

INTERNATIONAL ROAD MAINTENANCE HANDBOOK

PRACTICAL GUIDELINES FOR RURAL ROAD MAINTENANCE

Volume III of IV

Paved Roads

Financed and coordinated by



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FOREWORD

The road transport network of any country plays a vital role in its economy, and the physical condition of its infrastructure is critical. Without adequate and timely maintenance, highways and rural roads alike inexorably deteriorate, leading to higher vehicle operating costs, increased numbers of accidents, and reduced reliability of transport services. When repair work can no longer be delayed it will often involve extensive rehabilitation, and even reconstruction, costing many times more than simpler maintenance treatment carried out earlier. The need to protect the existing network and keep it in good condition is paramount, often taking precedence over new investment.

PIARC has been in the forefront in promoting this message and in drawing attention to the dangers of neglect. The matter has become increasingly important in recent years for all the highways of the world, but especially so for those in developing countries where there is constant pressure on slender budgets and, in many, an urgent need to cater for growing traffic loads and volumes.

In the late 1970's, the aid ministries of France, the Federal Republic of Germany and the United Kingdom joined forces to produce a "Road Maintenance Handbook" for maintenance foremen and workers in Africa. Published in 1982 under the auspices of the Economic Commission for Africa, the three volumes - in French and English - soon became widely known and used. By the end of the decade their use had spread far beyond Africa, and their straightforward instructions were being used for training purposes as well as for

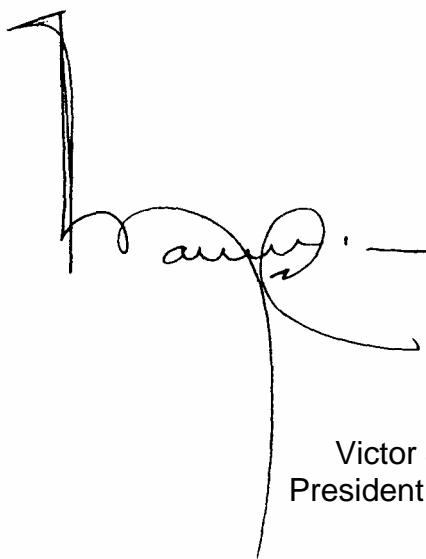
FOREWORD continued

on-the-job guidance in many countries. The need to reprint provided the opportunity to review the contents in the light of experience and make them more suitable for the wider audience now commanded. PIARC's Committee on Technology Transfer and Development, formerly the Committee on Roads in Developing Regions, undertook to help with this review, which was generously funded by the UK Overseas Development Administration. A sub-committee was established, embracing the three original donor countries, other developed and developing countries, and the World Bank. Although much of the original text has been retained, the new handbooks incorporate more information on labour and tractor-based techniques, and on the development of manpower management and the all-important question of safety at work. The range of maintenance problems addressed has been extended to strengthen their international appeal.

The past ten years have seen major reforms in the general thrust of maintenance policy and in its organisation, management and execution. These changes will continue, and PIARC will play its part along with other institutions in encouraging the process and pressing for further progress. Only a full appreciation of maintenance at the highest levels of policy-making and financial planning can ensure success. But these handbooks have a humbler task-to ensure that the men and women at the operational level are suitably skilled and trained and are using the appropriate tools and techniques, and have interest and motivation in their work.

FOREWORD continued

PIARC has been proud to nurture this project to the point where the new handbooks are available, but its involvement will reach far beyond that. It will provide the necessary international framework within which the handbooks can be translated and printed in many languages. Its worldwide membership of key figures in the national provision and management of highways will assist with their dissemination, ensuring that they find their way into the most appropriate hands in both the public and private sectors. Collectively, these hands will play a fundamental part in sustaining the vital asset which our roadway networks truly represent.

A handwritten signature in black ink, appearing to read 'Victor J Mahbub', with a long, sweeping underline that extends downwards and to the right.

Victor J Mahbub,
President of PIARC.

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INTRODUCTION

THE HANDBOOK

This is a guide for the **maintenance foreman or supervisor** assigned to bitumen or unpaved roads in tropical and moderate climates. The objective of the HANDBOOK is to assist him in all aspects of his work whether carried out by direct labour or by contract. Its pocket format enables the volume relevant to the day's work to be easily carried and consulted on site. The HANDBOOK should be his ready reference book. The text is concise and well illustrated. A quick reference should be all that is necessary.

This HANDBOOK does not include a course of study or discuss underlying causes of defects. Inspections, material sources, specifications and testing are also outside its scope. Furthermore it is sufficient here to remind the foreman that his plant and vehicles should be well maintained without telling him how to do it.

Even though the HANDBOOK is intended for use by the maintenance foreman, it will also be useful reading for the engineer or senior supervisor. This will make him more conscious of his duties towards the foreman and enable him to ensure that the maximum benefit is obtained from the HANDBOOK. Each supervisor must understand his responsibility and the part he has to play.

The HANDBOOK can also be used in training centres. With the assistance of country-specific supplementary information, photographic slides, models, and other supporting material, it will be a valuable tool for the trainer and can be distributed to students.

Road maintenance requires a range of organisational and technical skills and the work on roads in use by traffic makes the work potentially hazardous to both the workmen and road users.

It is therefore **essential** that appropriate formal and on-the-job training is given to each category of personnel involved in road maintenance activities to achieve efficient and safe operations.

The foreman usually has an important role in the initial and ongoing training of personnel.

Roads are an enormous national investment and require maintenance to keep them in a satisfactory condition and ensure safe passage at an appropriate speed and with low road user costs.

Late or insufficient maintenance will increase the ultimate repair costs and raise road user costs and inconvenience, and reduce safety.

Road Maintenance is therefore an essential function and should be carried out on a timely basis.

There is a diversity of maintenance activities, the class and type of the road, the cross section to be maintained, the defects recognised, and the resources available. However the general methods proposed here for each activity (with some exceptions) are given under the following headings:

- The task
- Defects
- Resources
- Maintenance method

Where appropriate options are shown for carrying out the work by:

- i) Heavy Equipment,
- ii) Tractor based methods, or
- iii) Labour based methods.

The decision on which method to be used should be made by the engineer or senior supervisor based on considerations of resources available, cost, policy etc.

Maintenance operations are usually grouped in each country according to planning, organisational and funding arrangements. They can normally be categorised as either ROUTINE or PERIODIC.

For the purposes of this HANDBOOK the following grouping is used.

ROUTINE : Operations required to be carried out once or more per year on a section of road. These operations are typically small scale or simple, but widely dispersed, and require skilled or unskilled manpower. The need for these can, to a degree, be estimated and planned and can sometimes be carried out on a regular basis.

PERIODIC : Operations that are occasionally required on a section of road after a period of a number of years. They are normally large scale and require specialist equipment and skilled resources. These operations are costly and require specific identification and planning. In this

handbook PERIODIC also includes certain improvement works such as thin bituminous overlays.

From time to time urgent or emergency works of any nature may be required and these are dealt with as the need arises.

The HANDBOOK consists of 4 separate volumes:

VOLUME I - MAINTENANCE OF ROADSIDE AREAS AND DRAINAGE

- PART A - List of Terms
- PART B - Works Management and Safety
- PART C - Roadside Areas
- PART D - Drainage
- General Index

VOLUME II - MAINTENANCE OF UNPAVED ROADS

- PART A - Grading
- PART B - Labour Based Reshaping
- PART C - Dragging
- PART D - Patching
- PART E - Regravelling (Mechanised)
- PART F - Regravelling (Labour and Tractors)

VOLUME III - MAINTENANCE OF PAVED ROADS

- PART A - General Repairs
- PART B - Surface Dressing (Mechanised)
- PART C - Resealing Options
- PART D - Thin Overlays

VOLUME IV -MAINTENANCE OF STRUCTURES AND TRAFFIC CONTROL DEVICES

PART A - Bridges

PART B - Traffic Control Devices

VOLUME III

Each Part A, B, C, and D describes tasks concerning exclusively paved roads*. Roads of that category have been given a surface course, generally containing bitumen or tar, because of their importance and their higher traffic.

