office Phnom Penh,
Guideline (Ver.1), June, 2016

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CHAPTER I

INTRODUCTION

Introduction

Roads are an enormous national investment and required maintenance to keep them in a satisfactory condition and ensure safe passage at an appropriate speed for the commuters. Late or insufficient maintenance will increase the ultimate repair cost and inconvenience and most importantly the safety.

The intent of this guideline is to present standard practical methods for paved and unpaved road repair to the Provincial Department of Public Works (DPWT) of Cambodia. From past experiences, various methods and materials had been adopted by DPWT which lead to diverse result that has different effect on lifetime of road, quality of the ride for the commuters and the cost of repairing.

This guideline for road repair will provide road engineers with an easy and clear instruction on repairing various job code. With the pocket format will allow engineers to be able to carry around and consulted on site. It is a quick reference should there be necessary.

This guideline handbook includes minimum requirement of work methods, description, possible causes and technical specifications. It is also important to remind the engineers to keep records in regards to materials, equipment, number of workers needed and the productivity of work expected daily for update of the guideline.

CHAPTER II

JOB CODE

Ministry of Public Works and Transport	**Job Code: 1100**	

Activity: Pothole repair- Asphalt Concrete (AC) by Plant Hot Mix (m^2)

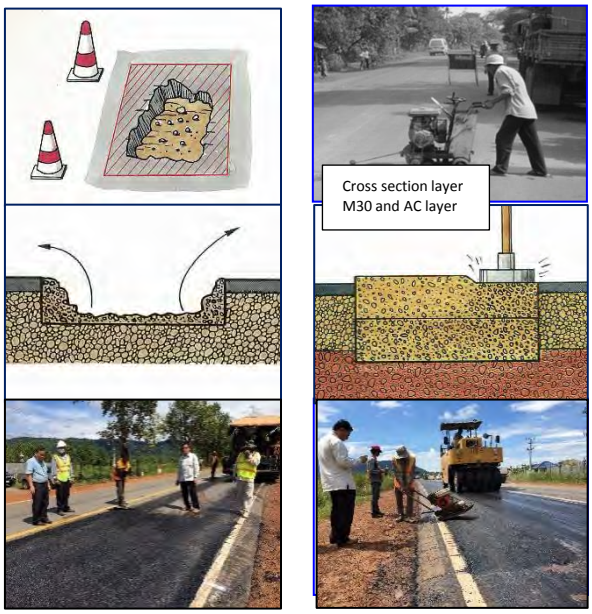
Description: Pothole are bowl shaped holes in the pavement surface. Average potholes depth is around 6 – 10 cm, the more severe case is bigger than 10 cm. Average pothole size is around 10cm ~ 100cm.

Possible Cause:

- Infiltration of water
- The bowl has broken into small piece of the lumps without prompt repairs.
- Incorrect compaction or grading of road surface
- Road crack left unrepaired (Develop from Alligator Cracks)
- Break away of material under the action of traffic.
- Final stage in the development of a depression.

Work method:

1. Mark out the pothole area in a rectangular shape
2. Used cutter machine and manual excavation
3. Remove debris from potholes
4. Excavate to remove all bad materials until firm material is found
5. Backfilling the hole with M30 aggregate as base material
6. CSS-1 (Equivalent prime coat 0.8 ~ 1.2 L /m^2)
7. Apply Asphalt Concrete (AC) by Plant Hot Mix.
8. Compact the patch area with vibrating roller, vibrating plate or a rammer.
9. Traffic can resume immediately after final compaction



Manpower	Tool and Equipment	Material
• 1 operator of hand roller compactor or vibrating plate compactor (rammer) • 2 safety officers at both end of work site • Approximately total of 10 men on the site	• Concrete cutting machine • Wheel barrow • Mechanical broom/shovels • Concrete Mixer (200 Lits.) • Tamping rammer (60Kg) or vibrating plate (60Kg) and Hand Roller Compacter (500Kg) • Safety sign, cones, vest	• Marking chalk or spray • M30 aggregates • CSS-1 • Plant Hot Mixed Asphalt Concrete (AC)
Quality Control	• Check all loose material are being removed before filling pothole • Surface of pothole should be slightly higher than the road by 1cm	
Productivity	• Approximately 50-100 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1101**	

Activity: Pothole repair- Asphalt Concrete (AC) by Site Mix (m^2)

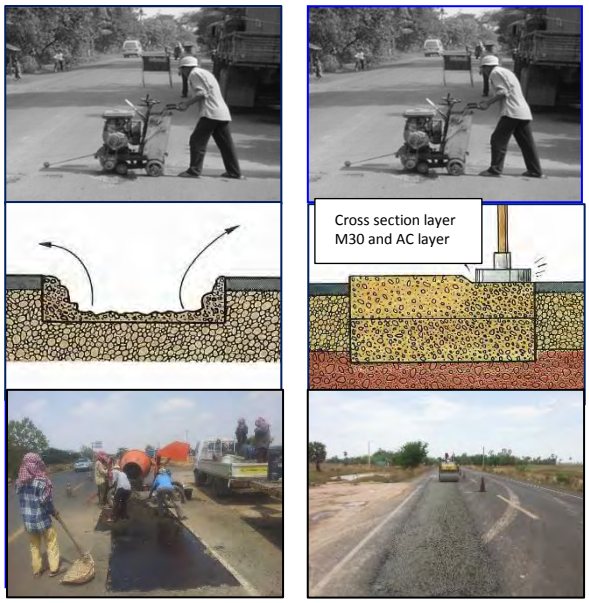
Description: Pothole are bowl shaped holes in the pavement surface. Average potholes depth is around 6 – 10 cm, the more severe case is bigger than 10 cm. Average pothole size is around 10cm ~ 100cm.

Possible Cause:

- Infiltration of water
- The bowl has broken into small piece of the lumps without prompt repairs.
- Incorrect compaction or grading of road surface
- Road crack left unrepaired (Develop from Alligator Cracks)
- Break away of material under the action of traffic.
- Final stage in the development of a depression.

Work method:

1. Mark out the pothole area in a rectangular shape
2. Used cutter machine and manual excavation
3. Remove debris from potholes
4. Excavate to remove all bad materials until firm material is found
5. Backfilling the hole with M30 aggregate as base material
6. CSS-1 (Equivalent prime coat 0.8 ~ 1.2 L /m^2)
7. Apply Asphalt Concrete (AC) by Site Mix.
   Site Mixed AC Method is shown as follows
   - 19 mm + 12 mm aggregate + sand are input in the mixer after weighing its ratio
   - Mixed for a few minutes then add CRS-2 + water and continue mixing for about 3 minutes
   - The AC is then ready to used
   - AC must be used within 2-3 hours after mixing
8. Compact the patch area with vibrating roller, vibrating plate or a rammer.
9. Traffic can resume 2 hours after final compaction



For example, in the case of 500 Kg AC mixed, we have:

1. Aggregate 12 mm = 30.5% →		A_{12} = 100 x 30.5% = 30.5 kg
2. Aggregate 18 mm = 20.34%→		A_{19} = 100 x 20.34% = 20.34 kg
3. Stone Powder	= 28.14%→	D = 100 x 28.14% = 28.14 kg
4. Sand	= 9.08% →	S = 100 x 9.08% = 9.08 kg
5. Cement	= 6.56% →	C = 100 x 2.72% = 2.72 kg
6. Asphalt (CRS-2)	= 6.56% →	B = 100 x 6.56% = 6.56 kg
7. Water	= 2.66% →	W = 100 x 2.66% = 2.66 kg

Total = 500 Kg

Manpower	Tool and Equipment	Material
• 1 operator of hand roller compactor or vibrating plate compactor (rammer) • 2 safety officers at both end of work site • Approximately total of 10 to 12 men on the site	• Concrete cutting machine • Wheel barrow • Mechanical broom/shovels • Concrete Mixer (200 Lits.) • Tamping rammer (60Kg) or vibrating plate (60Kg) and Hand Roller Compacter (500Kg) • Safety sign, cones, vest	• Marking chalk or spray • M30 aggregates • CSS-1 • Cement + Aggregate + Sand + CRS-2
Quality Control	• Check all loose material are being removed before filling pothole • Surface of pothole should be slightly higher than the road by 1cm	
Productivity	• Approximately 25 m^2 (Site Mix AC)	

Ministry of Public Works and Transport	**Job Code: 1131**	

Activity: Crack filling

1 layer 12mm aggregates with CRS 2 (m^2)

Description: Cracking are a series of interconnected cracks in an asphalt layer forming a different kind of patterns. It can be in many forms such as alligator cracks, transverse cracks and longitudinal cracks.

Possible Cause:

- Poor quality materials and poor workmanship
- Insufficient Pavement structure thickness
- Illegal overloading vehicle using the road
- Inadequate base support
- Poor base drainage
- Aging roads (Pavement age)

Work method:

1. There are 4 types of remedies such as:
    - Local sealing 1.5kg/m^2 of bitumen emulsion+1kg/m^2 of cut back bitumen)
    - Filling in the cracks (filled in with a bituminous slurry)
    - Treatment of isolated cracks (filled in with a hot cut back bitumen)
    - Patching (Dressing)

   In the case of extensive cracking of the surface or pavement structure, surface dressing will be necessary, however in this repair, only one method is adopted
2. Sweeping the surface area clean by broom/mechanical broom sweeper
3. Mark out the crack area to be repaired in box shape
4. Application of CRS-2 (0.5L/m^2)
5. Apply thin layer of 12mm aggregate
6. Depending on the area of the cracks. If the area is small, it should be compacted with vibrating plate. Large area uses 200kg hand roller compactor




Manpower	Tool and Equipment	Material
• 1 operators • 2 safety officer at both end • 4 unskilled workers • 2 skilled workers *Approximately total of 6 to 8 men on the site	• Broom/ mechanical sweeper • Wheel barrow • Shovels • Watering can • 60kg Vibrating plate compactor • 200kg hand roller compactor • Safety sign, cones and vest	• Marking chalk or spray • CRS-2 (tack coat) • 12mm aggregates
Quality Control	• Ensure that surface is cleaned before application of CRS-2	
Productivity	• Approximately 75-100 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1132**	

Activity: Crack filling

2 layers 19mm then 12mm aggregate with CRS-2 (m^2)

Description: Cracking are a series of interconnected cracks in an asphalt layer forming a different kind of patterns. It can be in many forms such as alligator cracks, transverse cracks and longitudinal cracks.

Possible Cause:

- Poor quality of materials and poor workmanship
- Insufficient Pavement structure thickness
- Illegal overloading vehicle using the road
- Inadequate base support
- Poor base drainage
- Aging roads (Pavement age)

Work method:

1. There are 4 types of remedies such as:
    - Local sealing 1.5kg/m^2 of bitumen emulsion+1kg/m^2 of cut back bitumen)
    - Filling in the cracks (filled in with a bituminous slurry)
    - Treatment of isolated cracks (filled in with a hot cut back bitumen)
    - Patching (Dressing)

In the case of extensive cracking of the surface or pavement structure, surface dressing will be necessary, however in this repair, only one method is adopted

2. Sweeping the surface area clean by broom/mechanical broom sweeper
3. Mark out the crack area to be repaired in rectangular shape
4. Application of CRS-2 (0.5L/m^2)
5. Apply thin layer of 19mm aggregates
6. Compact with vibrator plate and apply another layer of CRS-2 (0.3L/m^2)
7. Apply 12mm aggregates
8. Depending on the area of the cracks. If the area is small, it should be compacted with vibrator plate. Large area hand roller compactor

Crack sealing

Crack sealing

Compaction by roller

Manpower	Tool and Equipment	Material
• 2 operators(vibrating plate/ hand on roller and mechanical sweeper) • 2 safety officer at both end • 4 unskilled workers • 2 skilled workers *Approximately total of 8 to 10 men on the site	• Broom/ mechanical sweeper • Wheel barrow • Shovels • Watering can • 60kg vibrating plate compactor • 200kg hand on roller • Safety sign, cones and vest	• Marking chalk or spray • CRS-2 (tack coat) • 19mm aggregates • CRS-2 (tack cvvoat) • 12mm aggregates
Quality Control	• Ensure that surface is cleaned before application of CRS-2	
Productivity	• Approximately 50-75 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1140**	

Activity: Repaired paved shoulders (m^2)

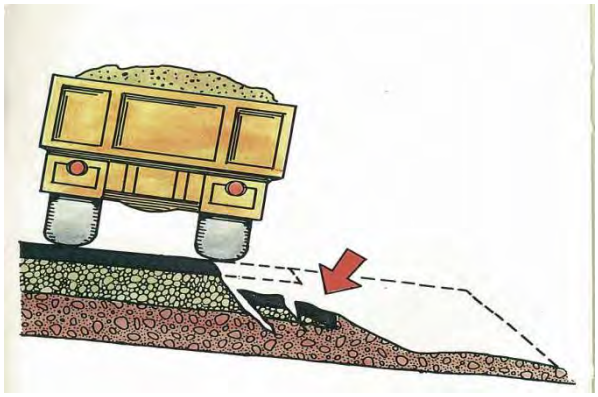
Description: Paved shoulder refers to the edge along the road pavement. Some roads shoulders can be big or small depending on the traffic, road design and specification.

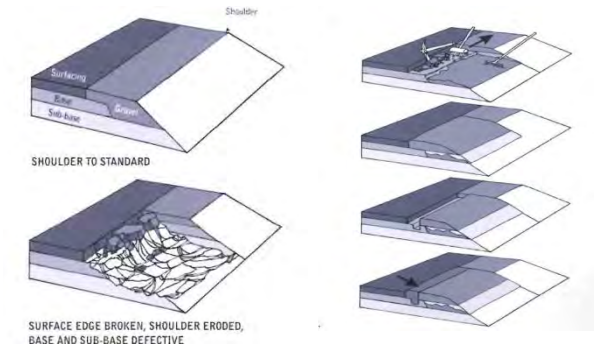
Possible Cause:

- Wear of the shoulder (aging road)
- Soil erosion - Rain water may wash away the dirt foundation of the shoulder
- Insufficient compacting of the edges of the bituminous pavements
- Road width could be too narrow

Work method:

1. Mark out the area to be repaired- drawing rectangular around the defect
2. Remove all unstable material of the depth and width of the damaged edge
3. Align the paved shoulder from one end to the other (fill the damaged edge)
4. If defects shallow (approximately 3cm), apply CRS-2 then 12mm aggregate and compact with hand on rollers
5. If defect is severe (approximately more than 5cm) apply CRS-2, then 19mm, compacted with hand-on-roller then apply CRS-2, 12mm aggregate
6. Compaction with vibrating smooth wheeled rollers





Manpower	Tool and Equipment	Material
• 2 operators(vibrating plate/ hand on roller and mechanical sweeper) • 2 safety officers at both end • 4 unskilled workers • 2 skilled workers *Approximately total of 8 to 10 men on the site	• Broom/ mechanical sweeper • Wheel barrow • Shovel and pickaxes • 200kg hand on roller • Steel wheeled roller(6 tons Tandem Roller is preferred) • Safety sign and cones • Matal rakes	• Marking chalk/ spray • 30mm aggregate • CRS-2 • 19mm aggregate • CRS2 • 12mm aggregate • Pegs and strings

Quality Control	• Ensure that defect area clear of water before commencing job • Good quality of materials are being used
Productivity	• Repairing of carriageway edge approximately 100-150 m^2 per day depending on the manpower, traffic condition and location.

Ministry of Public Works and Transport	**Job Code: 1150**	

Activity: Shape correction (Ruts/Settlement) (m^2)

Description:

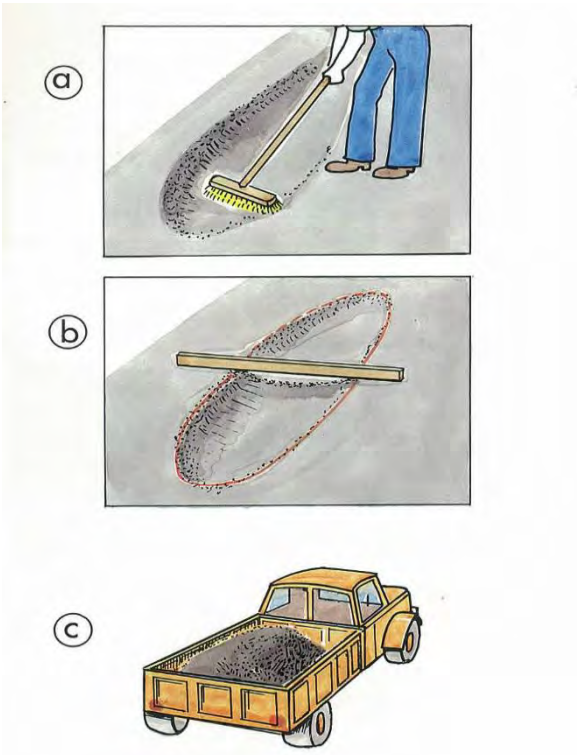
Ruts is a depression in the wheel paths. Pavement surface uplift may occur along the side of rut, however in many instances, ruts are noticeable only after a rainfall, when the wheel paths are filled with water.

Possible Cause:

- Insufficient foundation or pavement strength for the traffic being carried
- Inadequate stability of the bituminous surfacing material
- Settlement of the foundation soil.

Work method:

1. Marking out the area to be repaired by string line to flat level.
2. Clean area to be repaired by using mechanical broom or hand broom.
3. Spreading aggregate 4cm × 6cm on the area
4. Compaction using rammer or vibrating plate compactor
5. After spraying CRS-2 (1L/m^2) and spread aggregate 19mm.
6. Compaction using rammer or vibrating plate compactor.
7. Resealing binder-CRS2 (0.4L/m^2) over the surface using a spray lance or a watering can
8. Distribution of aggregate 12mm scattered by shovel from the truck or trailer
9. Compaction using rammer or vibrating plate compactor



Manpower	Tool and Equipment	Material
• 1 operator of rammer or vibrating plate compactor • 2 safety officers at both end of work site • Approximately total of 12 men on the site *Approximately total of 8 to 10 men on the site	• Concrete cutting machine • Wheel barrow • Mechanical broom or hand broom • Shovels • Rammer(60 Kg) or vibrating plate compactor(60kg) • Safety sign, cones, vest	• Aggregate 4cm x 6cm • Aggregate 19mm • CRS-2 • Aggregate 12mm
Quality Control	• Surface of ruts should be 10 mm maximum higher than the original road level.	
Productivity	• Approximately 75-125 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1161**	

Activity: Pothole repair-mixed stone based-DBST (m^2)

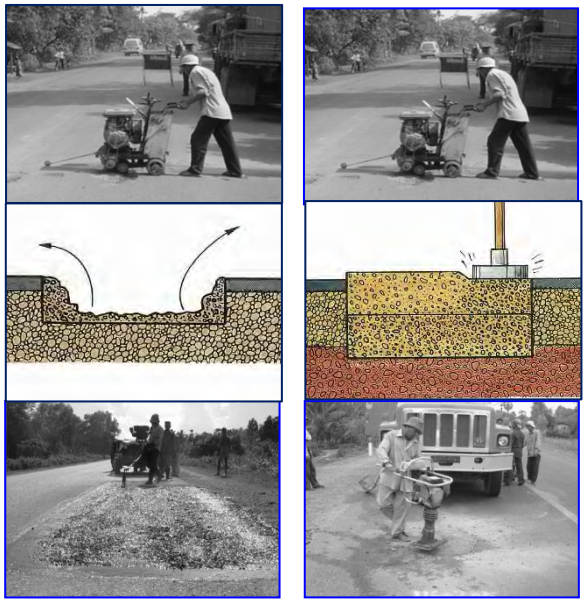
Description:
Potholes are bowl shaped holes in the pavement surface. The bowl has broken into small piece of the lumps without prompt repairs. Average pothole depth is around 6-10 cm. Average pothole size is around 10 – 100 cm.