Maintenance of the paved surface has the following objectives:

- To maintain the impermeability of the road surface, preventing water penetrating the surface or edge of the road pavement and weakening the pavement layers or foundation.
- To retain or renew the road surface quality and therefore good riding and safety conditions.

PART A - GENERAL REPAIRS

General repairs are routine maintenance tasks. Sometimes they are preliminary tasks, carried out before periodic maintenance operations.

NOTE - Terms with an asterisk are defined in List of Terms (See Volume I - Part A).

PART B - SURFACE DRESSING (MECHANISED)

Surface dressing is a periodic maintenance task. It is used to reseal the road surface and improve the riding quality/safety. Usually it is necessary to do general repairs before carrying out surface dressing.

PART C - RESEALING OPTIONS

Mechanised surface dressing is the most common type of periodic maintenance reseal. However in certain circumstances other techniques, such as Labour Based surface dressing, Fog spray or Slurry seal are more appropriate.

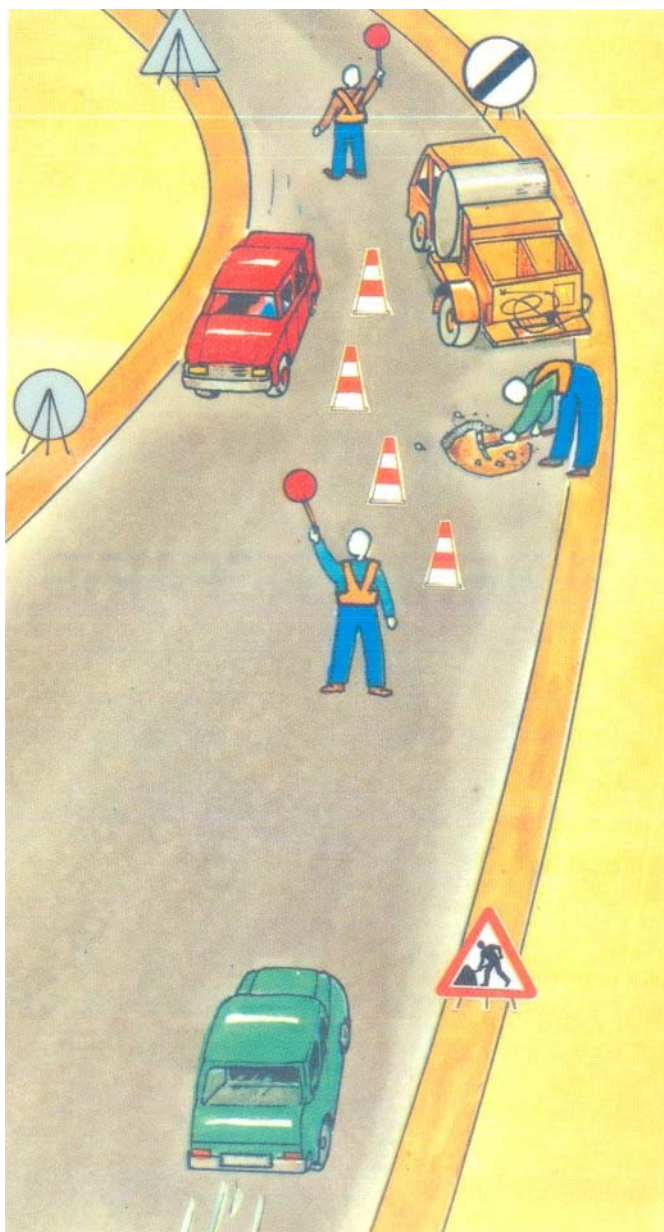
PART D - THIN OVERLAYS

A thin overlay is a periodic maintenance task. It is used to reseal the road surface, cover minor depressions or strengthen the road pavement. As with surface dressings, it is frequently necessary to do general repairs in preparation. An existing road surface that is cracked should not be overlaid without an investigation of the cause by the engineer.

NOTE : In many countries women carry out road maintenance tasks and supervisory duties. The use of male descriptions and diagrams in this handbook is for convenience only. The guidelines are applicable whether the work is carried out or supervised by men or women.

Part A

BRIDGES



NOTE: SHOWN FOR DRIVING ON THE RIGHT

1. THE TASK

GENERAL REPAIRS are normally a ROUTINE MAINTENANCE activity. However they are also carried out in advance of some PERIODIC MAINTENANCE operations.

- The term **General Repairs** covers all types of work on the road pavement :
 - of a localised nature
 - of limited size.
- The OBJECT is to :
 - improve the surface condition of the road
 - improve the pavement* structure
 - prevent water penetrating the pavement structure
- **General Repairs** must be carried out in good time in order to prevent further deterioration resulting in danger to traffic and leading to disintegration of the pavement.
- **General Repairs** employ simple methods but cover a large range of small work operations.
- Due to the materials, skill and safety requirements, this task is usually carried out by a mobile gang.

* See *List of Terms, Volume I.*



- A particular General Repair technique is involved for each type of defect.

This Part of the Handbook deals with the following techniques*:

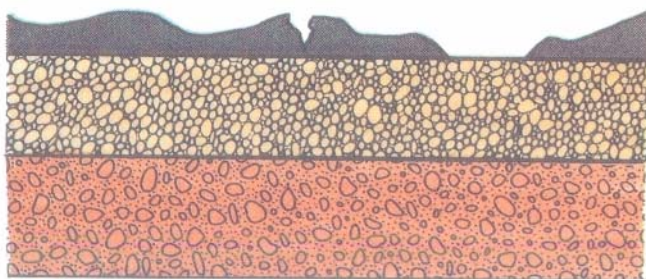
SANDING
LOCAL SEALING
CRACK SEALING
FILLING IN DEPRESSIONS
SURFACE PATCHING
BASE PATCHING

- In the case of surface repairs, use is made of bituminous binders, sands and aggregates.
- In the case of repairs to the pavement structure, use is made of natural or crushed materials and sometimes of cold bituminous mixtures.
- Often when work is carried out on pavement **General Repairs**, it is also necessary to repair defects on the shoulders and side ditches when the pavement defect is due to them. This will help to prevent the problem recurring. e.g.,
 - construction or cleaning out of ditches,
 - construction or cleaning of drainage outlets,
 - patching and reshaping of shoulders.

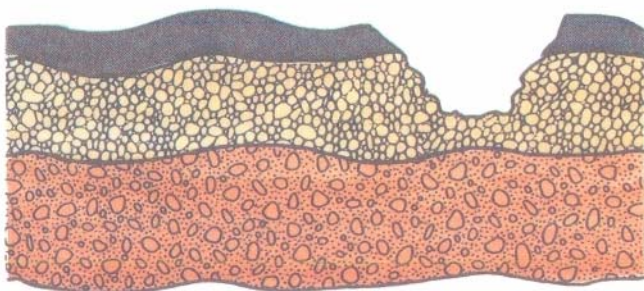
These operations are dealt with in Volume I.