Possible Cause:

- Poor quality DBST surfacing mix
- Incorrect compaction of the mix during construction
- Infiltration of water
- Break away of material under the action of traffic
- Final stage in the development of depression

Work method:

1. Mark out the pothole area in a rectangular shape
2. Use cutter machine and manual excavation
3. Excavate to remove all bad materials until firm material is found
4. Backfill the hole with aggregate (M30)
5. Compaction using rammer or vibrating plate compactor.
6. Reseal binder-CSS1 (1L/m^2) over the surface and spreading sand
7. Spay CRS-2
8. Spreading aggregate 19mm on the area(t = 2-3 cm)
9. Compaction using rammer or vibrating plate compactor.
10. Spray CRS2 (0.4L/m^2) over the surface
11. Spreading aggregate 12mm on the area(t = 1-2 cm)
12. Compaction using rammer or vibrating plate compactor



Manpower	Tool and Equipment	Material
• 1 operator of rammer or vibrating plate compactor • 2 safety officers at both end of work site • Approximately total of 8 to 10 men on the site	• Concrete cutting machine • Pickaxes • Wheel barrow • Mechanical broom or hand broom • Shovels • 60 Kg rammer or vibrating plate compactor (60kg) • Safety sign, cones, vest	• Aggregate M30 • CSS-1 • Sand • CRS-2 • Aggregate 19mm • Aggregate 12mm
Quality Control	• Surface of pothole should be 1 cm maximum higher than the original road level. • Check that all loose/poor material is removed before filling the potholes	
Productivity	• Approximately 50-100 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1162**	

Activity: Pothole repair-cement mixed based-DBST (m^2)

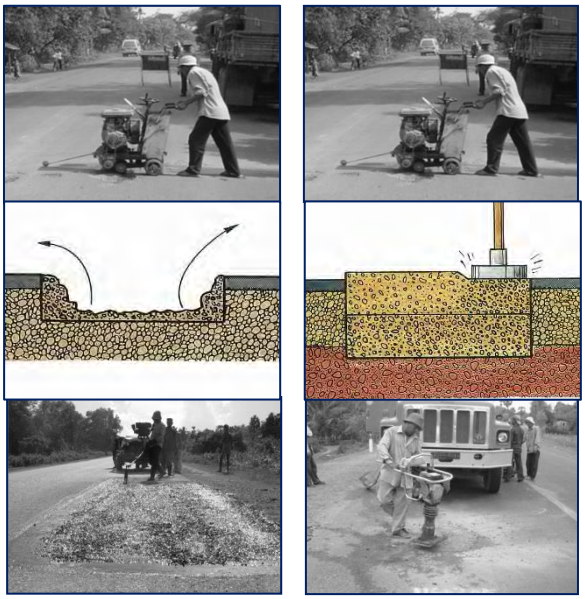
Description:
Potholes are bowl shaped holes in the pavement surface. The bowl has broken into small piece of the lumps without prompt repairs. Average pothole depth is around 6-10 cm. Average pothole size is around 10 – 100 cm.

Possible Cause:

- Poor quality DBST surfacing mix
- Incorrect compaction of the mix during construction
- Infiltration of water
- Break away of material under the action of traffic
- Final stage in the development of depression

Work method:

1. Mark out the pothole area in a rectangular shape
2. Use cutter machine and manual excavation
3. Excavate to remove all bad materials until firm material is found
4. Backfill the hole with Soil cement material (cement 80Kg/m3, soil 1600Kg/m3)
5. Compaction using rammer or vibrating plate compactor.
6. Reseal binder-CSS1 over the surface and spreading sand
7. Spray CRS-2
8. Spreading aggregate 19mm on the area(t = 2-3 cm)
9. Compaction using rammer or vibrating plate compactor.
10. Spray CRS2 over the surface
11. Spreading aggregate 12mm on the area(t = 1-2 cm)
12. Compaction using rammer or vibrating plate compactor



Manpower	Tool and Equipment	Material
• 1 operator of rammer or vibrating plate compactor • 2 safety officers at both end of work site • Approximately total of 8 to 10 men on the site	• Concrete cutting machine • Pickaxes • Wheel barrow • Mechanical broom or hand broom • Shovels • 60 Kg rammer or vibrating plate compactor (60kg) • Safety sign, cones, vest	• Aggregate M30 • CSS-1 • Sand • CRS-2 • Aggregate 19mm • Aggregate 12mm
Quality Control	• Surface of pothole should be 1 cm maximum higher than the original road level. • Check that all loose/poor material is removed before filling the potholes	
Productivity	• Approximately 50-100 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1163**	

Activity: Pothole repair-mixed gravel CRS2 & cement base – DBST (m^2)

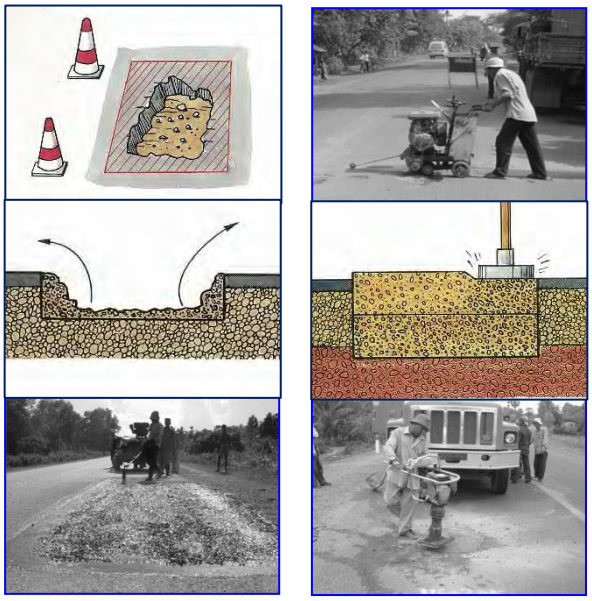
Description:
Potholes are bowl shaped holes in the pavement surface. The bowl has broken into small piece of the lumps without prompt repairs. Average pothole depth is around 6-10 cm. Average pothole size is around 10 – 100 cm.

Possible Cause:

- Poor quality DBST surfacing mix
- Incorrect compaction of the mix during construction
- Infiltration of water
- Break away of material under the action of traffic
- Final stage in the development of depression

Work method:

1. Mark out the pothole area in a rectangular shape
2. Use cutter machine and manual excavation
3. Excavate to remove all bad materials until firm material is found
4. Backfill the hole with mixed gravel max(1000Kg/m^3), sand (182kg/m^3), CRS2(130L/m^3), and cement(54Kg/m^3)
5. Compaction using rammer or vibrating plate compactor.
6. Reseal binder-CSS1 over the surface and spreading sand
7. Spray CRS-2
8. Spreading aggregate 19mm on the area(t = 2-3 cm)
9. Compaction using rammer or vibrating plate compactor.
10. Spray CRS2 over the surface
11. Spreading aggregate 12mm on the area(t = 1-2 cm)
12. Compaction using rammer or vibrating plate compactor



For example, in the case of 100 Kg, we have:

1. M30	= 86%	→	M30 = 100 x 86% = 86 kg
2. Cement	= 2.5%	→	C = 100 x 2.5% = 2.5 kg
3. Asphalt (CRS-2)	= 5%	→	B = 100 x 5% = 5 kg
4. Water	= 6.5%	→	W = 100 x 6.5% = 6.5 kg

Manpower	Tool and Equipment	Material
• 1 operator of rammer or vibrating plate compactor • 2 safety officers at both end of work site • Approximately total of 10 to 12 men on the site	• Concrete cutting machine • Pickaxes • Wheel barrow • Mechanical broom or hand broom • Shovels • 60 Kg rammer or vibrating plate compactor (60kg) • Safety sign, cones, vest	• Aggregate M30 • CSS-1 • Sand • CRS-2 • Aggregate 19mm • Aggregate 12mm
Quality Control	• Surface of pothole should be 1 cm maximum higher than the original road level. • Check that all loose/poor material is removed before filling the potholes	
Productivity	• Approximately 25-50 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1164**	

Activity: Pothole repair – Cold Mix AC (m^2)

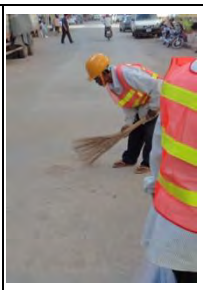
Description:
Urgent patching Application to pothole (maximum diameter 1.0 m, depth 50 mm ~ 100 m)

Possible Cause:

- Poor quality DBST surfacing mix
- Incorrect compaction of the mix during construction
- Infiltration of water
- Break away of material under the action of traffic
- Final stage in the development of depression

Work method:
In this explainary of application of cold AC Mix, EXCEL are being used:

1. Sweep the pothole.
   Clear and remove sands and soil from edge of the pothole by brushing
2. If pothole more than 5 cm depth, coarse material should be fill prior EXCEL patch
3. Loosen EXCEL
   Before open the bag, loosen EXCEL in the bag.
4. EXCEL in the pothole.
   Put Excel into the pothole. 40% surplus is recommended for even compaction. (see Figure) (1-2cm)
5. Level surface.
   Level surface of the Excel patching with trowel and shovel
6. Spread Sand on an EXCEL.
   Spread sand even on the surface of Excel
7. Compaction by foot or car tires/ vibrating plate compactor, compacting steel plate ”elephant leg”
   Compact surface by foot or tire of vehicle
8. Spread sand onto the EXCEL to reduce friction of EXCEL and car tires


1. sweep the pothole

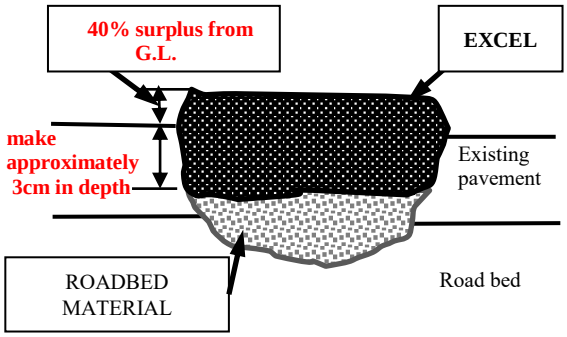

2. loosen an EXCEL


3. insert an EXCEL in the pothole

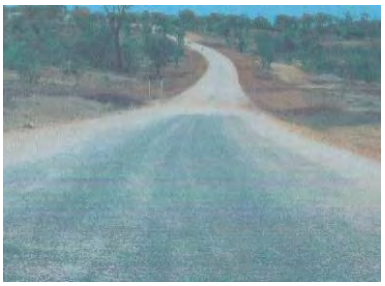

4. smooth a surface


5. sprinkle sand


6. compaction by foot



Manpower	Tool and Equipment	Material
• 1-2 unskilled worker	• Square Shovel, Broom, Water (+1 pickup for mobilization. • Pickaxe	• EXCEL, base course material, sand (for spread)
Quality Control	• To confirm the Excel surface after compaction is smooth and higher than existing road surface. (no water allowed stay)	
Productivity	• Approximately 25-75 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1160-3**	

Activity: Temporary road restore to facilitate traffic-laterite (m^3)

Description: In order to facilitate with the busy traffic, some roads are needed to be repaired immediately with quick solution such as Laterite. However, this solution is only applicable for short-term period only.

Possible Cause:

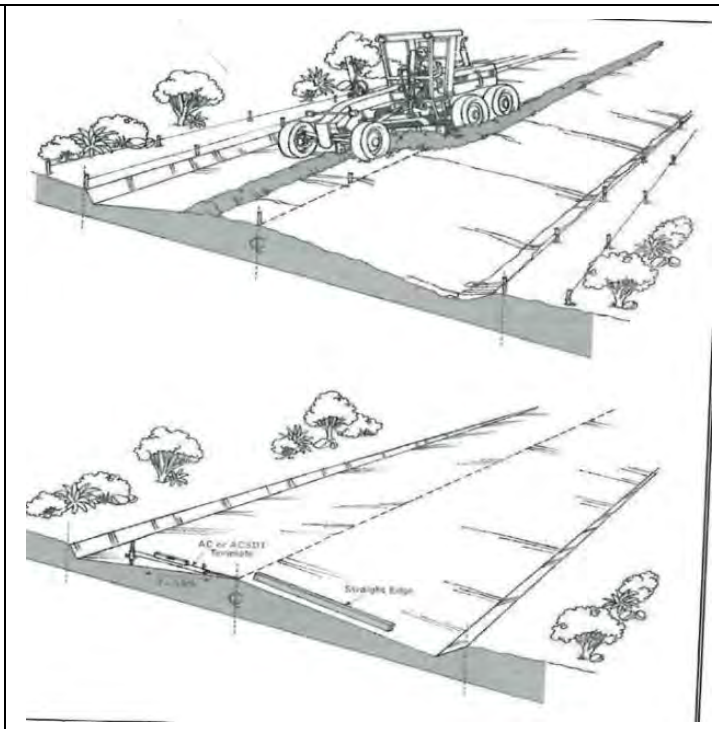
- Insufficient Pavement structure thickness
- Illegal overloading vehicle use the road
- Inadequate base support
- Poor quality of materials are being used

Work method:

1. Identify/mark the defect area
2. If water are present, remove the excess water
3. Scrape the defect area with excavator
4. Fill the defect area with laterite
5. Level the laterite with motor grader and compact with rubber tire roller.

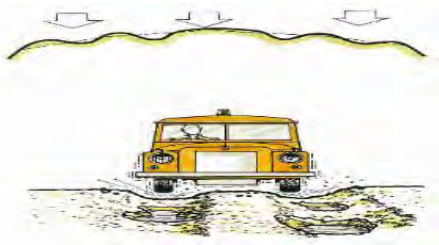
* Laterite should be filled and compact with rubber tire roller layer by layer- maximum thickness is 150mm

- Well compacted soil could prevent soil settlement, reduce seepage and increase load bearing capacity
- The road should be camber to fall away from the crown at a rate of 4-6cm for each meter from the center of the road.



Manpower	Tool and Equipment	Material
• 3 operators (excavator/ rubber tires roller/ motor grader. • 2 Drivers (dump truck, water tanker). • 2 safety officers at both end • 2 unskilled workers • 1 skilled workers * Approximately total of 10 men on the site	• Water tank 4kL • Excavator (0.05-0.1m3 bucket) • Dump truck (6 ton) • Motor grader at least 135hp • Shovels • Safety sign, cones and vest • Rubber tire roller is preferred 8ton. • Camber 4-6%	• White powder or spray • Laterite

Quality Control	• Work area should be clear of debris before dumping laterite. • Compaction must be done layer by layer • The road should be cambered to fall away from the crown at a rate 4-6cm for each one meter from the center of the road
Productivity	• Approximately 300 m2 per day

Ministry of Public Works and Transport	**Job Code: 1160-C3**	

Activity: Temporary road restore to facilitate traffic- mixed gravel (m^3)

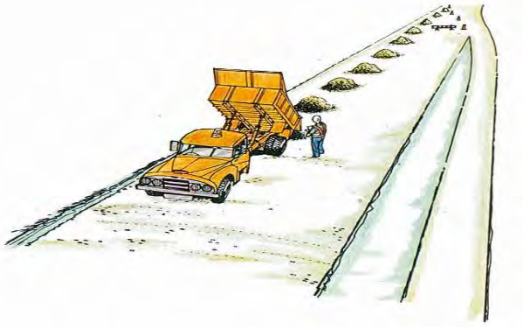
Description: In order to facilitate traffic, some roads are needed to be repaired with quick solution such as mixed gravel. Some materials that are chosen mainly due to availability of material, location and time constraint.

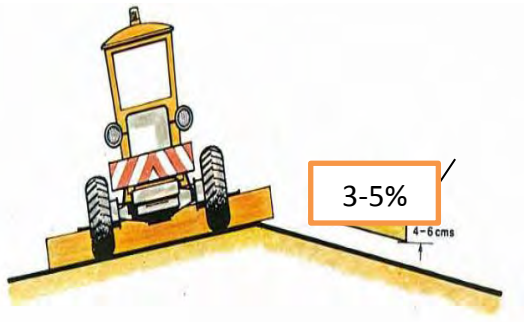
Possible Cause:

- Insufficient Pavement structure thickness
- Illegal overloading vehicle use the road
- Inadequate base support
- Poor quality of materials are being used
- Poor drainage system

Work method:

1. Identify and locate the defect area
2. Scarify or Excavate the defect areas to remove poor/bad materials
3. Laterites(for foundation) are then dumped at intervals for approximately 200m of work then grade/ spread by motorgrader and compact with roller compactor. Please note that if there is no detour route for traffic, work should only be done one side at a time.
4. Gravels are then dumped at intervals for approximately 200m of work then grade/ spread by motorgrader and compact with roller compactor. Please note that if there is no detour route for traffic, work should only be done one side at a time.
    - Grading are to be done at gradient approximately 3-5% to ensure water flow
    - Compaction are to be done from side to the center of road and run over about 8 times.





Manpower	Tool and Equipment	Material
• 3 operators (excavator/ Tire roller/ Motor grader. • 6 drivers (Dump truck) • 2 safety officers at both end • 2 unskilled workers • 1 water tank operator	• (0,05m3 - 0,1m3 bucket size) • 6 tons Dump truck • Motor grader at least 135 hp • Shovels • Safety sign, cones and vest • 8 tons steel wheeled roller • Camber 4-6%	• White powder or spray • Mixed gravels.
Quality Control	• Work area should be clear of debris before dumping mixed gravel • The road should be cambered to fall away from the crown at rate 4 – 6cm for each one meter from the center of the road	
Productivity	• Approximately 400 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1180**	

Activity: Reinforced concrete road- thickness 200 mm (m^2)

Description: Cast in place reinforced concrete provides good distribution of loads to foundation, good resistance to wear, does not erode and lasts long time with little maintenance if design properly.

Possible Cause:

- Heavy loading trucks/ vehicle using the roads
- Insufficient Pavement structure thickness
- Inadequate base support
- Heavy traffic area

Work method:

1. Grading the Base course with motor grader to allow an uniform thickness of concrete
2. Base course has to be free of water and debris such as leaves and mud
3. Fill and compact any ruts that caused by traffic
4. Placement of reinforced bars with spacing between 100-150mm depending on the road category
5. Use Concrete cubes to support the reinforce bars so that it is in the center of the slab thickness
6. Always spray appropriate water before casting concrete as to prevent water in concrete from being sucked by base course

Standard Specification

1. Concrete flexural strength : 4.5 MPa
(Ref. concrete compressive strength 36 MPa)
2. Minimum reinforcement bar density : 3kg/m2
3. Logitudinal Joint: same width of carriage way, maximum 5m
4. Expansion joint: standard pitch 200m.
5. Contraction joint: standard pitch 8m
6. Slump 6.5 (71.5) cm

Manpower	Tool and Equipment	Material
• 2 skilled workers to inspect the reinforced bar and concrete cube. • 7 unskilled workers • 2 safety officers at both end of road to ease the traffic	• Concrete mixing plant • Slip form paving machine • Crane needed if reinforced bars are ready tied • Vibrators for Concrete • Wheel barrows • Shovels • Safety sign, cones and vest • Pneumatic tires rollers	• Cements • Sand • Aggregate • Reinforced bars • Bar ties • Concrete cubes • Base Course
Quality Control	• Ensure that Base Course is wet before casting	
Productivity	• Approximately 150 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 1200**	

Activity: Grading shoulders (km)

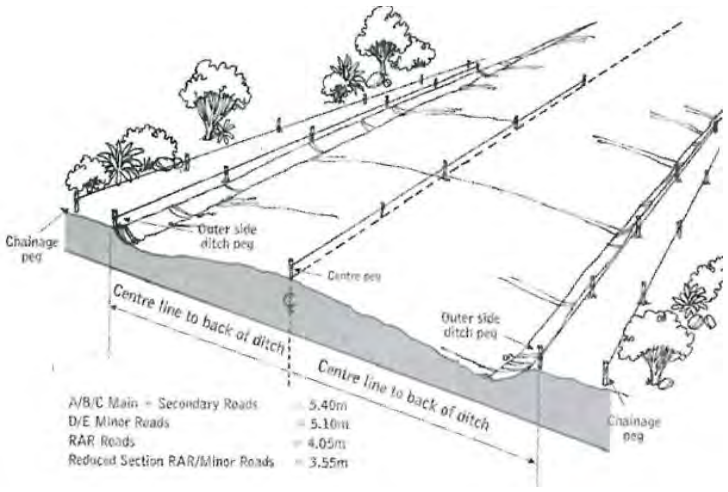
Description: Shoulder grading involves the shaping and stabilizing of unpaved roadway shoulder areas to eliminate the drop-off between the roadways and the shoulder to allow water to drain away from the road surface.

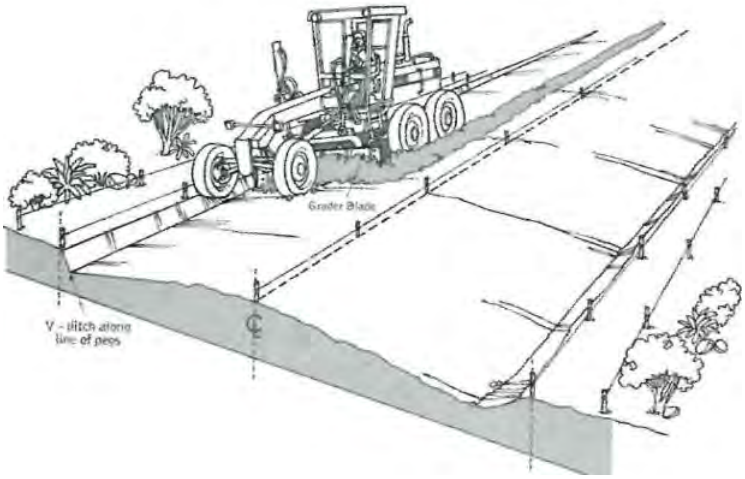
Possible Cause:

- Ruts are allowed to form and remain on the shoulder, water can enter and damage the edge of the pavement.

Work method:

1. Safety precautions and sign are set up prior to commencing of work
2. Set out the guide pegs for grader to follow between 20 to 50 intervals
3. Laterite for foundation are then randomly dump to be filled and graded by motor grader. After grading, roller compactor is used to compact the shoulder.
4. Motor grader are used to create the slope at the edge of shoulder to enable rainwater flow out of the shoulder.
5. Material of the same standard as the existing road shoulder are to be used to paved shoulder
    a. Cross sectional gradient; 2%(AC), 3%(DBST), 3-5%(laterites)
    b. Longitudinal gradient; 1-7%





Manpower	Tool and Equipment	Material
• 1 Site Supervisor • 1 to 2 Grader Operators • 1 Headperson +1 labourer for setting out • 2 to 3 labourers per grader to support	• Motor grader at least 135 HP • Tape Measure, 30 m • 1 Mason Hammer • Wooden Pegs • AC- or DBST -Template with Spirit Level	
Quality Control	• Check camber at regular intervals using AC or DBST template	
Productivity	• Approximately 0.5 to 2 Km per day, depending on the existing condition.	

Ministry of Public Works and Transport	**Job Code: 1201**	

Activity: Adding laterite to road shoulder(road) (m^3)

Description: Shoulder drop off could potentially be very dangerous to the commuters. Road shoulder should be slightly lower than paved surface that it enables water surface to runoff easily.

Possible Cause:

- Ruts are allowed to form and remain on the shoulder, water can enter and damage the edge of the pavement.
- Soil erosion due to the rain

Work method:

1. Carefully install safety cones and signs at both end of construction work
2. Roughly estimate the strategic points for dump truck to dump laterite
3. Using grader to grade the laterite to designed level
4. Water tank then sprayed onto the laterite for compaction
5. Additional laterite can be added and water can be sprayed to meet the design height
6. Roller compactor then used to compact the shoulder
7. Road shoulder should have gradient of 3-4% to enable water to drain from the roadway
8. At the end of the work, wet laterite that stay on the paved road should be manually sweep out of the pavement to the shouder.





Manpower	Tool and Equipment	Material
• 1 Site Supervisor • 1 Grader Operator • 1 roller compactor operator • 2 dump truck drivers • 2 safety officers • 2 to 3 unskilled workers	• Motor grader at least 135 HP • Roller compactor • Dump truck(5m^3) • Water truck and tank • Wooden Pegs • AC- or DBST -Template with Spirit Level	• Laterite
Quality Control	• Check camber at regular intervals using AC or DBST template	
Productivity		

Ministry of Public Works and Transport	**Job Code: 1250**	

Activity: Grading laterite (km)

Description: The first objective of maintenance is to keep the road in such a condition that it sheds water quickly. If the road does not shed water, the surface will become soft, and ruts and potholes will quickly appear. Earth roads soon become impassable. Maintenance is needed to restore a good camber on the road to enable water to drain off quickly. This is best achieved by regular grading. Grading and reshaping laterite roads to eliminate edge ruts, ridges, corrugation, high shoulders and to restore good drainage characteristics.

Possible Cause:

- Loss of shape (Cambere at Transersal)
- Rusts
- Pot-hole
- Corrugations
- Erosion gullies
- Blocks ditches

Work method:

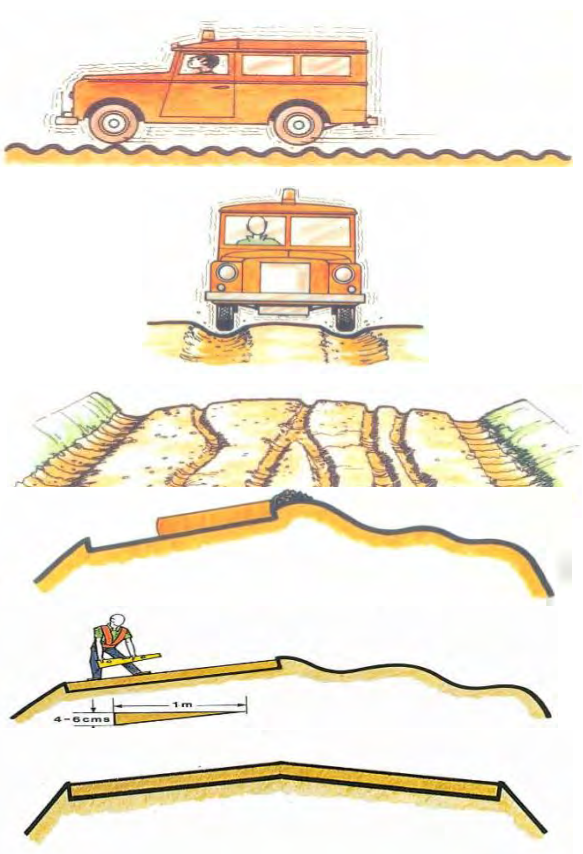
Preparation

1. Before work starts, warning signs must be placed at each end of the work area to ensure safety.
2. Filling of large potholes should be carried out in advance of the grading.
3. Areas of standing water should be drained. This penetration will ease the work and make the resulting surface last longer.

Grading

1. Set out shoulder carriageway line using pegs and strings at 10 or 20m intervals.
2. Blade the material toward the centre of the road starting from both edges to specified camber.
3. Check gradient with camber board.
4. Well graded and shaped road without ruts, ridges, corrugations and are flush with road surface with slope 4 to 5 percent.

The grader works on one side of the road at a time and works in passes of about 200m long to convenient and safe turning points. It will normally require 4 passes to reshape the road.



Manpower	Tool and Equipment	Material
• 1 motor grader driver • 2 unskilled workers	• Motor Grader • Single drum vibrating roller • Light towed grader with tractor • Shovels and Pickaxes • Wheel barrows	• Laterite
Quality Control	• The width of the carriageway including the shoulders to be checked using tape measure at every 100m with maximum tolerance +50mm or -20mm • The camber to be checked using a camber board at every 50m with and to have a maximum tolerance of +/-1%	
Productivity	• Approximately 0.5-2 km per day	

Ministry of Public Works and Transport	**Job Code: 1260**	

Activity: Heavy grading laterite Road (km)

Description: The first objective of maintenance is to keep the road in such a condition that it sheds water quickly. If the road does not shed water, the surface will become soft, and ruts and potholes will quickly appear. Earth roads soon become impassable. Maintenance is needed to restore a good camber on the road to enable water to drain off quickly. This is best achieved by regular grading. Grading and reshaping laterite roads to eliminate edge ruts, ridges, corrugation and high shoulders. This activity includes the application of small amounts of additional earth and includes the use of water and compaction equipment to restore the road surface and reduce road roughness.

Possible Cause:

- Loss of shape (Cambere at Transersal)
- Rusts
- Pot-hole
- Corrugations
- Erosion gullies
- Blocks ditches

Work method:

Preparation

1. Before work starts, warning signs must be placed at each end of the work area to ensure safety.
2. Filling of large potholes should be carried out in advance of the grading.
3. Areas of standing water should be drained. This penetration will ease the work and make the resulting surface last longer.

Grading

1. Set out shoulder carriageway line using pegs and strings at 10 or 20m intervals.
2. Blade the material toward the centre of the road starting from both edges to specified camber.
3. Check gradient with camber board.
4. A well graded and shaped road without ruts, corrugations and add more material to raise up level of road surface and -Grading and good copaction road base -Adding laterite for keeping road life -Grading laterite by keeping slope from 4-5 percent and watering with good compation.

The grader works on one side of the road at a time and works in passes of about 200m long to convenient and safe turning points. It will normally require 4 passes to reshape the road.

Manpower	Tool and Equipment	Material
• 1 motor grader driver • 2 unskilled workers	• Motor Grader • Light towed grader with tractor • Shovels and Pickaxes • Wheel barrows	• Laterite
Quality Control	• The width of the carriageway including the shoulders to be checked using tape measure at every 100m with maximum tolerance +50mm or -20mm • The camber to be checked using a camber board at every 50m with and to have a maximum tolerance of +/-1%	
Productivity	• Approximately 1km per day	

Ministry of Public Works and Transport	**Job Code: 2100**	

Activity: Channel cleaning by labour (m)

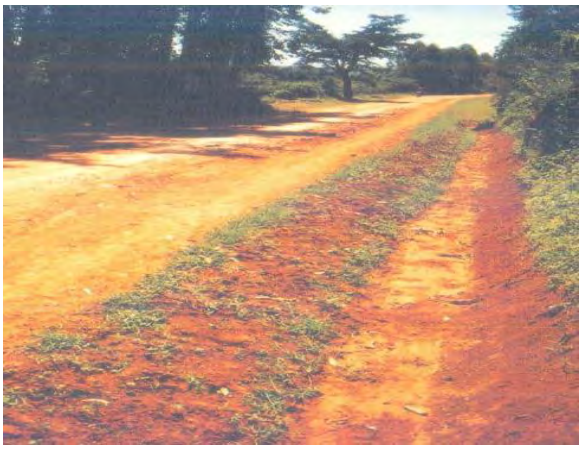
Description: Roadside channel is usually defined as open channel parallel to highway embankment and within the limits of the highway right of way. It is either in the U-shaped or V-shape cross section. Its main function is to collect surface run off and draining the subsurface water from the base of roadway.

Possible Cause:

- Soil erosion
- Growth of weeds, brush and trees in drainage channel
- Blockage by debris
- Sedimentation of soil which stop the water from flowing due to flat slop

Work method:

1. The object is to remove all soil, high vegetation, material and objects from the ditch which could possibly interfere with water flow or cause an eventual blockage of the ditch. This can include for example, rocks, loose silt and sand, weeds, trees, bushes, including their roots, etc. Dispose of these materials well away from the roadside so that water flow will not be impeded and they will not fall or wash back into the drain.
   On unlined ditches, a short grass cover can help to stabilise the invert and sides of the drain. Therefore, where side drain is established to the correct depth and profile with grass cover and no erosion, it is advisable to merely cut the grass short. This will leave the roots in place to bind the surface together.
2. The drain may be extended with a flat outfall to reduce the speed of the water when leaving the ditch. The gradient should ideally be between 2% and 5%,
   The drain could be realigned to follow the contour lines more closely, until a location is reached where it may safely discharge.



Manpower	Tool and Equipment	Material
• 2 cordless grass cutter operator • 6 unskilled workers(4 in the channel and 2 on the roadside) • 1 dump truck operator	• Cordless grass trimmer • Dump trucks • Wheel barrows • Shovels & pickaxes • Safety sign, cones and vest	• As this is a light maintenance job by labor, it does not require any materials.
Quality Control	• Ensure that debris is entirely removed out of the channel	
Productivity	• Approximately 50-100 meter per day (10 people)	

Ministry of Public Works and Transport	**Job Code: 2110**	

Activity: Channel cleaning by machine (m)

Description: Roadside channel is usually defined as open channel parallel to highway embankment and within the limits of the highway right of way. It is either in the U-shaped or V-shape cross section. Its main function is to collect surface run off water and draining the subsurface water from the base of roadway.

Possible Cause:

- Soil erosion
- Growth of weeds, brush and trees in drainage channel
- Blockage by debris
- Sedimentation of soil which stop the water from flowing due to flat slop

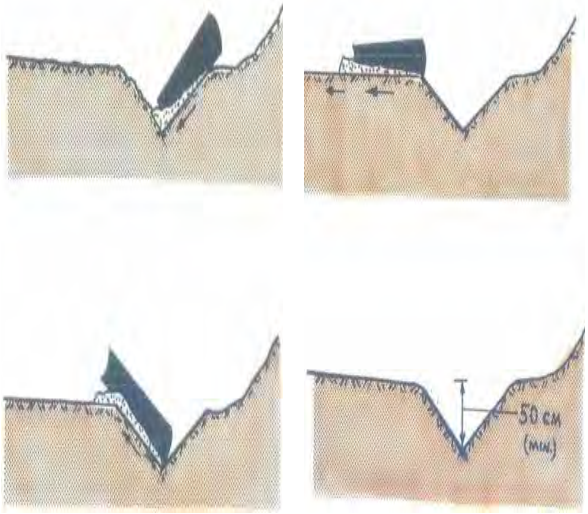
Work method:

1. When the Motor grader can operate beyond the ditch. Reverse the operations shown previously:

- Grade the inside slope, withdrawing material to the bottom of the ditch. Repeat as necessary to achieve the desired depth of ditch,
- Remove the withdraw material to the top of the outside slope,
- Move withdraw away from ditch edge and spread the material so that it will not wash back into the ditch,
- On completion, the ditch should have a depth of the design, which can be checked with a ranging rod and tape/rule,
- If necessary the grade of the ditch invert can be checked using the methods as described in labor method

2. When the Motor grader can operate only on the shoulder and in the ditch, but not beyond the ditch:

- Start by grading the outside slope of the ditch, windrowing the soil to the bottom of the ditch between the rear wheels. (This can be repeated to obtain the desired depth of ditch),
- The second pass cleans the invert of the ditch by removing the windrow to the top of the ditch at road shoulder,
- The third pass is required to move the withdraw material away from the shoulder ditch edge.



Manpower	Tool and Equipment	Material
• 1 motor grader operator • 4 unskilled workers • 2 dump truck operators • 2 safety officers at both end	• Dump trucks • Wheel barrows • Shovels • Safety sign, cones and vest • Motor grader	• Not required.
Quality Control	• Ensure that depth, width and alignment of the channel are correct	
Productivity	• Approximately 100-300 meter per day	

Ministry of Public Works and Transport	**Job Code: 2150**	

Activity: Excavate channel by machine (m)

Description: Roadside channel main function is to collect surface run off water from road and channel to accumulated run off water to acceptable outlet points. Also, its secondary function is to drain subsurface water from the base of roadway to prevent loss of support of pavement.