* See *List of Terms, Volume I.*

a



b



2. DEFECTS

2.1 DEFECTS

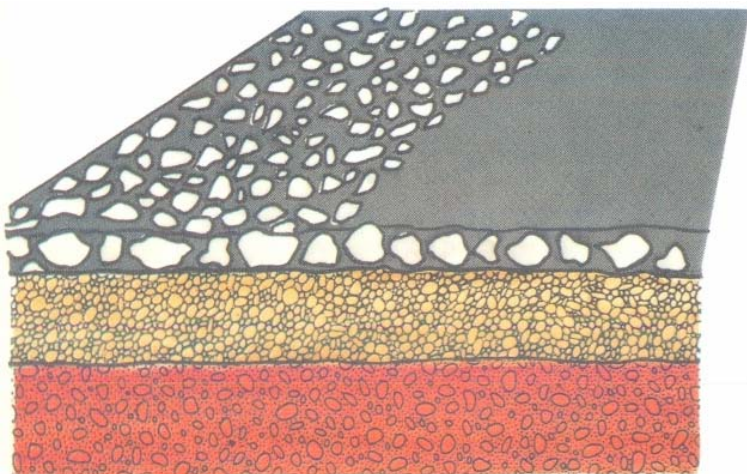
Defects can occur in:

- The road surface (**a**)
 - wear of the surface layer of the road,
 - cracking of the surface layer,
 - fatting-up of binder to the road surface.
- The pavement structure (**b**)
 - deformation,
 - potholes.

2.2 LIST OF DEFECTS

Information follows on the different types of defect with respect to:

- **Location:** parts of the pavement where the defect usually appears,
- **Main Causes of the defect,**
- **Development:** consequences if maintenance is not rapidly carried out,
- **Remedies:** usual repair treatments.



DEFECT: **BLEEDING***

Location

May involve a part or the whole of the road surface.

Main causes

- too much binder,
- unsuitable binder.

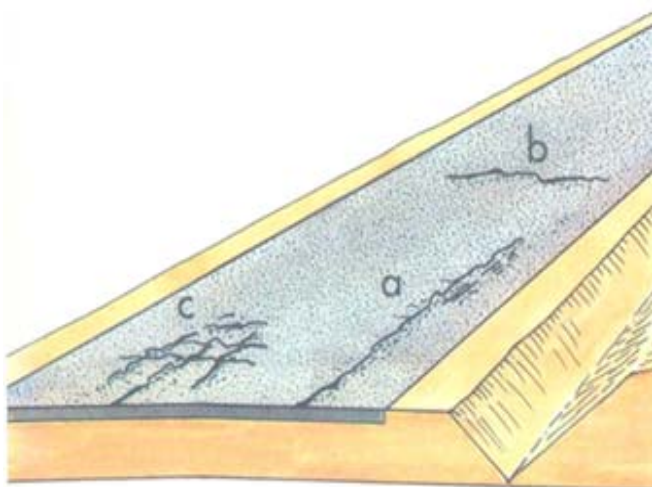
Development, if neglected

- the road surface becomes slippery when wet,
- separation and break-away of surface layer under the action of traffic.

Remedies

- sanding (Page III - 51),
- surface dressing (Page III - 83).

* See *List of Terms, Volume I.*



DEFECT: **CRACKS**

(in the surface and in the pavement structure)

Location

- a. longitudinal: parallel to the centre line (often along the wheel tracks or along the edges of the surfacing).
- b. transverse: perpendicular to the road direction (across the whole or part of the cross-section).
- c. mesh cracking: intersecting cracks dividing the pavement surface into isolated elements of different sizes down to the small elements involved in crazing.

Main Causes

- poor quality materials,
- poor workmanship,
- insufficient pavement thickness for the traffic being carried,
- shrinkage (see Note),
- pavement age.

NOTE: Shrinkage: cement treatment of road base results in a reduction in volume after the cement has set and dried out.



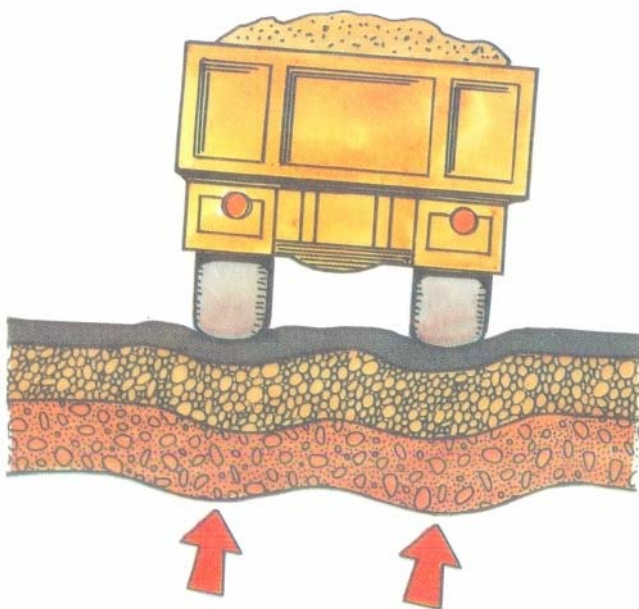
DEFECT: CRACKS (Continued)**Development**, if neglected

- a general or local destruction of the pavement.

Remedies

- surface cracking: local sealing (Page III - 53) or filling-in of the cracks (Page III - 57).
- cracks in the pavement structure: local sealing (Page III - 53) or filling-in of the cracks (Page III - 57), and patching in cases of severe cracking (Page III - 71).

NOTE: In the case of extensive cracking of the surface or the pavement structure (without rutting or deformation), surface dressing will be necessary (see Part B or C).



DEFECT: **RUTS AND DEPRESSIONS**

Location

- in the wheel tracks of vehicles (ruts),
- local areas (depressions*).

Main Causes

- insufficient foundation or pavement strength for the traffic being carried,
- inadequate stability of the bituminous* surfacing materials.

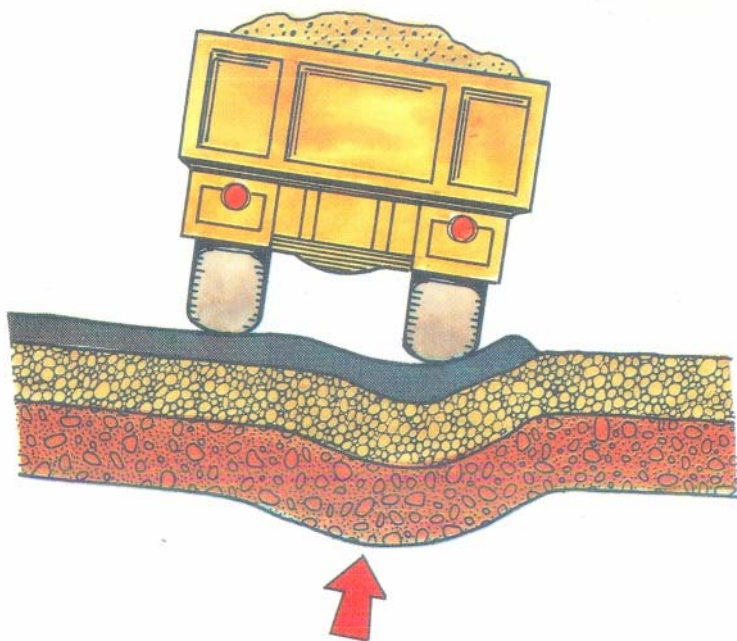
Development, if neglected

- if water is able to penetrate into the body of the pavement, then there will be a rapid increase in the degree of rutting often leading to cracking and breakup of the pavement.

Remedies

- slight rutting (less than 5 cm): filling in of the ruts and depressions (Page III - 63),
- deep rutting: local restoration of the pavement structure (Page III - 71).

* See *List of Terms, Volume I.*



DEFECT: EDGE SUBSIDENCE AND RUTTING**Location :**

Usually along the edges of the pavement where it borders unsealed shoulders.

Main Causes

- inadequate or badly maintained shoulder,
- penetration of water into the pavement structure or foundation and resulting loss of bearing strength,
- poor drainage,
- narrow carriageway.