Possible Cause:

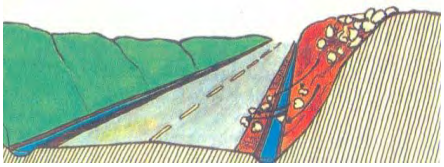
- Ditch gradient is too flat
- Ditch cross-section is too small
- Flooded road
- Roadsides higher than the pavement which unable to drain away water

Work method:

1. Determined the length and width of channel to be excavated
2. All safety measure has been placed to notify commuters
3. Excavate the channel to the specify width and depth
4. Dump truck are used to discard the waste excavate by the excavator
5. Wheel barrow and shovel can be used in case dirt are spilt during excavating
   - Please note that the dirt being removed by excavator should be dumped to an area in which this dirt can be use later on.
   - After each day of work, road should be cleaned to provide a safe and cleaned ride for commuter

Before excavation

Manpower	Tool and Equipment	Material
• 1 excavator operator • 4 unskilled workers • 2-4 dump truck operators • 2 safety officers at both end	• Long reach Excavator • Dump trucks • Wheel barrows • Shovels • Safety sign, cones and vest	• Not required.
Quality Control	• Ensure that depth, width and alignment of the channel are correct	
Productivity	• Approximately 100 meters per day	

Ministry of Public Works and Transport	**Job Code: 4800**	

Activity: Clearing rock falling (m^3)

Description:
Clearing Rock falling is a hazardous activity and should be planned and executed carefully. The slip material should be excavated so that, at all times, the slip and embankment or cutting face are stable.

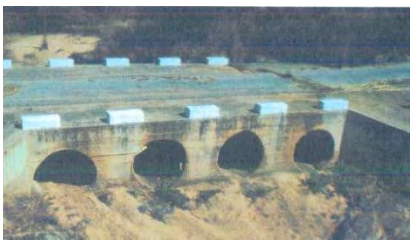
Possible caused:

- The slope was too steep for its height
- Water penetrating the slope from above
- Ground water pressure of flow

Work method:

1. Excavate all slipped rock or stone to carriageway, shoulder and ditch by loader or by hand,
2. Big rock need to be broken into small pieces by using hammer or explosion
3. Load onto trucks and remove to suitable dump sites,
4. Remove last layer of slipped soil from the shoulder or carriageway by hand,
5. Clear the ditch and regrade or reshape if necessary,
6. If the area requires to be protected from further slipping, the most suitable method can only be determined from site inspection.

Manpower	Tool and Equipment	Material
• 1 to 2 masons • 5 to 10 workmen • 2 traffic controllers	• Safety sign, cones, vest • Rake • Shovels • Sledgehammer • Hand rammers • Broom • Wheelbarrow • Backhoe (0.6 m^3 : in the case of more than 50 m^3)	
Quality Control	• To confirm all slip material need to be removed from the area	
Productivity	• Approximately 1-3 m^3 per day (by hand) • Approximately 10 m^3 per day (by Backhoe)	

Ministry of Public Works and Transport	**Job Code: 3100**	

Activity: Cleaning culvert transversal (nos.)

Description: During raining season, dirt washed from the driveway, wastes from the commuters and residents nearby and vegetation caused blockage to the culvert. As the sedimentation such as Sanding and Silting getting higher and higher, without care and maintenance, these could blocked the water flow and cause flooding and eventually heavy damage to the road.

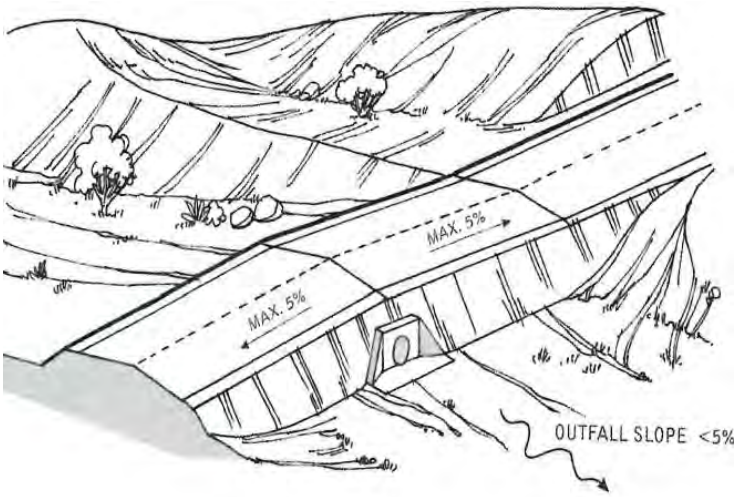
Possible Cause:

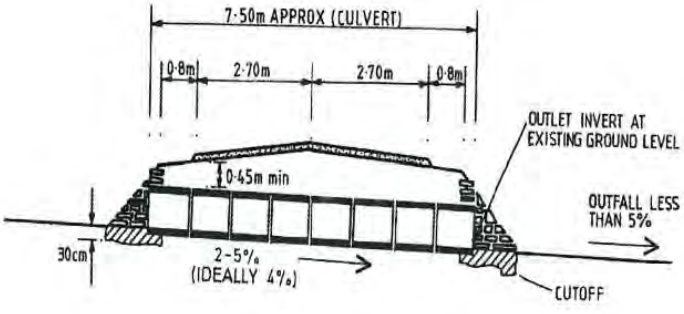
- Invert slope too flat.
- Soil erosion during rainy season accumulate inner culvert as sedimentation.
- Wastes caused by the commuters and resident nearby.
- Vegetation grow in the culvert.
- Culvert constructed too low.

Work method:

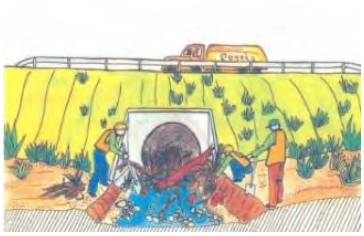
In order to function properly, a culvert must retain the full opening over its complete length.

1. Using a shovel, slowly remove the sediment along the culvert.
2. In case of the culvert smaller than person workable these culverts can be cleaned by pulling a cable or rope through, to which is attached a bucket to remove the sediments.
3. Alternatively, long handled shovel and spike can be used if culvert completely block.
4. When the culvert is cleaned out, check for cracks in the along culverts (use torch if necessary)
5. Sedimented material and debris from the culvert must be spread or dumped where they cannot cause as obstruction to water flow, preferably on the downstream side of the culvert/waste collection area and well away from the water course.





Manpower	Tool and Equipment	Material
• 1 excavator operator • 2 dump truck drivers • 6 unskilled workers for cleaning • 2 Safety Guards	• Pick axe and shovels • Wheel barrow • Long handled shovel + spike • Pressure water • Safety sign, cones, vest	• As this is a cleaning activity, material is not required.
Quality Control	• Check sedimentation and vegetation have been fully removed	
Productivity	• Approximately 20-30 meters long culvert daily (Ø 1.0 m culvert)	

Ministry of Public Works and Transport	**Job Code: 3110**	

Activity: Cleaning culvert longitudinal (m)

Description: During raining season, severe erosion from the driveway, wastes from the commuters and residents nearby and vegetation caused blockage to the culvert. As the floating debris and the sedimentation such as sanding and silting are getting higher and higher, without care and maintenance, these could block the water flow and cause heavy damage to the road.

Possible Cause:

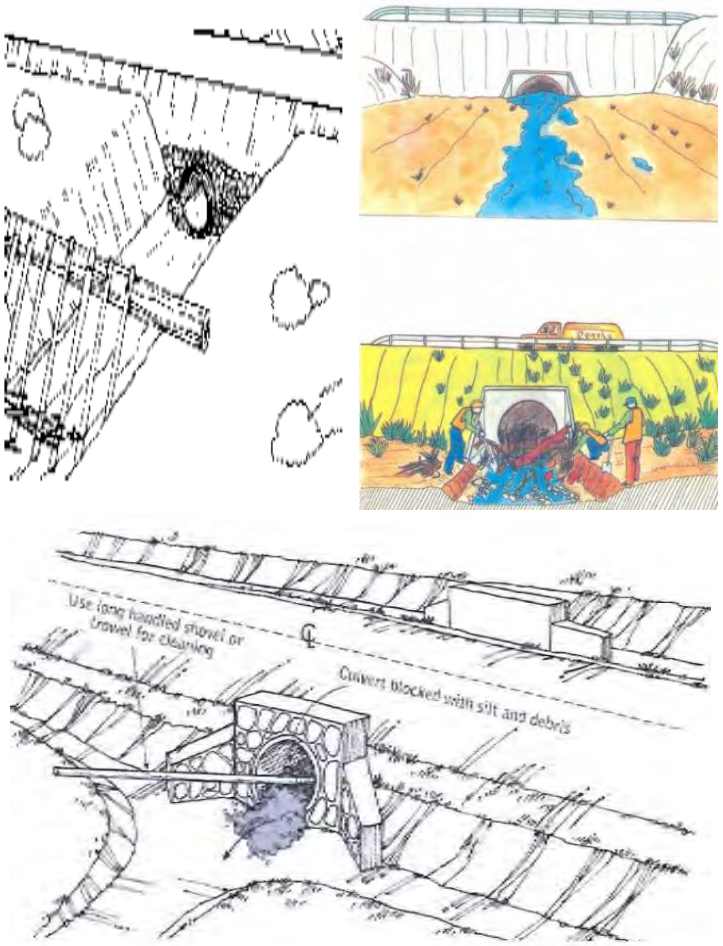
- Invert slope too flat
- Soil erosion during rainy season
- Wastes caused by the commuters and residents nearby

Work method:

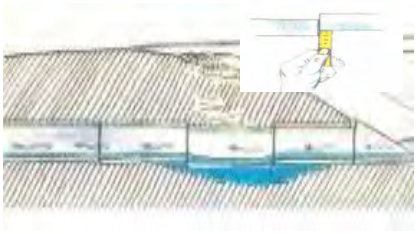
Floating debris (tree branches, bushes, etc.) carried by water may completely block the culvert inlet.

1. Using a shovel, slowly remove the sediment at the inlet and outlet area.
2. If the sedimentation and debris are unable to removed due to too much quantity and compacted, back hoe or Shovel (Excavator) machine are available for them.
3. 2 Dump trucks are more useful for continuous removal of sedimentation with one Excavator.
4. Sedimented material and debris from the culvert must be spread or dumped where they cannot cause an obstruction to water flow preferably on the downstream side of the culvert, well away from the water course.

The culvert must be always clean without any debris.
Minimum allowance of silting depth: 20cm



Manpower	Tool and Equipment	Material
• 1 excavator operator • 2 dump truck drivers • 4 unskilled workers for cleaning • 2 safety guards	• Hand shovel • Back hoe and shovel machine (Excavator) • Wheel barrow • Dump truck • Pressure water • Safety sign, cones, vest	• Material is not required due to cleaning
Quality Control	• Visual inspection to check that the culvert, inlet and outlet are cleaned and maintained to the correct standard dimensions. • Check longitudinal profile of outlet using strings and line-level.	
Productivity	• Approximately 20-30 m cleaning per day (Ø 1 m)	

Ministry of Public Works and Transport	**Job Code: 3130**	

Activity: Repair culvert transversal (nos.)

Description:

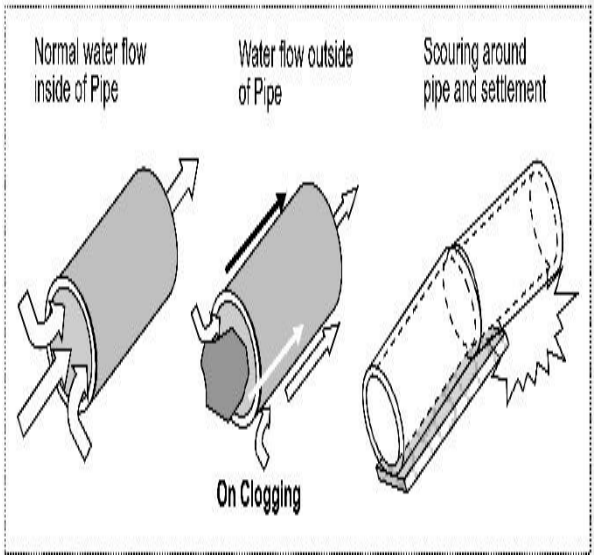
- Culvert should be repair regularly depending the area, traffic flow and flood condition of the area. Prior to repair, engineers should be able to identify damages to the culvert such as:
- Horizontal and vertical deflection of pipe.
- Size and location of voids visible through separated joints and holes in the culvert.
- Sounding the culvert interior with a hammer to listen for "hollow" sounding area.
- Culvert flow capacity is not sufficient so that overflow occurs.
- Misalignment of pipe level and settlement at pipe joints.

Possible Cause:

- Settlement of soil below culvert.
- Dead or live load on culvert exceeding the design capacity (insufficient design)
- Culverts installation are too low due to road alignment
- Improper installation or insufficient compaction
- Water flow outside of pipe brings scouring due to clogging
- Increased in soil or groundwater elevation (during rainy season)

Work method:

1. Identify the defect causes
2. Clean the culvert and divert flow prior to repair so that work place can be kept in dry condition
3. After removing sedimentation, check the condition in the culvert for:
   - Size and location of void in the joints and cracks
   - Misalignment of pipe joints
   - Sounding the culvert with hammer for hollow sound and repair then due to the result
4. Reconstruct culvert at correct level and fall
   - It is advisable to raise the level of culvert by re-excavation and relaying
   - Culverts of less than 60 cm opening are extremely difficult to desilt and the preferred minimum diameter size for ease of maintenance is 1 meter.



Manpower	Tool and Equipment	Material
• 1 excavator operation (excavator or crane) • 1 dump truck driver • 2 skilled workers • 8 unskilled workers	• Hoe and shovels • Crane 12 t • Excavator • Dump truck • Pressure water • Wire brush • Safety sign, cones, vest	• Straight bitumen • Cement, Sand, Gravel • Larger pipe culverts (Ø>1.0m)
Quality Control	• Check sedimentation and vegetation have been fully removed	
Productivity	• Reconstruction Culvert: 6 m/12 person.day (Relaying or change of precast pipe culvert)	

Ministry of Public Works and Transport	**Job Code: 3141**	

Activity: Repair pipe culvert longitudinal (m)

Description: There are variety of problem that could occur to culverts as follows;

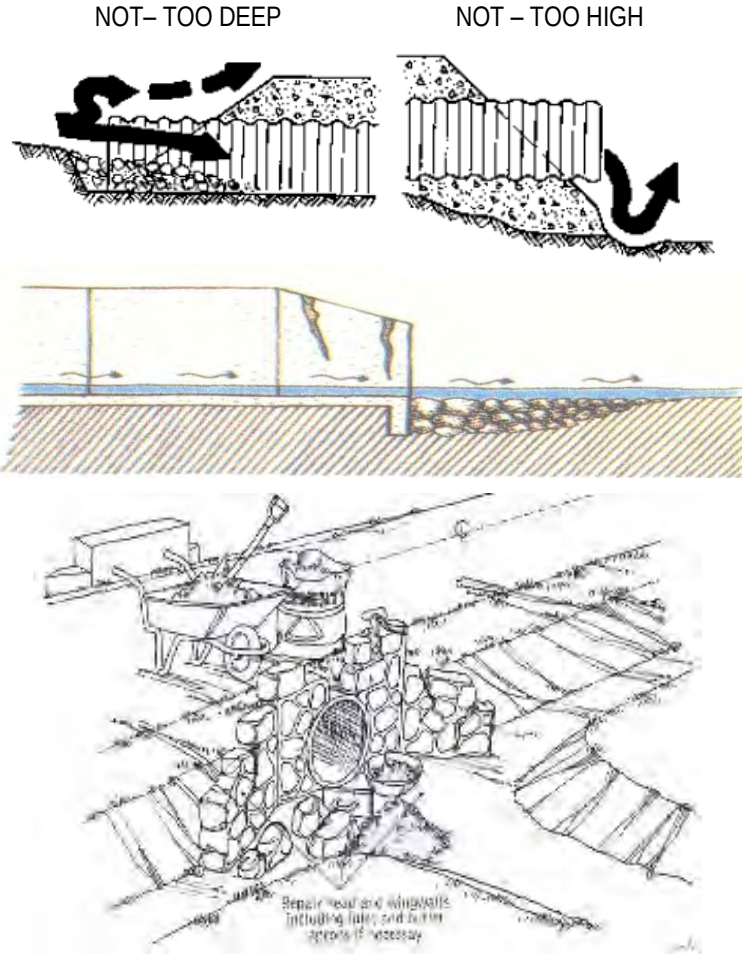
1. The stream bed is washed away and a pool or ravine development.
2. The culvert downstream headwalls, wingwalls, even a section of the culvert and road embankment can collapse.
3. Inlet invert level is too low.
4. Outlet invert level is too high.
5. Cracks in concrete and masonry.

Possible Cause:

- Culvert invert has been constructed too steep so that the water flows too fast
- Culvert design gradient not sufficient
- Soil erosion during rainy season
- Wastes caused by the commuters and residents nearby
- Vegetation grow in the culvert

Work method:

1. Using a hoe/shovel, slowly remove the sediment within the culvert
2. Determine the causes of deterioration Outlet
   - Apron shall be connected with Skirt (toe) to prevent the water from seeping into the bottom of culvert
   - Joints between Culvert and Wingwall or Apron shall be checked to be connected water tight
3. Implement repair works as follows
   - Fill eroded area with stone blocks of about 30 cm size to produce a rough energy dissipator. In dry season, the blocks can be grouted with mix (1 cement: 4 sand:8 gravel)
   - Head wall/apron repair (damage by erosion or settlement
     - Remove settlement or damage section of them
     - Compact the underlying soil
     - Rebuild the headwall or apron using similar material to the original
     - Grout up all joints with mortar (1 cement:4sand)



Manpower	Tool and Equipment	Material
• 2 skilled workers • 1 dump truck drivers • 4 unskilled workers for cleaning	• Hoe and shovels • Wheel barrow • Hammer • Dump truck • Pressure water • Safety sign, cones, vest	• Cement, Sand, Gravel • Stone (30 cm size)
Quality Control	• Ensure that no void is present within the joint, to prevent potential soil erosion through the leak. • Sufficient skirt (toe) depth of the outlet.	
Productivity	• Approximately 30 m per day	

Ministry of Public Works and Transport	**Job Code: 3142**	

Activity: Repair box culvert longitudinal (concrete)(m)

Description:

1. Culvert should be repair regularly depending the area, traffic flow and flood condition of the area. Prior to repair, engineers should be able to identify damages to the culvert such as:
2. Horizontal and vertical deflection of pipe
3. Size and location of voids visible through separated joints and holes in the culvert
4. Sounding the culvert interior with a hammer to listen for "hollow" sounding area
5. Culvert flow capacity is not sufficient so that over flow occurs
6. Misalignment of box level and settlement at box joints

Possible Cause:

- Settlement of soil below culvert
- Culvert installation are too low due to road alignment
- Dead or live load on culvert exceeding the design capacity (insufficient design)
- Improper installation or insufficient compaction
- Water flow outside of culvert brings scouring due to clogging
- Increased in soil or groundwater elevation (during rainy season)

Work method:

1. Inspection
Identify the defect causes
- Culvert
- Wingwall
- Joints

2. Cleaning
Clean the culvert and divert flow prior to repair so that work place can be kept in dry condition

3. Sealing
Any cracks found on the surface of culvert should be sealed by mortal

Manpower	Tool and Equipment	Material
• 1 excavator operator • 2 dump truck drivers • 4 unskilled workers for cleaning	• Hoe and shovels • Wheel barrow • Excavator • Dump truck • Pressure water • Safety sign, cones, vest	
Quality Control	• Check sedimentation and vegetation have been fully removed	
Productivity	• Depend on damages	

Ministry of Public Works and Transport	**Job Code: 3150**	

Activity: Install pipe culvert (m)

Description:
Culvert are commonly used for channel relief and pass water under road to collection point. They need to be properly size, installed and protected from erosion. Concrete culvert are to be used

Possible Cause:

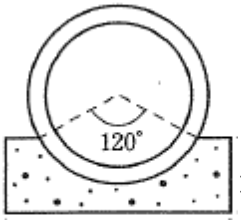
Work method:

1. Determine the design elevation level of the culvert
2. Excavate with long hand excavator to the design depth
3. Install the concrete base according to the above level, align the joint and settlement of the pipe with crane carefully
4. After checking the correctness of the pipe alignment and invest level, pipe should be fixed with stone wadges and mortar at joint
5. Backfill material should be a moist, well graded granular. Uniform fine sand is discouraged as it is non-cohesive and very susceptible to scour.