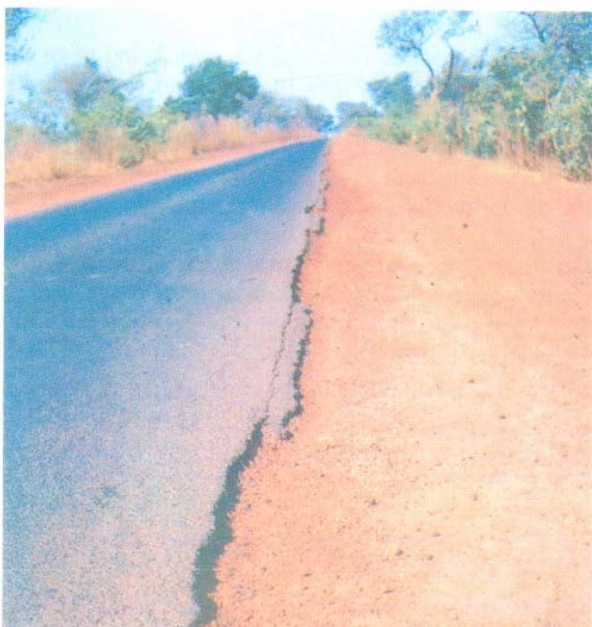
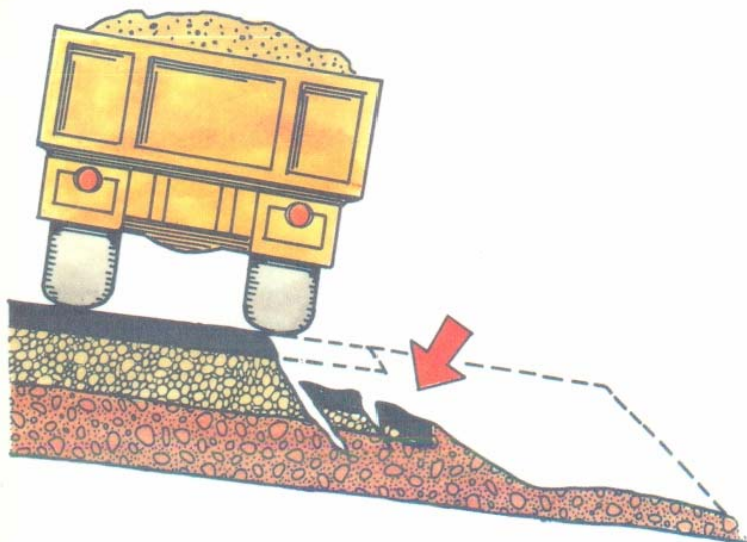
Development, if neglected

- rapid during the rainy season leading to the disintegration of the edges of the pavement.

Remedies

- slight subsidence (less than 5 cm): filling in of ruts and depressions (Page III - 63) and restoration of shoulder (see Volume I),
- deep subsidence: local restoration of the pavement structure (Page III - 71) and restoration of the shoulder (see Volume I),

Also consider improvements to the drainage (see Volume I), or sealing of the shoulder (Part B or C) to help prevent the problem recurring.



DEFECT: EDGE DAMAGE
(degradation of pavement structure)

Location

Along the edges of the pavement*.

Main Causes

- wear of the shoulder* (formation of step),
- action of water,
- insufficient compaction of the edges of bituminous pavements,
- road too narrow.

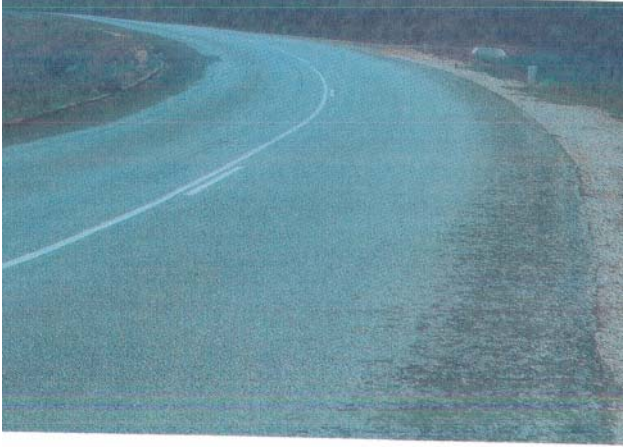
Development, if neglected

- rapid during the rainy season.

Remedies

- local restoration of the pavement structure (Page III - 71).

* See *List of Terms, Volume I.*



DEFECT: LOCAL AGGREGATE LOSS**Location**

Small areas or strips of the road surface.

Main Causes

Loss of surface aggregate due to:

- insufficient binder due to faulty spray jet,
- aggregate dirty when laid,
- insufficient penetration of aggregate,
- poor premix quality or workmanship.

Development, if neglected

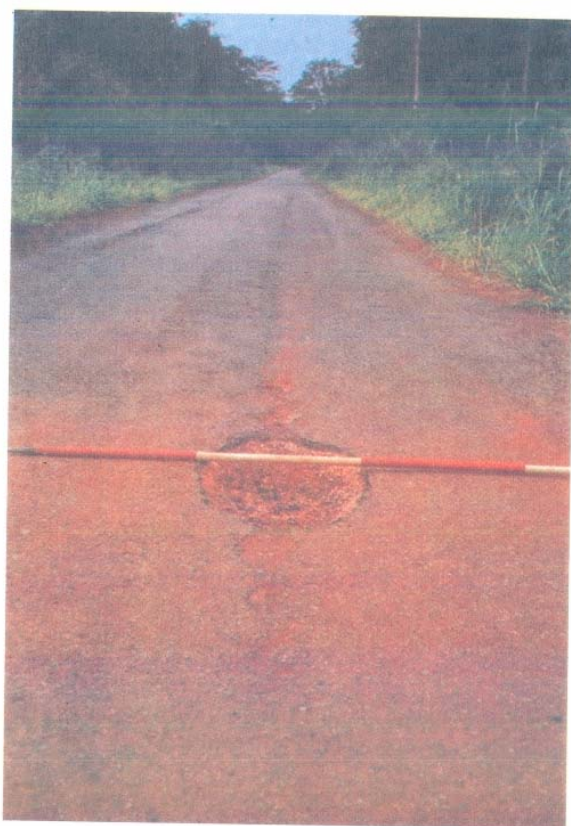
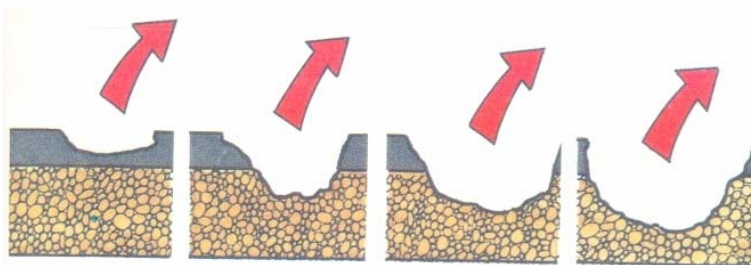
- minor stripping/fretting/streaking*.

Remedies

- surfacing patching (Page III - 67).

* See List of Terms, Volume I.

NOTE: For large areas of aggregate loss, surface dressing should be considered as a remedy (Part B or C).



DEFECT: POTHOLES
(degradation of the pavement structure)

Location

No particular location but often in areas showing cracks, deformation or aggregate loss.*

Main Causes

- poor quality of material used for the construction of the pavement,
- infiltration of water,
- break away of material under the action of traffic,
- final stage in the development of crazing* or of a depression*.

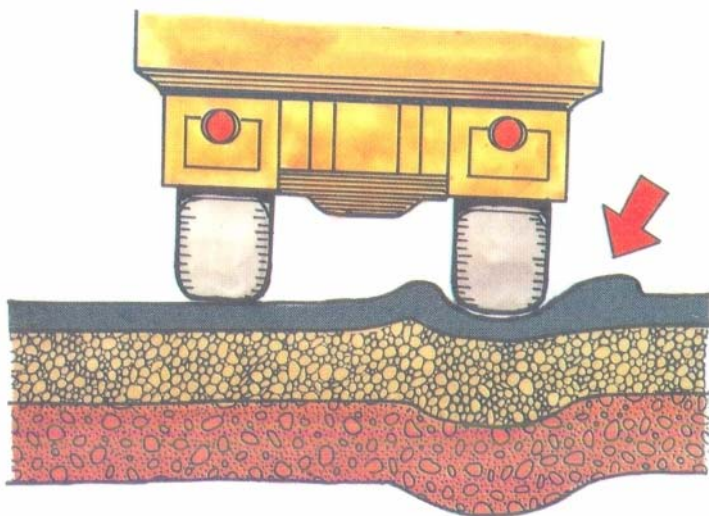
Development, if neglected

- progressive enlargement of the hole and formation of additional potholes.

Remedies

- local restoration of the pavement structure (Page III - 71).

* See List of Terms, Volume I.



DEFECT: SHOVING
(defects in the surface or pavement structure)

Location

Usually on either side of the wheel tracks. The irregularities are usually associated with deformation and subsidence.

Main Causes

- ingress of water: reduced bearing capacity of the pavement,
- materials: of poor quality,
- workmanship: insufficient compaction,
- traffic: passage of vehicles which are too heavy for the pavement structure.

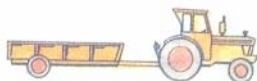
Development, if neglected

- forcing up of weak materials as deformation occurs,
- progressive disintegration of the pavement.

Remedies

- small irregularities: filling in of irregularities (Page III - 63),
- large irregularities together with cracks: local restoration of the pavement structure (Page III - 71).

PART A – GENERAL REPAIRS



3. RESOURCES

3.1 PERSONNEL

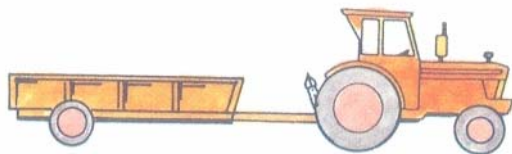
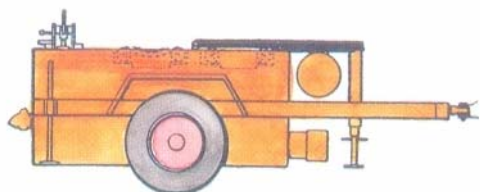
- **Work Force**
 - 1 foreman,
 - 1 spray lance/bitumen operator,
 - 2 to 4 workmen,
 - 2 traffic controllers.

- **Plant Operators and Drivers**
 - 1 patching vehicle* driver,
 - 1 tipper/flat bed truck driver,
 - 1 vibrating roller operator.

OR

- 1 tractor driver,
- 1 vibrating plate operator.

* *If this vehicle is available.*



3.2 PLANT AND TOOLS

▪ **Patching Vehicle***

Specially equipped vehicle or towed equipment fitted with a heated tank for the binder and a double hopper for the aggregates.

OR

If, not available, a suitable means of heating (unless bitumen emulsion is used) and applying the bitumen are required. e.g. towed bitumen heater/distributor.

▪ **Tipper/Flat Bed Truck, or Tractor and Trailer**

For transporting the aggregates, small items of equipment and the personnel.

* If Such a vehicle is not available a truck or tractor & trailer is used to transport

- *the personnel,*
- *the equipment,*
- *the aggregates,*
- *binder in drums,*
- *premixed materials (if used).*

PART A – GENERAL REPAIRS

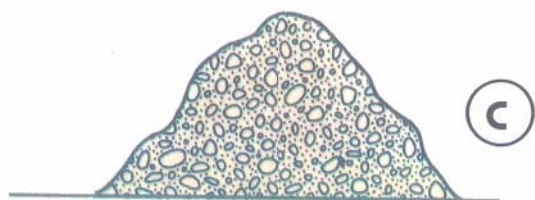
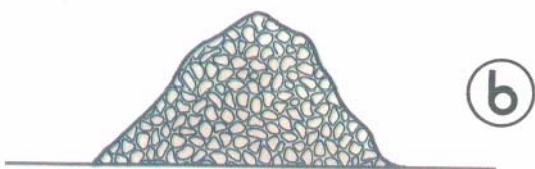
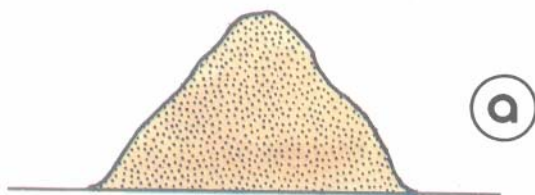


- **A small vibrating roller** (or, if not available, a vibrating plate compactor or hand rammers) for use in compacting the aggregates and other materials. The vibrating roller can be transported by mounting it on a special trailer which is towed by the truck. Otherwise ramps or a hoist are required to help load onto truck or trailer.
- **Small items of equipment :**
 - 2 wheelbarrows,
 - 4 shovels,
 - 4 pickaxes,
 - 2 hand rammers,
 - 4 brooms,
 - 2 watering cans,
 - 2 squeegees,
 - bitumen thermometer.

If bitumen emulsion is used

- 1 cold emulsion single drum sprayer.
- **Tools and supplies**
 - 1 drum of diesel oil for use in cleaning the spray lance*, and other tools,
 - 1 spare jet for the spray lance,
 - 1 box of tools for use in dismantling the spray lance,
 - rags,
 - number of paint brushes,
 - 1 metal bucket,
 - 1 two-metre straight edge,
 - chalk for marking.

* See List of Terms, Volume I.



3.3 MATERIALS

The materials used consist of aggregates*, and bituminous binders* that are either applied separately or in the form of a bituminous mixture.

▪ **Aggregates****

The aggregates may be:

- sand mixtures*d/D (a)
- stone chippings*d/D (b)
- natural gravel or crushed rockd/D (c)

The materials should meet the grading requirements set by the engineer.

The maximum size of aggregate varies according to the type of work involved, normally:

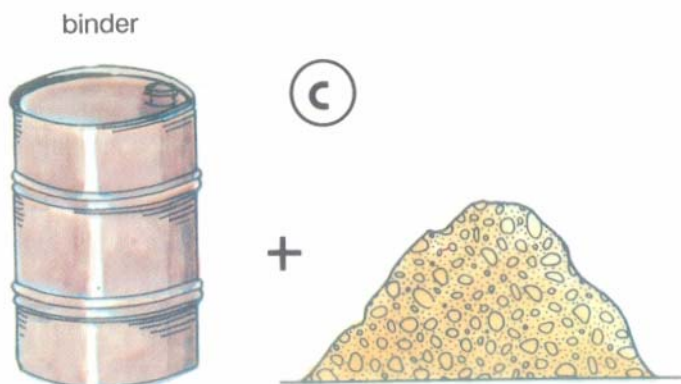
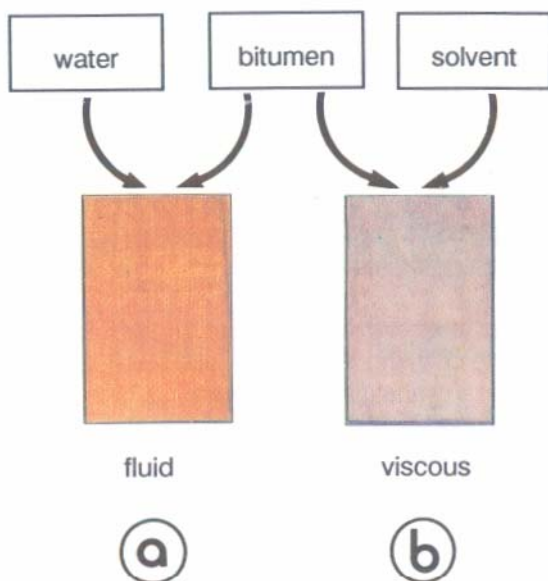
- sandingDmax = 5 mm
- surfacingDmax = 10 mm
- base coursesDmax = 40 mm

(Dmax = nominal maximum diameter)

In addition to the grading it is also necessary to check the hardness and the cleanliness of these aggregates. These properties should be tested regularly according to the specifications.