Foundation Type

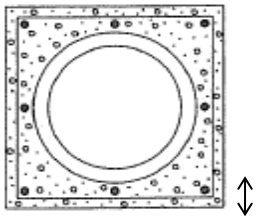
120° concrete foundation

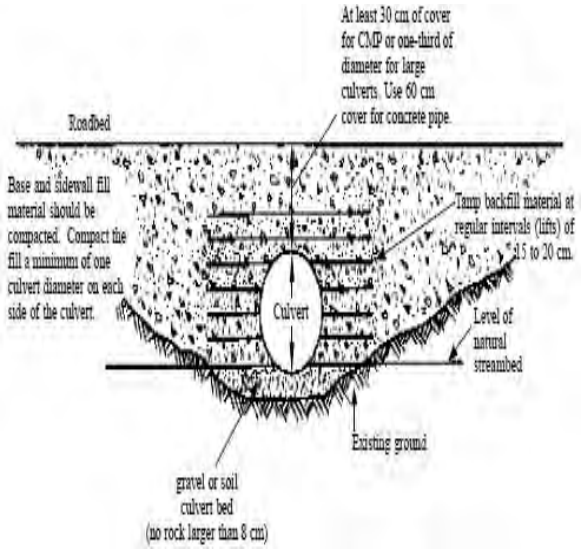
Overburden >50cm or pavement thickness



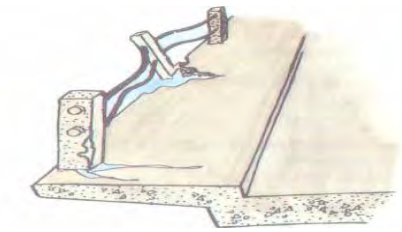
360° concrete foundation

Overburden < 50cm or pavement thickness





Manpower	Tool and Equipment	Material
• 1 excavator operator • 1 crane operation • 2 dump truck drivers • 4 unskilled workers for cleaning	• shovels • Wheel barrow • Crane 10 t • Pipe transportation truck • Safety sign, cones, vest	• Compacted • Concrete • Concrete Pipe • Mortar for joint
Quality Control	• Check joint and compaction of the backfilling material, the gradient of the waterflow is sufficient	
Productivity	• Approximately 15-40 meters of culvert daily (Ø1.0 m concrete pipe culvert)	

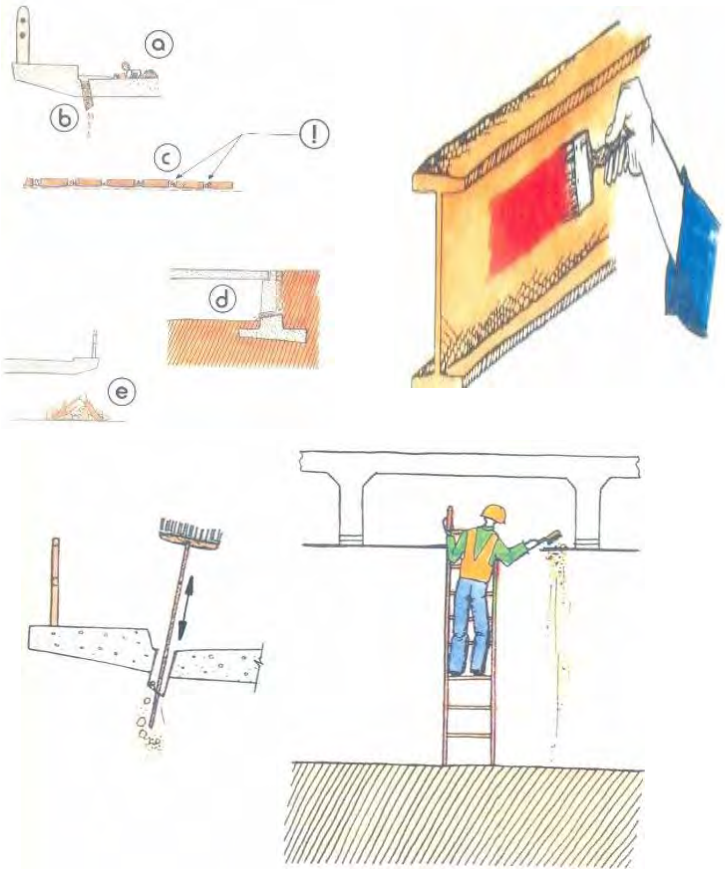
Ministry of Public Works and Transport	**Job Code: 3200**	

Activity: Minor Bridge repair (person.hour)

Description:
The minor repair and cleaning of bridges using handtools. Includes the replacement or repair of wooden bridge decks, repair of hand rails, cleaning of drainage openings, repair of curbs, repair of bridges approaches and guard rails and repair of signs and other bridge appurtenances.

Possible Cause:

- Accumulation of dirt and soil on bridge deck and guard rails
- Stone, soil, dirt in joints and around bearings
- Rubbish, soils clogged in the drainage outlet
- Debris accumulate under the bridge
- Loose or missing nailed/bolted connectors (steel bridge)

Work method	Pictures
Problem 1. Safety measures and signs are set up at both end of work site 2. Debris/Rubbish are manually pick up by shovels 3. Clogged Wastewater drainage are poked by metal rod to allow water flow out of the bridge 4. Pressured water is used to clean the dirt and in some case repaints may be needed 5. Debris/rubbish under the bridge need to be excavate by excavator and deliver by dump trucks to the dump sites 6. Wooden bridge should be repair or replace by metal 7. Steel bridge often after operation sometime, bolts and nuts are loosen and lost. Therefore tighten, replace are needed and some case wielding to ensure safety of the bridge.	

Manpower	Tool and Equipment		Material
• 2 operators • 2-3 unskilled workers	• Pressured spray water • Shovel • Wheel barrows • Excavators	• Dump trucks • Paint brushes • Wire brushes • Hammers • Brooms	• Bridge paints
Quality Control	• Ensure that all dirt is removed completely and paint to be left dry then open for traffic.		
Productivity	• Cleaning: Approximately 8 person.hour/small bridge		

Ministry of Public Works and Transport	**Job Code: 4150**	

Activity: Vegetation control (Shrub, Plant and tree) (km)

Description: Vegetation along the road shoulder can be very helpful in preventing soil erosion and providing a pleasant ride for the users. However, if vegetation left not taken care off, if could potentially cause blockage of view for the users, reducing the width of road which lead to motorbikes using vehicle roads and collapsing or falling of trees that can cause accident to the users.

Possible Cause:

- No routine maintenances were implemented
- Raining season which cause the vegetation to growth rapidly
- Unplanned growth of vegetation

Work method:

1. Identify the amount of work to be done
2. Install safety cones and signs
3. Grass cutting machine then used to cut grass along the road
4. For small tree trunks, workers can manually chop off the tree with axe
5. Larger trunk would need to use chain saws
6. Once the leaves, grass has been cut, workers can manually pick up the waste, dump into the dumping truck- wheel barrow should be used to transport

(1) Vegetation Free Zone : 0cm : carriage way
(2) Inner Zone: <15cm
(3) Outer Zone: <30cm

Outer zone vegetation

Innerzone vegetation

Inner zone vegetation

Manpower	Tool and Equipment	Material
• 1 Site Supervisor • 1 chain saw operator • 3 grass cutting machine operator • 2-4 unskilled workers	• Chain saw • Grass cutting machine • Axes • Wheelbarrow • Dump truck • Safety sign and cones	
Quality Control	• Ensure that the cut leaves and trunk are remove from site to prevent fires.	
Productivity	• Approximately 1km to 5km per day	

Ministry of Public Works and Transport	**Job Code: 4200**	

Activity: Sand bag work- slope protection(bag)

Description:

Sand bag work is an inexpensive temporary barrier or wall. It can be constructed by stacking sand-filled sandbags align with the slope and each bag is firmly stack on each other. This method is a temporary solution. We use the sand bag for protecting flood, flow across the road, wave to hit the slope and to fill big hole for traffic move quickly.

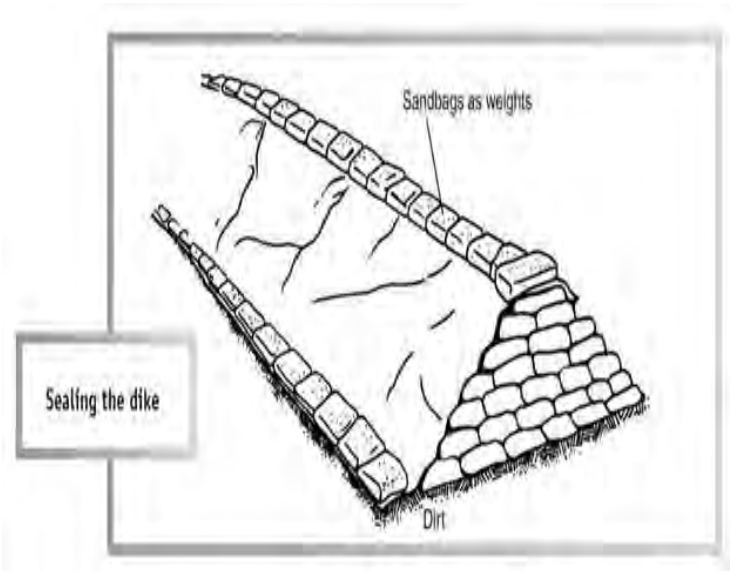
Possible Cause:

- Temporary solution to protect slope
- Slope become saturated with water, its strength and stability will decrease
- Steep geometric condition

Work method:

1. Fill sandbag half-full of sands
2. Fold the top of the sandbag down and place on its folded top
3. Place each sandbag on one layer first before starting next layer
4. Using pyramid sandbag placement
   - Please note that if sand bag work wants to have a longer lasting protection, sand can be mixed with cement.

Note: In the case of emergency road flooding, sandbag can be used to block the water along the road to prevent severe damage to access road.



Manpower	Tools and Equipment	Materials
• It is a team work job- 1 team=2 non-skilled workers (1 holding bag, 1 shovel) • 5 teams • 5 non-skilled workers • 1 dump truck driver	• Shovels • Wheelbarrow • Dump truck • Safety sign and cones • Sand bags (size and thickness of bag and quality)	• Sand-bags • Sand • Cement (if required)
Quality Control	• Ensure that the sand-bag place on it folded top and triangular form	
Productivity	• Approximately 200 sand bags per day	

Ministry of Public Works and Transport	**Job Code: 4400**	

Activity: Grass planting on the slope(m^2)

Description: Grass planting not only help in protection soil erosion, it can also enhance the looks of the slope. Grass will anchor the soil in place even during rains or winds.

Possible Cause:

- Green solution in protecting the slope
- Saturated soil will cause land slide
- Steep geometric condition

Work method:

1. Carefully select the strategic grass type
2. Gently dragging a rake over the soil area
3. Sprinkle of grass seed (ensure that only select seeds that does not wash away after planting)

Strategic grass type:

1.
2.
3.

Manpower	Tools and Equipment	Materials
• 5-8 unskilled workers • 1 site manager	• Shovels • Wheelbarrow • Rake • Buckets • Safety sign and cones	• Fertilize soil • Grass seed • Fertilizer (if required)
Quality Control	• Ensure that the soil is raked before sprinkle the seed	
Productivity	• Approximately 100 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 4500**	

Activity: Adding soil to the slope(m^3)

Description:

Road sub base is very important in determining the life of road. Without proper base and underground water way, this could lead the erosion of the base and sub base which caused dragon hole.

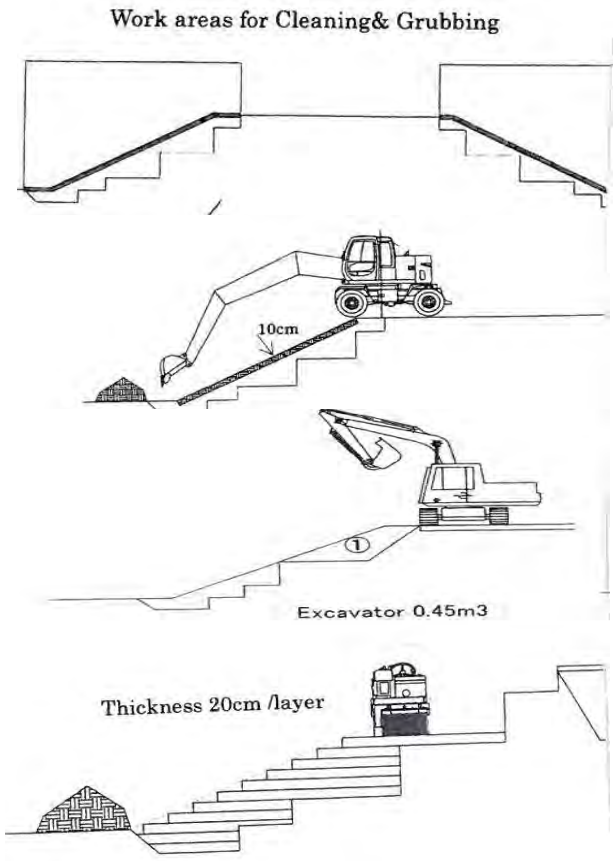
Possible Cause:

- Due to dispersive soil
- Road side drainage is not functioning well
- Sub base compaction of road were not compacted to standard
- Incorrect use Sub base material
- Natural disaster
- Embankment of roadside is not done properly

Work method:

1. Determine the dragon hole and outlet points (if presented)
2. Cleaning &Grubbing
   Remove all spoil material such as root of trees, rubbish etc. above the ground surface.
3. Removal of Topsoil (thickness approx. 10cm). Keep on the end of the slope to reused as the Soddy material after slope filling
4. Scarily top soil (approximately 10cm)
5. Excavation & Hauling
6. Mixing soil and additives*
7. Slope filling
8. Covering of Topsoil
9. Final Inspection

***** Cement and Fly ash are available as additives.
Portion of additives are as follows
Cement: 1-3 % of soil in weight
Fly ash: >7 % of soil in weight



Manpower	Tools and Equipment	Materials
• 1 vibrating compaction plate operator • 4 unskilled workers	• shovels • Wheel barrow • Vibrating compactor • Safety sign, cones, vest • Backhoe	• Mixed soil • Laterite • Sand • Cement of Fly ash as additives
Quality Control	• To confirm material use is good quality.	
Productivity	• Approximately 100 m^3 per daily	

Ministry of Public Works and Transport	**Job Code: 4610**	

Activity: Access road (public to national road) by AC (m^2)

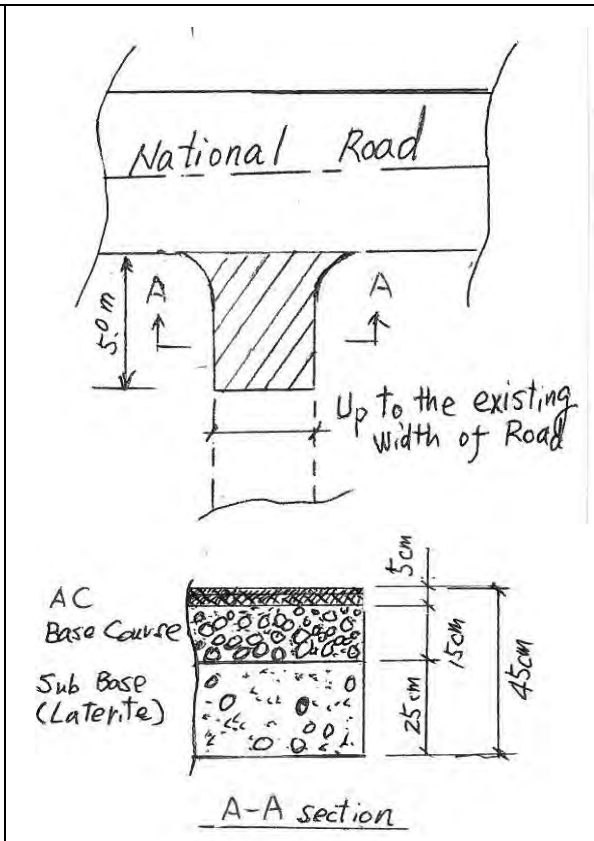
Description:
When vehicles are crossing from public laterite road to AC pavement road, the connection shoulder edge of main road may be effected. Access road (public to national road) by AC is to keep the smooth connection between two roads.

Possible Cause:

- Vehicles crossing

Work method:

1. Marking out the connection area to pave (5m Length and Width-depending on crossing road width)
2. Clean out and excavate the area
3. Removal of the 45cm depth of the existing road material by back hoe
4. Leveling by back hoe
5. Compacted original Level by Steel Wheel Roller
6. Spread the laterite as sub base by hand and compacted by Steel Wheel Roller (t =25 cm)
7. Spread the Base Course Material and compacted by Steel Wheel Roller (t =15 cm)
8. Spay Bitumen Emulsion-CSS1 over the surface using
9. Apply Asphalt concrete(AC) (t =5 cm)
10. Compaction using Steel Wheel Roller and Rubber Tire Roller.