* See List of Terms, Volume I.

** For aggregate abbreviations see Page III-III.



- **Bituminous binder***

This can consist of:

- a cold bitumen emulsion (**a**),
- a hot cut back bitumen (**b**).

The bitumen is either applied to the road surface as a film or used in bituminous mixtures.

- **Bitumen film**

The bituminous binder is applied with a spray bar/lance*, or by hand from a measuring container, to cover the surface and ensure that it will be impervious to water.

The bitumen film is covered with stone chippings or aggregates to provide protection from traffic.

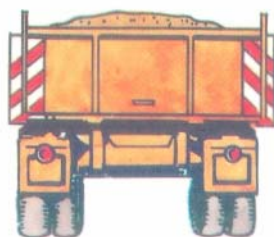
- **Bituminous mixtures (c)**

The bituminous binder is used to bond the other materials together.

Bitumen mixtures can consist of:

- bitumen emulsion slurries -applied immediately after manufacture,
- cold bitumen emulsion mixtures - manufactured in advance of their application,
- hot fluxed or cut back bitumen mixtures (hot mix) applied immediately after manufacture.

* See List of Terms, Volume I.



3.4 SIGNS AND SAFETY EQUIPMENT

- Advance Warning Signs The following signs are to be placed on the shoulder for both directions of traffic:
 - 2 "Men Working" signs,
 - 2 "End of Restriction" signs.

- Site Protection Equipment:
 - 4-10 traffic cones,
 - 2 reversible "Stop/Go" signs.

- **Safety Equipment**
Use should be made of the following equipment for personnel and the different vehicles as far as possible:
 - yellow/orange shoulder belts for the foreman, the spray lance operator and the other workmen,
 - red and white striped marker boards attached to the patching vehicle, the truck or tractor and trailer.

A fire extinguisher should be provided for each vehicle working with or near heated bitumen.

TYPICAL WORKSHEET GENERAL REPAIRS

Worksheet No : Date:

District:.....

Zone :Gang:.....

Road No. :from kmto km.....

from kmto km.....

from kmto km.....

TYPE OF REPAIR :

Sending ☐ Surface ☐Local sealing ☐ Base patching ☐Crack sealing ☐ Resurfacing of shoulders ☐Filling in depressions ☐

MATERIALS :

Type of binder :

Aggregate :

Bituminous mixtures:

QUANTITIES REQUIRED:

Binder:kg

Aggregate :m³Bituminous mixtures:m³

STOCK POSITION & COMMENTS :

.....

.....

.....

.....

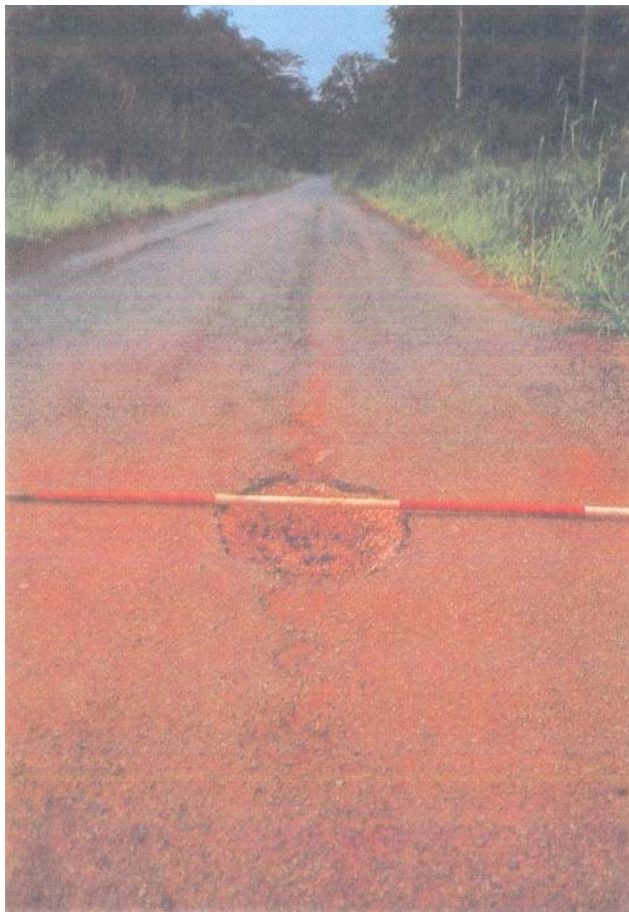
4. MAINTENANCE METHODS

4.1 PRELIMINARY TASKS

Successful results for General Repairs depend on good preparation and organisation of the work. There are three preparation activities:

1 Refer to the Work Sheets

These sheets give the dates when work on the road section concerned is to be carried out, the activities required, as well as information on the materials that are to be used.

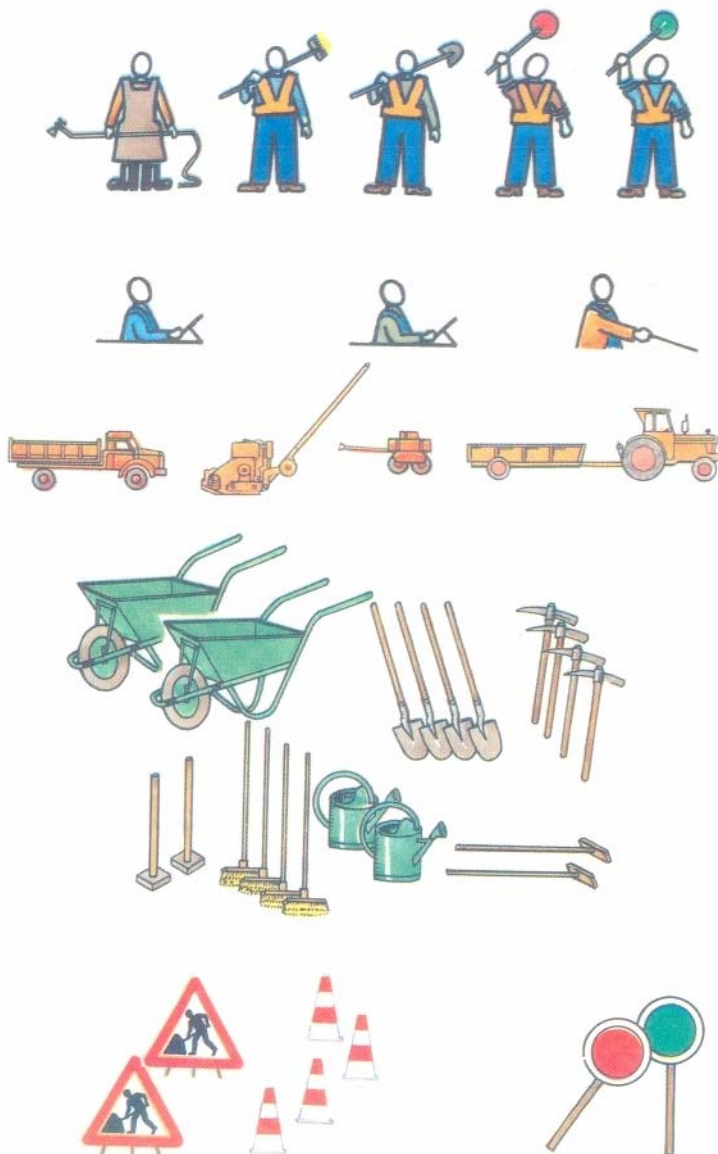


2 Examine the section of road to be repaired

The section of road to be repaired must be examined along its whole length in order to determine:

- the types of defect to be repaired (Pages III - 7 to 111-25),
- the extent of the defects, and to
- check the resources required.

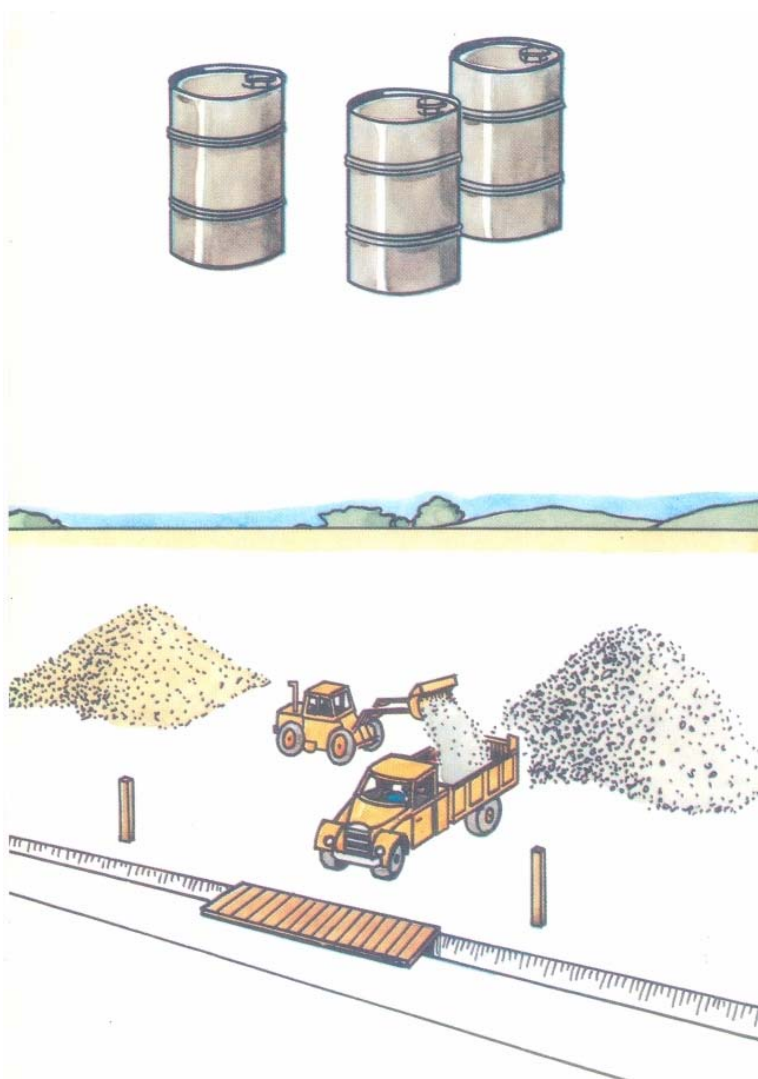
PART A – GENERAL REPAIRS

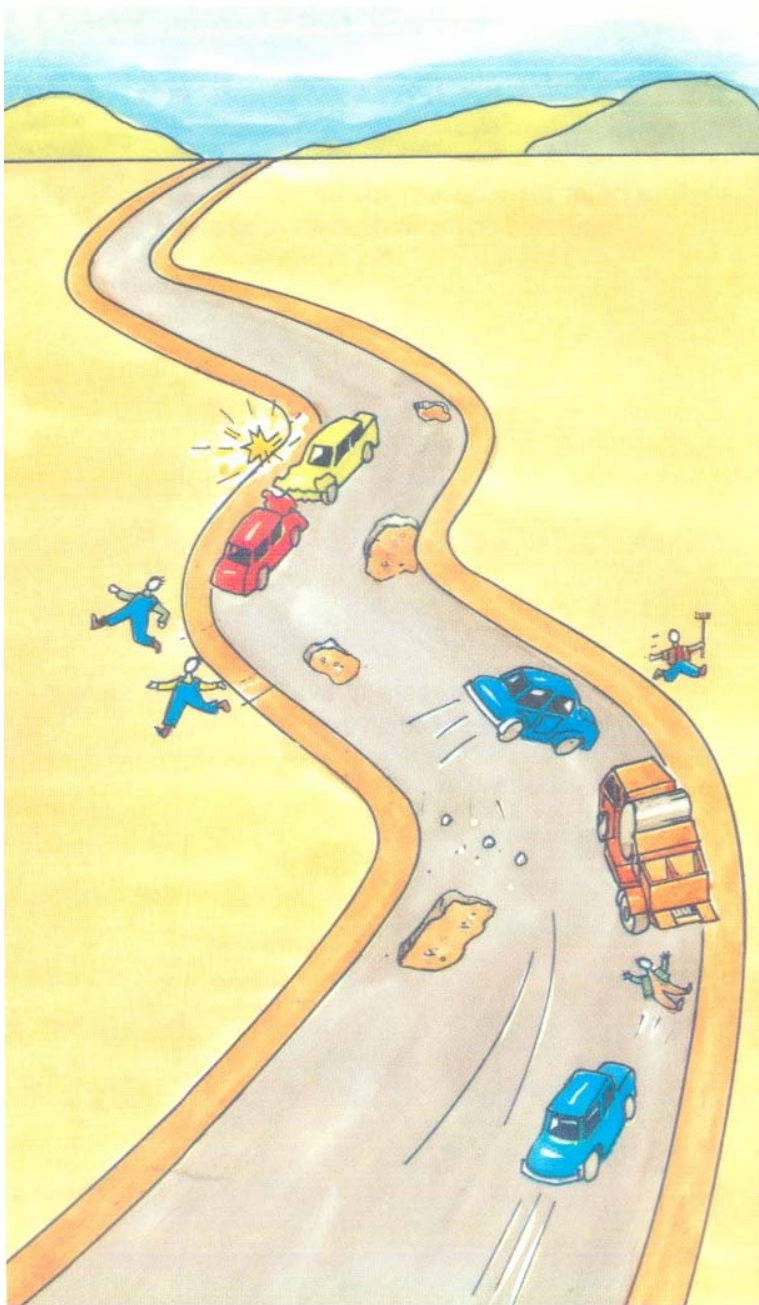


3 Resource Availability

Before the work starts it is necessary to ensure:

- that all necessary personnel are available,
- that all items of equipment to be used are available and in good condition,
- that all small items of equipment, hand tools and the necessary traffic signs are available,