Manpower	Tool and Equipment	Material
• 1 operator of roller • 2 safety officers at both end of work site • Approximately total of 12 men on the site	• Pickaxes • Shovels • Steel Wheel Roller (more than 3 ton) • Back hoe (0.1 m3) • Safety sign, cones, vest • Rubber Tire Roller (8 ton)	• Laterite • Aggregate M30 • CSS-1 • Asphalt Concrete
Quality Control	• To confirm the Patching surface is good quality before letting vehicles run over.	
Productivity	• Approximately 50m^2/day	

Ministry of Public Works and Transport	**Job Code: 4620**	

Activity: Access road (public to national road) by DBST(m^2)

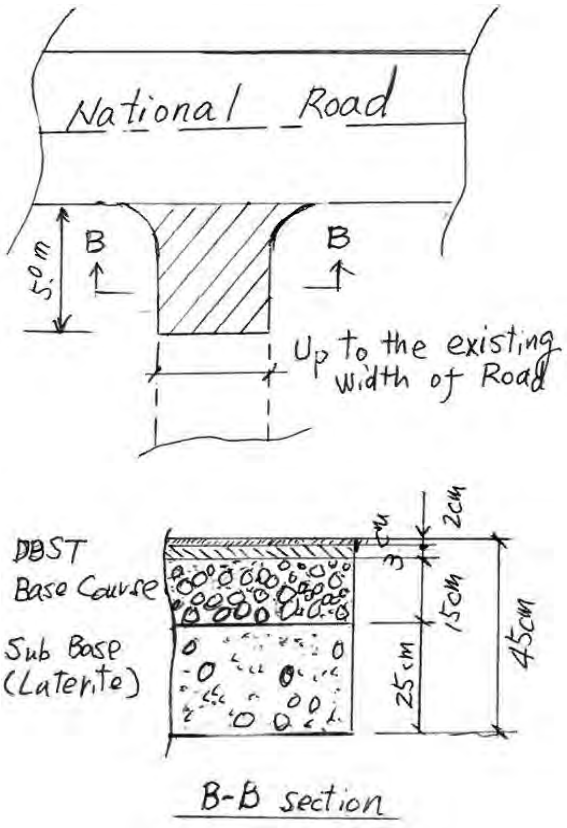
Description:
When vehicles are crossing from public laterite road to DBST pavement road, the connection shoulder edge of main road may be effected. Access road (public to national road) by DBST is to keep the smooth connection between two roads.

Possible Cause:

- Vehicles crossing

Work method:

1. Marking out the connection area to pave (5m Length and Width-depending on crossing road width)
2. Clean out and excavate the area
3. Removal of the 45cm depth of the existing road material by back hoe
4. Leveling by back hoe
5. Compacted original Level by Steel Wheel Roller
6. Spread the laterite as sub base by hand and compacted by Steel Wheel Roller (t =25 cm)
7. Spread the Base Course Material and compacted by Steel Wheel Roller (t =15cm)
8. Resealing binder-CSS1 over the surface using a spray lance and sand spreading
9. Spray CRS-2
10. Spread aggregate 19mm on the area (DBST = 3 cm)
11. Compaction using a Tire Roller or Steel Wheel Roller
12. Spray CRS2 over the surface
13. Spreading aggregate 12mm on the area (DBST =2 cm)
14. Compaction using a Tire Roller or Steel Wheel Roller



Manpower	Tool and Equipment	Material
• 2 operators of Roller and Back hoe • 2 safety officers at both end of work site • Approximately total of 12 men on the site	• Pickaxes • Shovels • Back hoe (0.05~0.1 m3 bucket) • Safety sign, cones, vest • Steel Wheel Roller (more than 3 ton) • Tire Roller (8 ton)	• Laterite • Aggregate M30 • CSS-1 • Sand • CRS-2 • Max 19 mm Aggregate • Max 12 mm Aggregate
Quality Control	• To confirm the surface is good quality before letting vehicles run over.	
Productivity	• Approximately 50 m^2/day	

Ministry of Public Works and Transport	**Job Code: 4630**	

Activity: Access road (public to national road) by macadam(m^2)

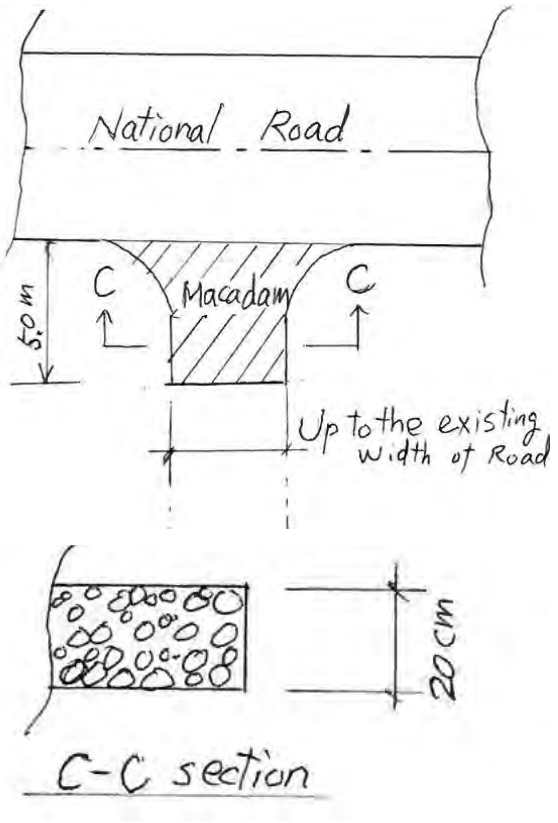
Description:
When vehicles are crossing from public laterite road to Macadam pavement road, the connection shoulder edge of main road may be effected. Access road (public to national road) by Macadam is to keep the smooth connection between two roads.

Possible Cause:

- Vehicles crossing

Work method:

1. Marking out the connection area to pave (5m Length and Width-depending on crossing road width)
2. Clean out and excavate the area
3. Removed of the 20cm depth of the existing material
4. Spreading aggregate 4cm x 6cm on the area
5. Compaction using rubber tire roller
6. Spreading aggregate 19mm into gap of aggregate 4cm x 6cm above.
7. Compaction using tire Steel Wheel Roller



Manpower	Tool and Equipment	Material
• 1 operator of roller • 2 safety officers at both end of work site • Approximately total of 12 men on the site	• Pickaxes • Shovels • Rubber Tire Roller (8 ton) • Safety sign, cones, vest • Steel Wheel Roller (more than 3 ton)	• Aggregate 4cm x 6cm • Sand • CRS-2 • Aggregate 19mm •
Quality Control	• To confirm the Patching surface is good quality before letting vehicles run over.	
Productivity	• Approximately 150 to 250m^2/day	

Ministry of Public Works and Transport	**Job Code: 4700**	

Activity: Dragon hole filling (m^3)

Description:
Road sub base is very important in determining the life of road. Without proper base and underground water way, this could lead the erosion of the base and sub base which caused dragon hole.

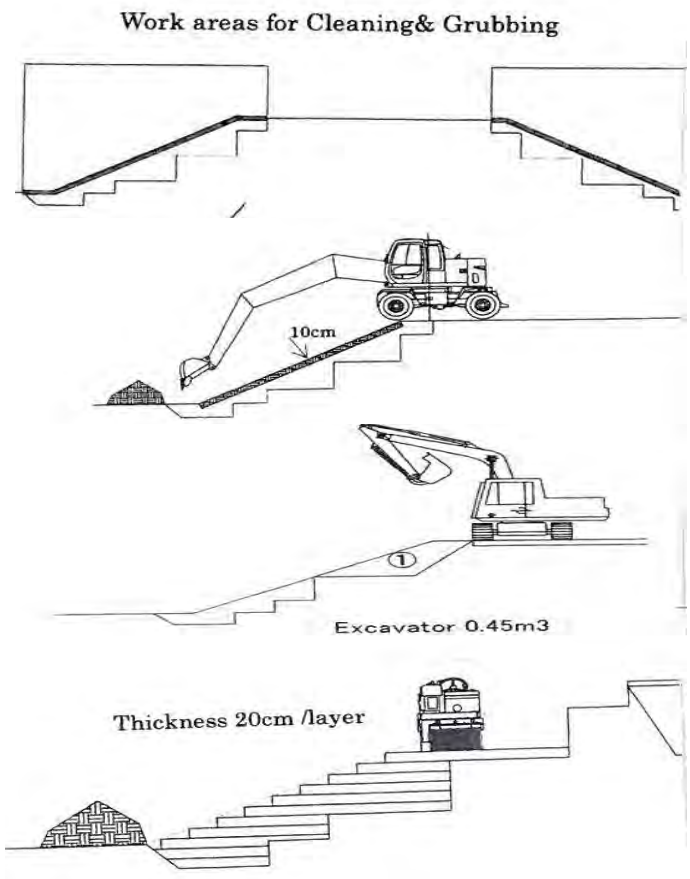
Possible caused:

- Due to dispersive soil
- Road side drainage is not functioning well
- Sub base compaction of road were not compacted to standard
- Incorrect use Sub base material
- Natural disaster
- Embankment of roadside is not done properly

Work method:

1. Determine dragon holes and outlet points
2. Cleaning and grubbing

   Remove all bad materials such as root of trees, rubbish etc.
3. Mixing of refills soils with additive(Cements)
4. Fill in the outlets/dragon holes
5. Covering of topsoil
6. Final inspection



Manpower	Tool and Equipment	Material
• 1 vibrating compaction plate operator • 4 unskilled workers	• shovels • Wheel barrow • Vibrating compactor • Safety sign, cones, vest • Backhoe	• Mixed soil • Laterite • Sand • Cement of Fly ash as additives
Quality Control	• To confirm material use is good quality.	
Productivity	• Approximately 30 to 70 m^3 per daily	

Ministry of Public Works and Transport	**Job Code: 5100**	

Activity: Traffic lanes painting (Thermoplastic)(m)

Description: Road painting are used on paved roadways to provide guidance and information for drivers and pedestrians. Therefore, it is important to always re-paint the road marking as soon as the road mark is no longer visible. For the best practice, it should have a schedule painting (e.g. yearly).

Possible caused:

- Quality of the paint were not to the standard
- Heavy traffic flow area (reduce the life of road mark)
- Quality of asphalt that caused cracks to the marking
- Accident that could scrap off the painting
- Weathering

Work method:

1. No painting work should start until all warning and speed reduction signs and the flagmen are in position as indicated in the temporary sign and the flagmen are in position as indicated in the temporary signposting plan. Ensure that the workforce can work safely.
2. The road surface must be dry,
3. Clean existing road markings where required using a stiff brush. No dirt, dust or other contamination should be left on the surface to be painted.
4. Apply the paint sparingly after thoroughly mixing and adjusting the stencil to the line edges. Thick paint lines tend to crack on drying. Paint only within the limits of the existing markings, otherwise the edges will look ragged. If a spill occurs, clean pavement surface immediately.
5. The road marking paint should dry in about 10-15 minutes (depending on paint type and weather conditions). Do not remove any cones or allow traffic to run over the freshly painted lines before the paint is dry enough for traffic.
6. Ensure that the warning cones are correctly spaced and located along the line being painted. Cones displaced by traffic should be reset in position without delay.
7. Observe the progress of the work and move the flagmen and warning signs as soon as the paint has dried over a sufficiently long section of road.
8. The work must be organized so that all painted areas will be traffic-dry by the time cones and signs have to be removed at the end of the day's work.
9. Remove any unwanted markings using a blowlamp and scraper. Do not over heat the bitumen road surface.
   Minimum thickness of the line: 1.5mm
   Normal width of line: 15 cm

Manpower	Tool and Equipment	Material
• 2 unskilled workers • 2 skilled workers (mixing the paint) • 1 truck driver	• Broom/ mechanical broom • Nylon string • Measuring tape • Safety sign, cones, vest • Handliner • burner	• pigment • binders • solvent • thermoplastic paint • glass beads
Quality Control	• Road to be cleaned before paint	
Productivity	• Approximately 75 to 100 m^2 per day	

Ministry of Public Works and Transport	**Job Code: 5200**	

Activity: Clean and paint traffic sign (nos.)

Description: Traffic sign are signs erected at the side or above roads to give instruction or provide information to road users. It is vital in providing road users information of the coming road and traffic ahead of them. Some of the sign such as narrow road, city area, speed limit, bumpy road, merging lane and many more. Therefor it is essential to keep them clean, clear and visible to road users.

Possible caused:

- Vandalism
- Traffic raises dust clouds during dry weather or splashes during wet weather on to signs and posts.
- Bird droppings
- Aging sign boards

Work method:

1. If it is heavy traffic, two men at both end needed to be there to direct traffic. If low traffic, not necessary, only safety cone and sign are required.
2. Clean signs, reflectors, guide-posts etc. at least twice a year or more often if local conditions require.
3. Wash the surface using a cloth, water and detergent solution. Take care not to scratch the surface or damage a reflective paint surface.
4. After washing, remove all traces of detergent with a cloth, and soft brush, and rinse with water.
5. Clean the back of the sign at the same time using water and a cloth. Use a hand brush to remove dirt from corners and fittings.
6. Where signs or reflectors are contaminated with bitumen or oil steaks, use kerosene for cleaning and then wash down with water.
7. If surface paint is flaky, use a wire brush to remove all loose paint and rust.
8. Clean surface area to be repainted using water and cloth, and then allow surface to dry thoroughly.
9. Use sandpaper on existing paint to provide a key for the new paint. Brush the surface clean.
10. As soon as the surface is dry, apply a prime coat evenly to all areas where old paint is damaged or removed. Allow to dry.
11. Apply the finishing coat (Use only paints of approved type and color).

Manpower	Tool and Equipment	Material
• 2 unskilled workers • 1 truck driver	• Ladder • Safety sign, cones, vest • Truck (2 ton) • Wire brush • Sand paper	• Cleaning agent • Paint • Kerosen
Quality Control	• Road to be cleaned before paint	
Productivity	• Approximately 20 to 40 sign boards per day	

Ministry of Public Works and Transport	**Job Code: 5230**	

Activity: Traffic sign repair (nos.)

Description:

Traffic sign are signs erected at the side or above roads to give instruction or provide information to road users. It is vital in providing road users information of the coming road and traffic ahead of them. Some of the sign such as narrow road, city area, speed limit, bumpy road, merging lane and many more. Therefore, it is essential to keep the signs to its full function with regular repair.

Possible caused:

- Tilting of road signs due to poor foundation such as soil erosion
- Rusty sign boards
- Road accidents

Work method:

1. Surface to be painted are to be cleaned free of rust, dirt and all other contamination.
2. Use only clean soft brushes or rollers.
3. Painting should only be carried out during dry weather. Do not paint on a wet surface or during rain.
4. Paints mush be thoroughly mixed before application. If thinners are to be used, follow manufacturer's instructions, take precautions against fire.
5. When reflectors are set into or mounted on surfaces to be painted, cover these completely with paper or tape for protection during painting.
6. Road sides sign can be repaired by using ladder as it is typically about 3 matters.
7. Overhead road sign, crane needed to be used to hoist workers up. If it is heavy traffic, two men at both end needed to be there to direct traffic. If low traffic, not necessary, only safety cone and sign are required.
8. Repairing work may involve work such as welding, cutting, manual excavating and casting of concrete for foundation of sign.

Manpower	Tool and Equipment	Material
• 1 skilled • 1 unskilled workers • 1 truck driver	• Ladder or crane • Welding machine • Pickaxe • Safety sign, cones, vest • Soft brushes or Roller for paint • Truck (2 ton)	• Bolts and nuts • Sign poles • Concrete- sand, cement, aggregate • Paints • Thinner • Tape
Quality Control	• Road to be cleaned before paint	
Productivity	• Approximately 10 to 30 sign boards per day	

Ministry of Public Works and Transport	**Job Code: 5250**	

Activity: New traffic sign installation (nos.)

Description:
Traffic sign are signs erected at the side or above roads to give instruction or provide information to road users. It is vital in providing road users information of the coming road and traffic ahead of them. Some of the sign such as narrow road, city area, speed limit, bumpy road, merging lane and many more. Therefore, it is essential to install traffic sign at strategic location for the full benefit for the road users.

Possible caused:

- Narrow or dangerous roads
- Unforeseen obstacles that road users should be aware of
- Inform road users about directions and unexpected turns
- One direction road

Work method:

1. Identify the strategic location that need to let road users know of speed limits, unexpected turns, one direction road and many more.
2. Determine if road sign should be by the road side or above.
3. Manually excavate with pickaxe and shovel to a depth of at least 800mm with diameter of 250mm
4. Insert the pole center to the hole till bottom. Please note that even though the pole rest at bottom, that length of the traffic sign pole should be design tall enough above ground that is visible to road user. (base of traffic sign should be about 2.2 meter above ground)
5. Steel posts should be case into a concrete footing (h =800 mm, Ø 250 mm)

Manpower	Tool and Equipment	Material
• 1 skilled • 2 unskilled workers • 1 truck driver	• Ladder • Welding machine • Pickaxe and shovels • Safety sign, cones, vest • Concrete Mixer (200L)	• Bolts and nuts • Sign poles and Boards • Concrete- sand, cement, aggregate
Quality Control	• Foundation of pole should be about 800 mm depth	
Productivity	• Approximately 5 to 10 traffic signs per day	

Ministry of Public Works and Transport	**Job Code: 6100**	
Activity: Cleaning and painting safety pole (nos.)		

Description:
Safety poles keep vehicles within their roadway and prevent vehicles from colliding with dangerous obstacles such as boulders, walls or large storm drains. They are also installed at the roadside to prevent errant vehicles from traversing steep (non-recoverable) slopes or entering deep water.

Possible caused:

- Vandalism
- Dusty roads area
- Aging

Work method:

Cleaning

1. Wash the surface using a cloth, water and detergent solution. Take care not to scratch the surface or damage a reflective paint surface,
2. After washing, remove all traces of detergent with a cloth, and soft brush, and rinse with water,

Repainting

1. Wash thoroughly all dirt, soil, dust etc. from surfaces and allow to dry
2. Apply one coat of water-based, cement or latex paint of specified colour to visible surfaces,
3. Poles can be painted with the same type of paint of a specified contrasting colour.

Manpower	Tool and Equipment	Material
• 3 unskilled workers • 1 truck driver	• Soft brush for cleaning • Safety sign, cones, vest • Brush for paint	• Cleaning agent • Paint
Quality Control	• Safety Poles need to be cleaned before paint	
Productivity	• Approximately 50 to 100 Poles per day	

Ministry of Public Works and Transport	**Job Code: 6150**	

Activity: Safety poles installation (nos.)

Description: Safety poles keep vehicles within their roadway and prevent vehicles from colliding with dangerous obstacles such as boulders, walls or large storm drains. They are also installed at the roadside to prevent errant vehicles from traversing steep (non-recoverable) slopes or entering deep water.

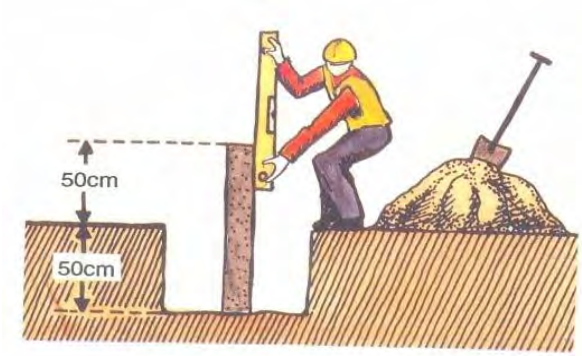
Possible caused:

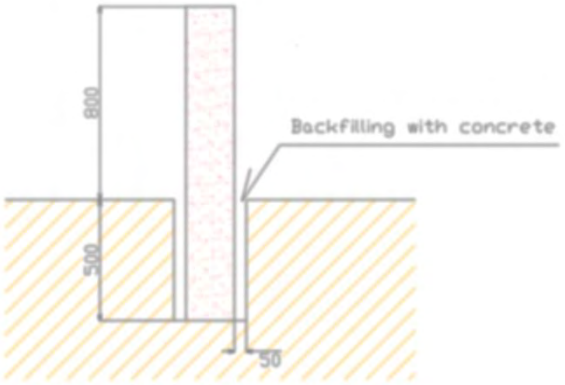
- Vehicle accident

Work method:

1. Remove the broken pole
2. Manually excavate the pole hole with pickaxe and shovel to a depth of at least 50cm
3. Place new pole in the excavation, check position, height and alignment. The post must be kept vertical and in alignment during backfilling,
4. Place the backfill in layers not exceeding 10 cm loose soil. Compact the loose soil with a hand rammer. Repeat until the soil backfill is level with the ground surface,

.





Manpower	Tool and Equipment	Material
• 1 skilled • 2 unskilled workers • 1 truck driver	• Pickaxe and shovels • Safety sign, cones, vest • Hand rammer	• Safety Poles •
Quality Control	• Foundation of pole should be about 50cm depth	
Productivity	• Approximately 10 to 30 Poles per day	

Ministry of Public Works and Transport	**Job Code: 7100**	
Activity: Cleaning & painting kilometer post(nos.)		

Description:
Kilometer Posts are necessary to inform road users of their location, and to identify and locate maintenance works.

Possible caused:

- Vandalism
- Dusty roads area
- Aging

Work method:

1. Remove the broken pole (if there is any)
2. Manually excavate the pole hole with pickaxe and shovel to a depth of at least 50cm
3. Place new post in the excavation, check position, height and alignment. The post must be kept vertical and in alignment during backfilling,
4. Place the backfill in layers not exceeding 10 cm loose soil. Compact the loose soil with a hand rammer. Repeat until the soil backfill is level with the ground surface,

.

Manpower	Tool and Equipment	Material
• 4 unskilled workers • 1 truck driver • 1 crane truck driver	• Safety sign, cones, vest • Crane truck	• Kilo post

Quality Control	• Ensured that the height and facing of the kilo post is correct
Productivity	• Approximately 7 to 20 Posts per day

Ministry of Public Works and Transport	**Job Code: 7130**	

Activity: Repairing kilometers post (nos.)

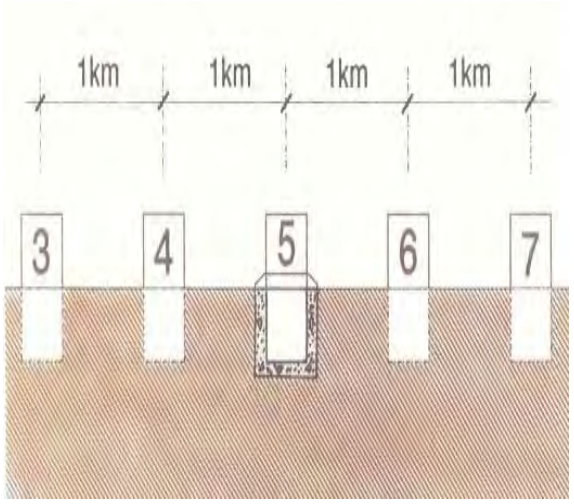
Description: Kilometer Posts are necessary to inform road users of their location, and to identify and locate maintenance works.

Possible caused:

- Tilting of Kilometer Post due to poor foundation such as soil erosion
- Road accidents

Work method:

1. Identify Kilometer Post need to be repaired
2. They are normally relocated in a simple excavation which is then backfilled with soil.
3. The location is normally determined and staked out by the road surveyor.
4. Some Kilometer Post may be required to be more stable and therefore set on a concrete foundation.



Manpower	Tool and Equipment	Material
• 1 skilled • 3 unskill workers • 1 truck driver	• Safety sign, cones, vest	• Concrete- sand, cement, aggregate
Quality Control	• Road Kilometer Post to be more stable and right location.	
Productivity	• Approximately 6 to 15 Kilometer Posts per day	

Ministry of Public Works and Transport	**Job Code: 7150**	

Activity: Kilometer post installation (nos.)

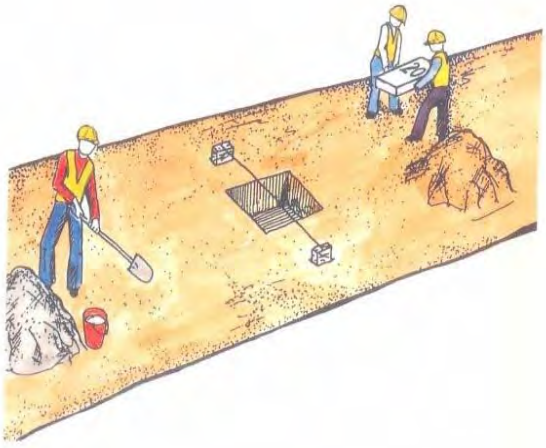
Description:
Kilometer Posts are necessary to inform road users of their location, and to identify and locate maintenance works.

Possible caused:

- Vehicle Accident

Work method:

1. Excavate the foundation at the location fixed by the surveyor and deep enough for stability (usually half the depth of the kilometer-post) and wide enough to allow for compaction of the backfill with available hand rammers,
2. Level off foundation base and compact with the hand rammer,
3. Centre the kilometer-post in the foundation excavation, check plumb and correct orientation,
4. Backfill evenly around the kilometer-post base in loose layers not exceeding 10 cm, compact with the hand rammer
5. As soon as the compacted backfill has reached a level slightly higher than the surrounding ground, smooth-off the soil surface and remove surplus soil



Manpower	Tool and Equipment	Material
• 2 unskilled workers • 1 truck driver	• Safety sign, cones, vestSafety sign, cones, vest	• Kilometer Post
Quality Control	• Kilometer Post to be cleaned before paint	
Productivity	• Approximately 7 to 20 Kilometer Posts per day	

Ministry of Public Works and Transport	**Job Code: 7200**	

Activity: Replacing safety guardrail(steel) (m)

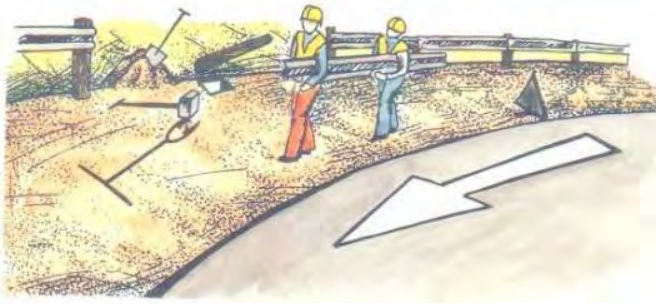
Description: Guardrail barrier Systems for road safety are widely used for highway safety and fixed on the side of the roads especially on curves and slopes for preventing vehicles from riding out from roads.

Possible caused:

- Vehicle accident

Work method:

1. Unbolt damaged guardrail panels and posts and remove.
2. Manually excavate the post hole with pickaxe and shovel to a depth of at least 1m with diameter of 350mm
3. Place the post in the excavation, check position, height and alignment. The post must be kept vertical and in alignment during backfilling,
4. Steel posts should be cast into a concrete footing as shown (a), allow the concrete to set
5. Assemble the new guardrails
6. Tighten all bolts and nuts.



Manpower	Tool and Equipment	Material
• 1 skilled • 2 unskilled workers • 1 truck driver	• Pickaxe and shovels • Safety sign, cones, vest • Concrete Mixer (200 L)	• Bolts and nuts • Steel posts • Guardrail panel • Concrete- sand, cement, aggregate
Quality Control	• Foundation of pole should be about 1m depth	
Productivity	• Approximately 5 to 10 Guardrail posts with panels per day	

CHAPTER III

EQUIPMENT LIST

Different type of compactors

1. Light Soil Compacting Equipments:

These equipments are used for soil compacting of small areas only and where the compacting effort needed is less. Below are light equipments for soil compaction:

Rammers: Rammers are used for compacting small areas by providing impact load to the soil. This equipment is light and can be hand or machine operated. The base size of rammers can be 15cm x 15cm or 20cm x 20cm or more. Rammers are suitable for compacting cohesive soils as well as other soils. This machine in areas with difficulty in access.	
Vibrating Plate Compactors: Vibrating plate compactors is used for compaction of small areas in confined space. This machine is suitable for compaction of all types of soil by vibrations set up in a base plate through a spring activated by an engine driven reciprocating mechanism. They are usually manually guided and weigh between 50 and 100 kg.	

2.Heavy Soil Compaction Equipments:

These compacting machines are used for large areas for use on different types of soils. The heavy compaction equipments are selected based on moisture content of soil and types of soil. Following are different types of these equipments:

Smooth Wheeled Rollers:

Smooth wheeled rollers are of two types:

- Static smooth wheeled rollers
- Vibrating smooth wheeled rollers

The most suitable soils for these roller type are well graded sand, gravel, crushed rock, asphalt etc. where crushing is required. These are used on soils which does not require great pressure for compaction. These rollers are generally used for finishing the upper surface of the soil. These roller are not used for compaction of uniform sands.

The performance of smooth wheeled rollers depend on load per cm width it transfers to the soil and diameter of the drum. The load per cm width is derived from the gross weight of the drum.

The smooth wheeled rollers consists of one large steel drum in front and two steel drums on the rear. The gross weight of these rollers is in the range of 8-10 tonnes (18000 to 22000 lbs). The other type of smooth wheel roller is called Tandem Roller, which weighs between 6-8 tonne (13000 to 18000 lbs).

The performance of these rollers can be increased by increasing the increasing the weight of the drum by ballasting the inside of drums with wet sand or water. Steel sections can also be used to increase the load of the drum by mounting on the steel frame attached with axle.

The desirable speed and number of passes for appropriate compaction of soil depends on the type of soil and varies from location to location. About 8 passes are adequate for compacting 20 cm layer. A speed of 3-6 kmph is considered appropriate for smooth wheel rollers.

Vibrating smooth wheeled rollers

In case of vibrating smooth wheeled rollers, the drums are made to vibrate by employing rotating or reciprocating mass.

These rollers are helpful from several considerations like:-

(i) Higher compaction level can be achieved with maximum work

(ii) Compaction can be done up to greater depths

Pneumatic Tyred Rollers: Pneumatic tyred rollers are also called as rubber tyred rollers. These rollere are used for compaction of coarse grained soils with some fines. These rollers are least suitable for uniform coarse soils and rocks. Generally pneumatic tyred rollers are used in pavement subgrade works both earthwork and bituminous works.	
Pad Foot / Tamping Rollers These rollers are similar to sheep foot rollers with lugs of larger area than sheep foot rollers. The static pad foot rollers also called tamping rollers have static weights in the range of 15 to 40 tonnes and their static linear drum loads are between 30 and 80 kg/cm. These rollers are more preferable than sheep foot roller due to their high production capacity, and they are replacing sheep foot rollers.	

CHAPTER IV

GUIDELINE ROAD MARKING

Phnom Penh, 31, December 2014

BRAKAS
ON
Longitudinal Marking Size Revised and Traffic Control Devices Standards Picture Updating

The Ministry of Public Works and Transport

-The Constitution of the Kingdom of Cambodia;

-Royal Decree No. NS/RKD/0908/1055 dated September 25, 2008, on the appointment of the Royal Government of Cambodia;

-Royal Kram No. 02/NS/94, dated July 20, 1994, on the organization and functioning of the council of Minister;

-Royal Kram No. NS/KR/0196/03, dated January 24, 1996, promulgating the law on the Establishment of the Ministry of Public Works and Transport;

-Subdecree No. 14 S.E, dated March 3, 1998, on the organization and functioning of the Ministry of Public Works and Transport;

-Necessity of the Ministry of Public Works and Transport

HEREBY DECIDES

Article 1: Longitudinal marking size revised in towns and countryside, and also standards picture updated as following:

a. Longitudinal marking size revised in towns and countryside
-In standard part 2 "Detail Picture Sign and Size" Page (14-21 and 5-21, 6-21)

b. Yellow-White Curb Marking changed to Yellow-Black Curb Marking
-In standard part 1 "Picture and Content" Page (6-2-1 and 6-2-4)

c. Updating picture
-In standard part 2 "Detail Picture Sign and Size" Page (6-21 and 7-21)

Article 2: The new revised content as attached in BRAKAS is replace by old picture content and adding more as stage in page of Article 1, and public by Ministry of Public Works and Transport.

Article 3: Chief Cabinet, Director of General Administration, Director of Department of Public Works, Director of Department of Transport, Secretariat of the General Secretariat, Director of Road Department, Director of Department of Public Works and Transportation and Head of Unit under the Ministry are have responsibility to announced from the signing date.

Minister

Tram Iv Teuk

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងសាធារណការ និង ដឹកជញ្ជូន
លេខ: ៦៤១.....ស.ក.ក. សក

រាជធានីភ្នំពេញ, ថ្ងៃទី ៣១ ខែ ឧសភា ឆ្នាំ២០១៤

ប្រកាស
ស្តីពី
ការកែសម្រួលទំហំគំនូសសញ្ញាតាមបណ្តោយទ្រូងផ្លូវ និង ធ្វើបច្ចុប្បន្នភាពរូបភាពមួយចំនួនក្នុងបទដ្ឋានសញ្ញាចរាចរណ៍ផ្លូវគោក

រដ្ឋមន្ត្រីក្រសួងសាធារណការ និង ដឹកជញ្ជូន

- បានឃើញរដ្ឋធម្មនុញ្ញ នៃព្រះរាជាណាចក្រកម្ពុជា
- បានឃើញព្រះរាជក្រឹត្យលេខ នស/រកត/០៩០៨/១០៥៥ ចុះថ្ងៃទី២៥ ខែកញ្ញា ឆ្នាំ២០០៨ ស្តីពីការតែងតាំងរាជរដ្ឋាភិបាល នៃព្រះរាជាណាចក្រកម្ពុជា
- បានឃើញព្រះរាជក្រមលេខ ០២/នស/៩៤ ចុះថ្ងៃទី២០ ខែកក្កដា ឆ្នាំ១៩៩៤ ដែលប្រកាសឱ្យប្រើច្បាប់ស្តីពីការរៀបចំ និងការប្រព្រឹត្តទៅនៃគណៈរដ្ឋមន្ត្រី
- បានឃើញព្រះរាជក្រម លេខ នស/រកម ០១៩៦/០៣ ចុះថ្ងៃទី២៤ ខែមករា ឆ្នាំ១៩៩៦ ដែលប្រកាសឱ្យប្រើច្បាប់ស្តីពីការបង្កើត ក្រសួងសាធារណការ និង ដឹកជញ្ជូន
- បានឃើញ អនុក្រឹត្យលេខ ១៤ អនក្រ-បក ចុះថ្ងៃទី០៣ ខែមីនា ឆ្នាំ១៩៩៨ ស្តីពីការរៀបចំ និងការប្រព្រឹត្តទៅរបស់ក្រសួងសាធារណការ និង ដឹកជញ្ជូន
- យោងប្រកាសលេខ ៤៩៨ ប្រក.សក ចុះថ្ងៃទី២៩ ខែវិច្ឆិកា ឆ្នាំ២០០៥ ស្តីពីការកំណត់ឱ្យប្រើប្រាស់ជាផ្លូវការនូវ "បទដ្ឋានសញ្ញាចរាចរណ៍ផ្លូវគោក"
- យោងប្រកាសលេខ ០០១ សក.មបស ចុះថ្ងៃទី០២ ខែមករា ឆ្នាំ២០០៩ ស្តីពីការបង្កើតគណៈកម្មការបច្ចេកទេសសំរាប់សិក្សា និងពិភាក្សាពិនិត្យផ្តល់យោបល់ចងក្រងបទដ្ឋានគតិយុត្តនានា ដែលពាក់ព័ន្ធនឹងការងារហេដ្ឋារចនាសម្ព័ន្ធសំណង់សាធារណការ
- យោងតាមការចាំបាច់របស់ក្រសួង

សម្រេច

ប្រការ ១ -

ត្រូវបានកែសម្រួលទំហំគំនូសសញ្ញាតាមបណ្តោយទ្រូងផ្លូវ ទាំងក្នុងទីប្រជុំជន និងជនបទ ព្រមទាំងធ្វើបច្ចុប្បន្នភាព រូបភាពមួយចំនួន ដូចខាងក្រោម៖

ក- កែសម្រួលទំហំគំនូសសញ្ញាតាមបណ្តោយទ្រូងផ្លូវទាំងអស់ ទាំងតាមទីប្រជុំជន និងតាមផ្លូវជនបទ

- ក្នុងបទដ្ឋាន ភាគទី ២ "លំអិតរូបសញ្ញា និងទំហំ" ត្រង់ទំព័រ (14-21 និង 5-21 , 6-21)

មហាវិថីព្រះនរោត្តម , ភ្នំពេញ
ទូរស័ព្ទ-ទូរសារ: (៨៥៥) ២៣ ៤២៦ ៦៤០, (៨៥៥) ២៣ ៤២៧ ៨៦៥

ខ- ផ្លាស់ប្តូរគំនូសសញ្ញាទោល លឿង - ស គែមចិញ្ចើមផ្លូវទៅគំនូសសញ្ញាទោល លឿង - ខ្មៅ លើចិញ្ចើមផ្លូវ

- ក្នុងបទដ្ឋាន ភាគទី ១ "រូបភាព និង ខ្លឹមសារ" ត្រង់ទំព័រ **(6-2-1 និង 6-2-4)**

គ- ធ្វើបច្ចុប្បន្នភាព រូបភាព ដើម្បីងាយយល់

- ក្នុងបទដ្ឋាន ភាគទី ២ "លំអិតរូបសញ្ញា និងទំហំ" ត្រង់ទំព័រ **(6-21 និង 7-21)**

ប្រការ ២-

ខ្លឹមសារដែលបានកែសម្រួលថ្មី ដូចមានភ្ជាប់ក្នុងប្រកាសនេះ ត្រូវជំនួសរូបភាពខ្លឹមសារចាស់ និងបន្ថែមថ្មី ត្រង់ទំព័រដូចមានចែងក្នុងប្រការ១ ខាងលើ និងត្រូវប្រកាសផ្សព្វផ្សាយជាផ្លូវការ ដោយក្រសួងសាធារណការ និងដឹកជញ្ជូន ។

ប្រការ ៣-

នាយកខុទ្ទកាល័យ អគ្គនាយករដ្ឋបាល អគ្គនាយកសាធារណការ អគ្គនាយកដឹកជញ្ជូន អគ្គាធិការ ប្រធានគ្រប់អង្គភាពក្រោមឱវាទក្រសួង ប្រធានមន្ទីរសាធារណការ និងដឹកជញ្ជូន រាជធានី ខេត្ត និងអ្នកពាក់ព័ន្ធទាំងអស់មានភារកិច្ចរៀងៗខ្លួនទទួលបន្ទុកអនុវត្តប្រកាសនេះ ចាប់ពីថ្ងៃចុះហត្ថលេខាតទៅ ។

រដ្ឋមន្ត្រី

ស៊ុន ចាន់ថុល

កន្លែងទទួល៖

- ក្រសួងព្រះបរមរាជវាំង
- អគ្គលេខាធិការដ្ឋានក្រុមប្រឹក្សាធម្មនុញ្ញ
- អគ្គលេខាធិការដ្ឋានព្រឹទ្ធសភា
- អគ្គលេខាធិការដ្ឋានរដ្ឋសភា
- អគ្គលេខាធិការរាជរដ្ឋាភិបាល
- ខុទ្ទកាល័យសម្តេចនាយករដ្ឋមន្ត្រី
- ខុទ្ទកាល័យឯកឧត្តម លោកជំទាវឧបនាយករដ្ឋមន្ត្រី
- គ្រប់ក្រសួង ស្ថាប័ន

"*ដើម្បីជូនជ្រាប*"

- គ្រប់សាលារាជធានី ខេត្ត
- ដូចប្រការ ៣

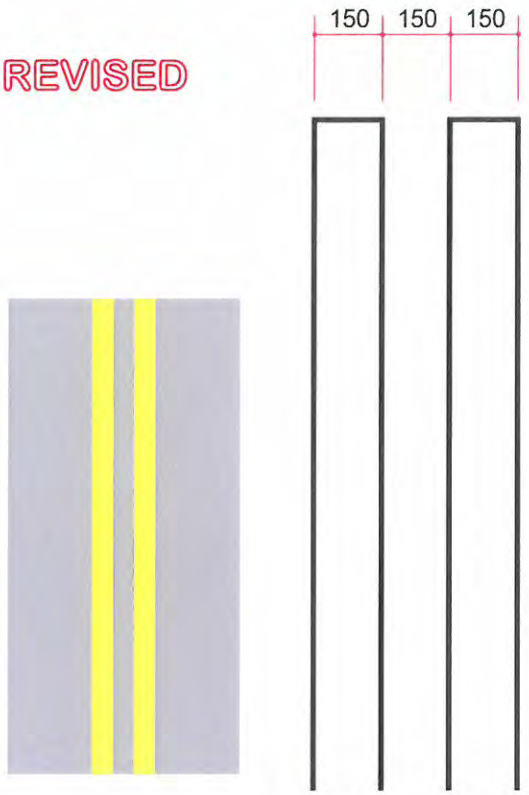
"*ដើម្បីអនុវត្តន៍*"

- រាជកិច្ច
- ឯកសារ កាលប្បវត្តិ

M2-03 គំនូសសញ្ញាស្ពោះជាប់ បែងចែកទិសចរាចរ

REVISED

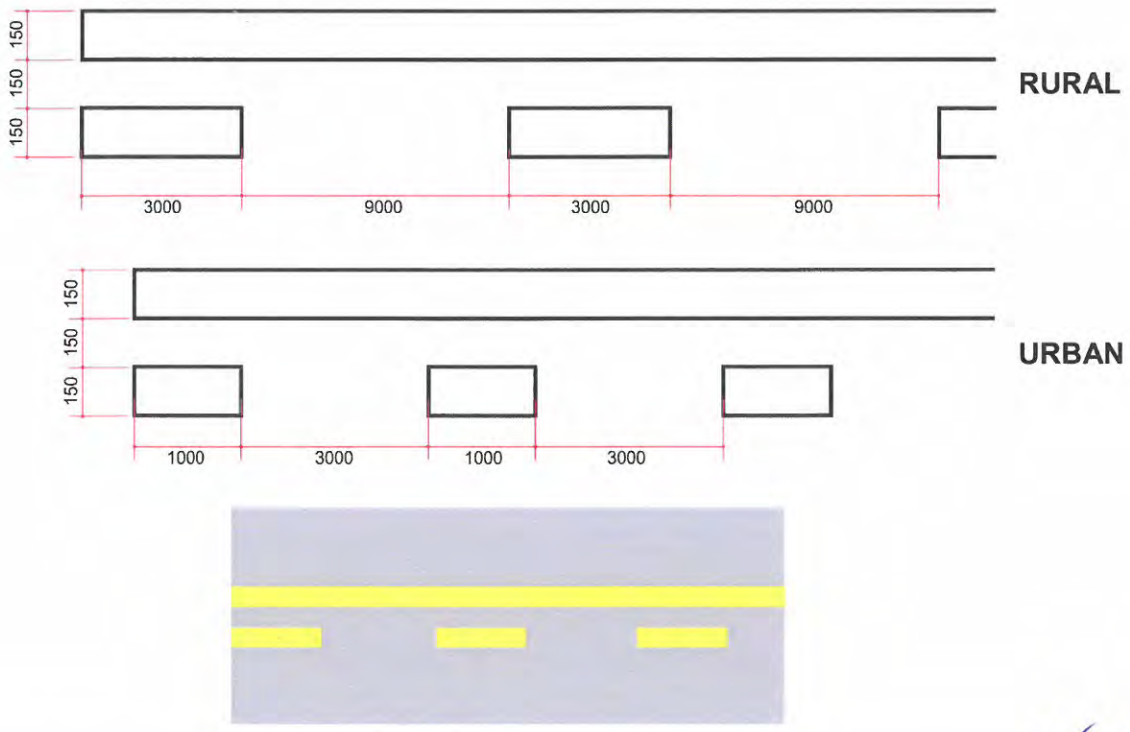
DOUBLE YELLOW SOLID LINE



M2-04 គំនូសសញ្ញាស្ពោះ បែងចែកទិសចរាចរ (មានគំនូសដាច់ៗនៅខាងឆ្វេង)

DOUBLE YELLOW COMBINATION LINE

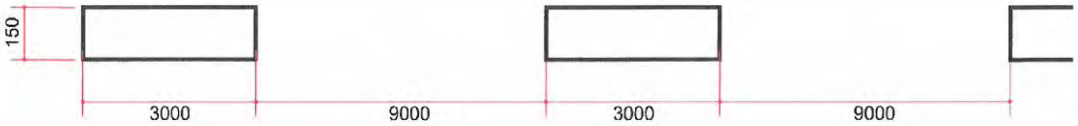
REVISED



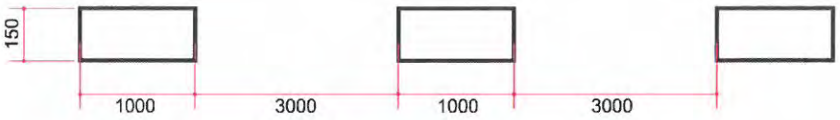
M2-06 គំនូសសញ្ញាដាច់ៗ បែងចែកគន្លងផ្លូវ

SINGLE WHITE BROKEN LINE

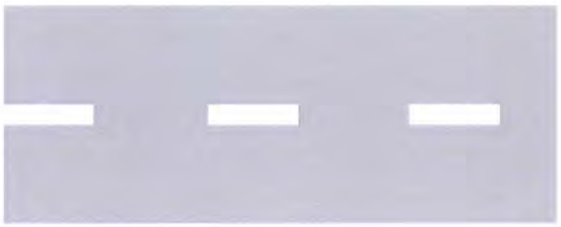
REVISED



RURAL



URBAN



M2-07 គំនូសសញ្ញាដាប់ បែងចែកគន្លងផ្លូវ

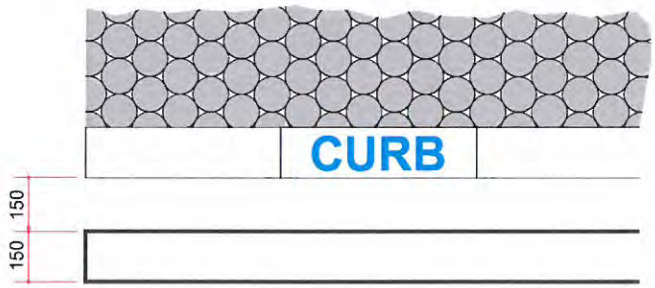
SINGLE WHITE SOLID LINE

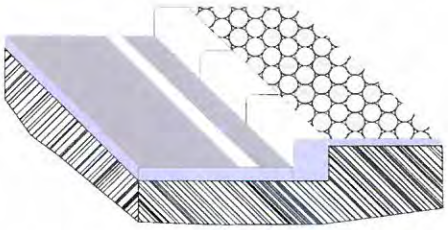
REVISED

M2-08 គំនូសសញ្ញា កំណត់ជាយផ្លូវ

EDGE LINE

REVISED

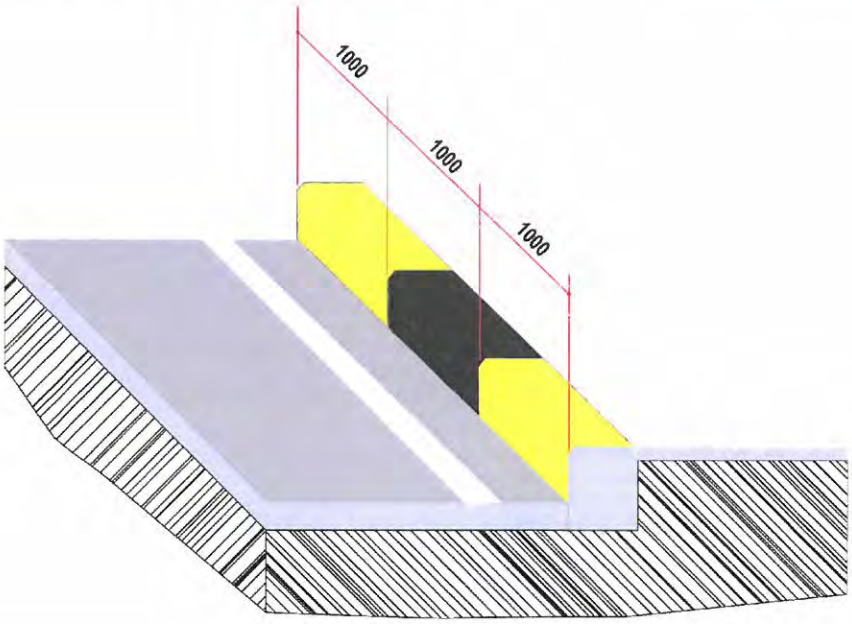




M2-09 គំនូសសញ្ញាទោល លឿង-ខ្មៅ លើគែមចិញ្ចើមផ្លូវ

YELLOW-BLACK CURB MARKINGS

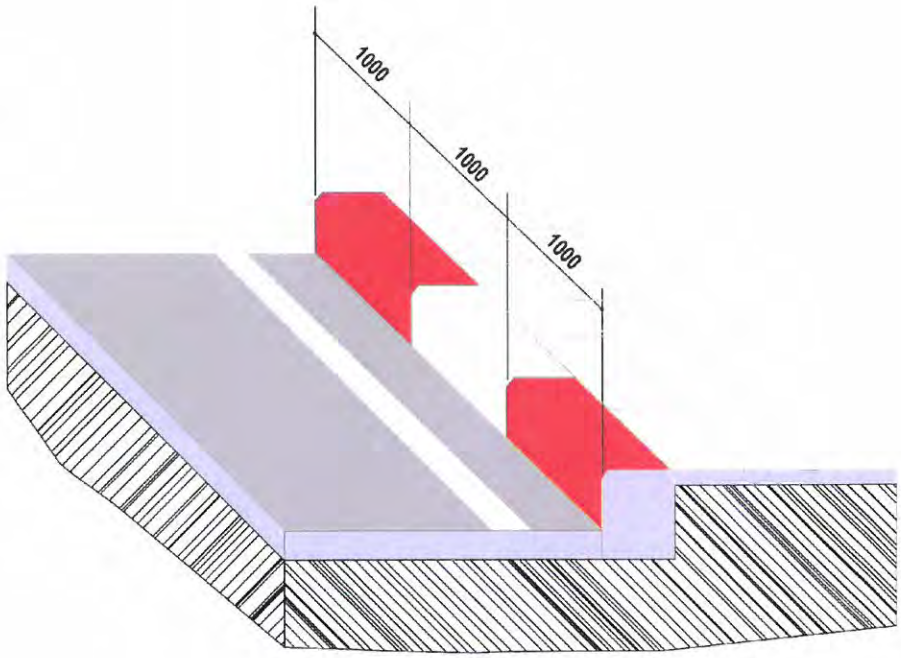
REVISED



M2-10 គំនូសសញ្ញាឆោល ក្រហម-ស លើគែមចិញ្ចើមផ្លូវ

REVISED

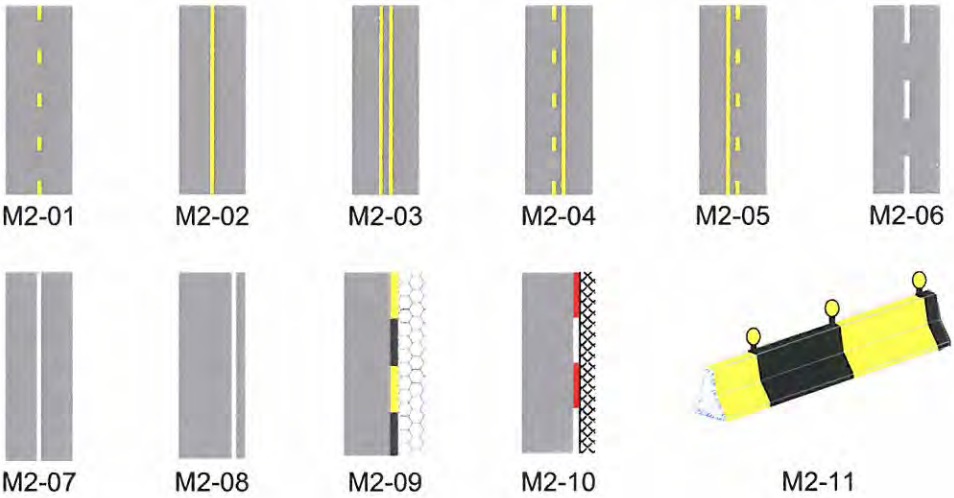
RED-WHITE CURB MARKINGS



๒๒. គំនូសសញ្ញាតាមបណ្តោយទ្រូងផ្លូវ
Longitudinal Markings

គំនូសសញ្ញា តាមបណ្តោយទ្រូងផ្លូវ ជាខ្សែគំនូស ជាប់ ឬ ដាច់ៗ ទោល ឬ ភ្លោះ ពណ៌ លឿង ស ឬ ក្រហម ទៅតាមប្រភេទ គំនូស សញ្ញានិមួយៗ ។ ការបើកបរជាន់ពីលើ តាមបណ្តោយ គំនូសសញ្ញា ប្រភេទនេះ ត្រូវហាមឃាត់ ។

តារាងសង្ខេបនៃ គំនូសសញ្ញាតាមបណ្តោយផ្លូវ
Index of Longitudinal Markings



REVISED

គំនូសសញ្ញាជាប់ បែងចែកគន្លងផ្លូវ
WHITE SINGLE SOLID LINE

លេខកូដ :PW03-M2-07

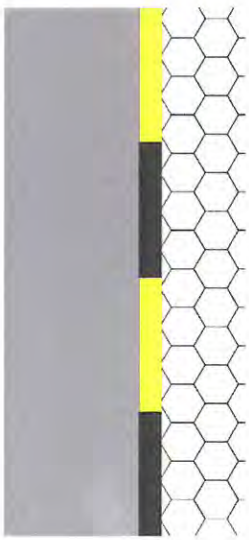
ខ្លឹមសារ : គំនូសសញ្ញា ជាប់ ទោល ពណ៌ស តាមបណ្តោយ ទ្រូងផ្លូវ ប្រើសំរាប់បែងចែកគន្លងផ្លូវចរាចរ នៅជិតផ្លូវប្រសព្វ ។ អ្នកបើកបរ មិនត្រូវ ឆ្លងកាត់គំនូសនេះ ដើម្បីប្តូរគន្លងផ្លូវឡើយ ។

គំនូសសញ្ញា កំណត់ជាយផ្លូវ
EDGE LINE

លេខកូដ :PW03-M2-08

ខ្លឹមសារ : គំនូសសញ្ញា ជាប់ ទោល ពណ៌ស តាមបណ្តោយ ជាយផ្លូវប្រើសំរាប់កំណត់ជាយផ្លូវអោយយានជំនិះធ្វើចរាចរ ។

REVISED



គំនូសសញ្ញាទោល លឿង-ខ្មៅ លើគែមចិញ្ចើមផ្លូវ
YELLOW-BLACK CURB MARKINGS

លេខកូដ :PW03-M2-09

ខ្លឹមសារ : គំនូសសញ្ញាទោល ពណ៌ លឿង-ខ្មៅ តាមបណ្តោយគែមចិញ្ចើមផ្លូវ ប្រើសំរាប់ ការហាមចត ។

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11. Directors and Deputy Directors of 25 Provincial and Municipal Public Works and Transport