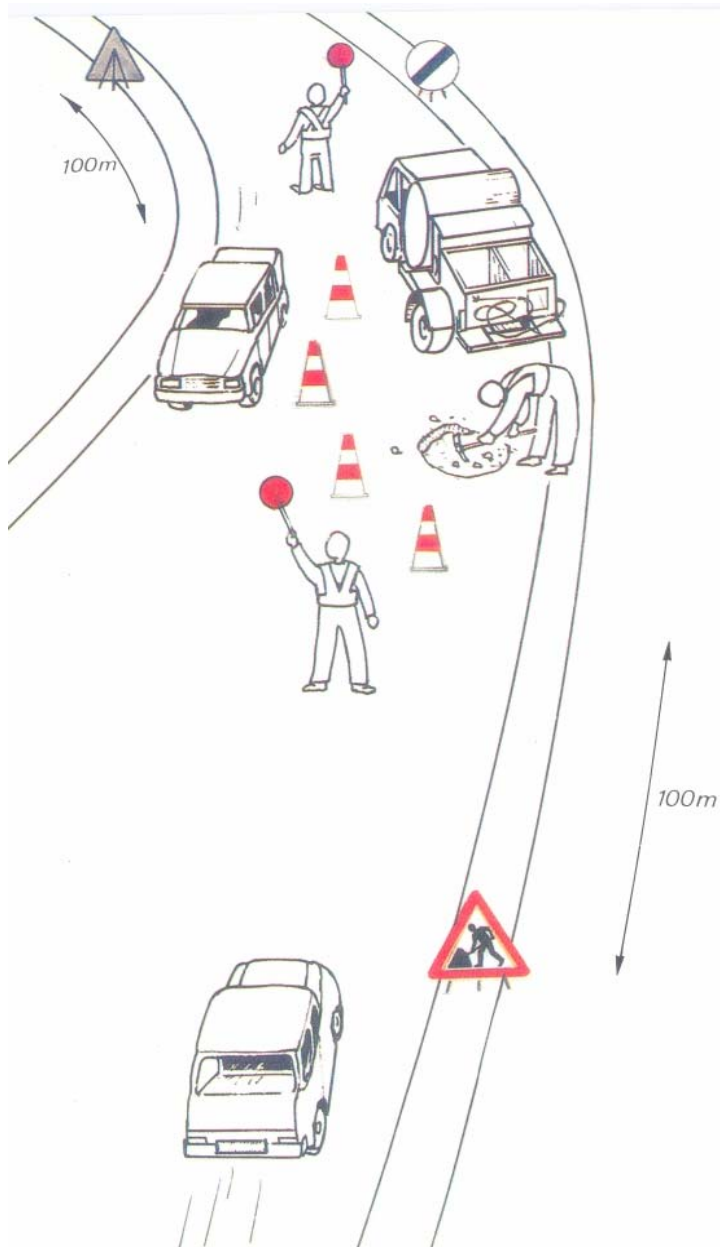




4.2 TEMPORARY SIGNPOSTING

Traffic signs conforming to the regulations must be correctly placed before starting any work. This is to ensure the safety:

- of the road users,
- of the personnel working on the site,
- of the vehicles and equipment to be used on the site.

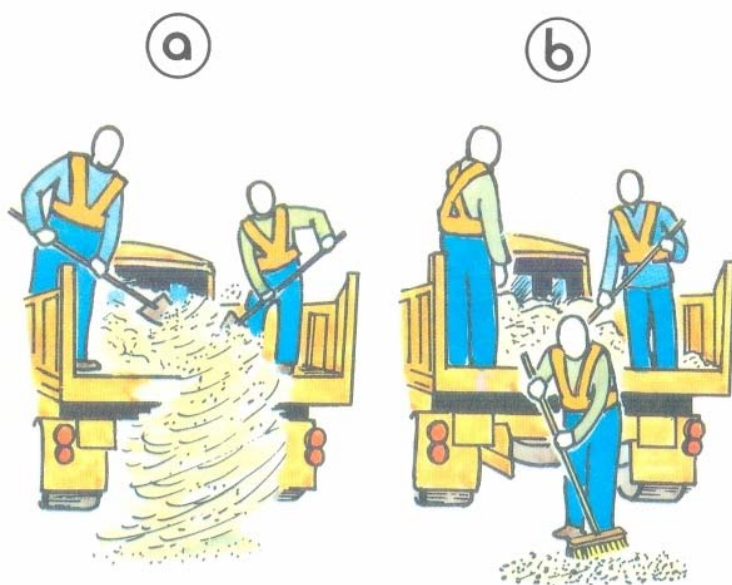


NOTE: SHOWN FOR DRIVING ON THE RIGHT

The signs are :

- **located on the shoulder on the side of the approaching traffic**, 100 m ahead of each end of the roadworks:
 - 1 "Men Working" sign,
- **located along the length of the roadworks :**
 - 4 to 10 traffic cones, as required to clearly separate the traffic from the roadworks.
- **located on the shoulder on the side of the departing traffic**, at each end of the site:
 - 1 "End of Restriction" sign.

NOTE: In busy traffic 2 men must be assigned to direct the traffic in alternate direction past the roadworks.



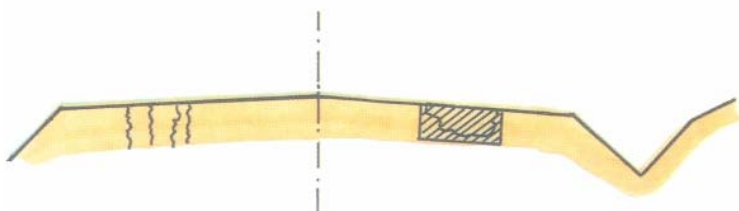
4.3 EXECUTION OF THE WORK

SANDING

Sanding is the treatment to be used where the road surface is **bleeding**^{*}, coarse sand up to 5 mm should be used where possible. Two activities, which may need to be repeated, are involved in the treatment:

- 1 **The sand is scattered** by shovel over the affected surfaces from a truck or trailer (a).
- 2 The sand is then **spread out with a broom** so that the surface is evenly covered (b).

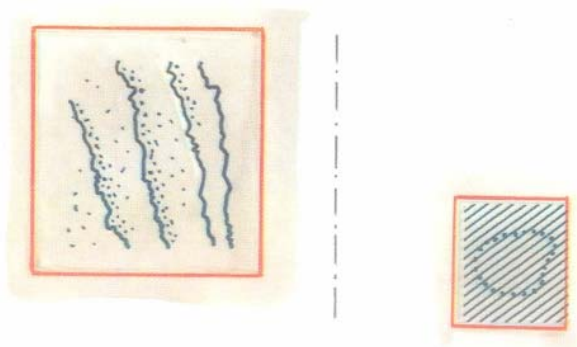
^{*} See *List of Terms, Volume I*.



a



b



LOCAL SEALING

This treatment is used to repair cracks (Page III - 11). It is also employed as the final treatment in the case of any local repair to the road (Page III - 71).

The treatment is applied in four stages:

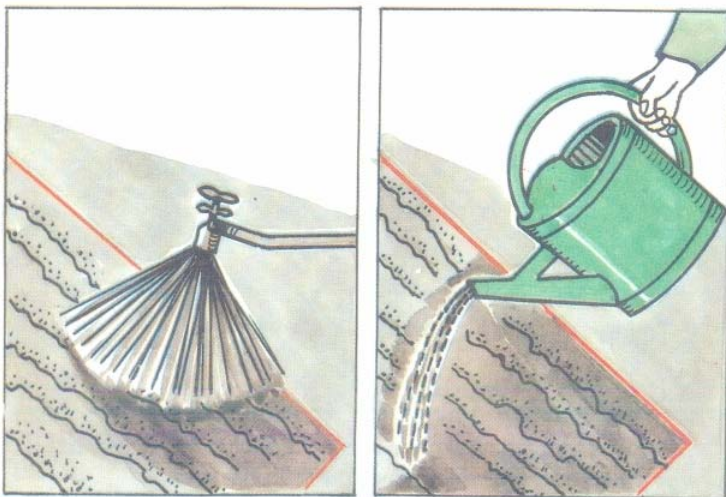
1 Sweep the area (a)

This is carried out by hand. The road surface **must be clean and dry** following this operation.

2 Mark out the area to be sealed (b)

The surfacing that is to be covered is outlined in chalk.

c



d



3 Distribution of the binder (c)

The binder is distributed over the surface using a spray lance* or a watering can at the following rates:

- 1.5 kg/m² for bitumen emulsion,
- 1 kg/m² for cut back bitumen.

It is important not to overheat the cut back bitumen or cationic emulsion as this will affect its durability. A thermometer should be used to check the temperature during heating (see Page III - 143). Anionic emulsion does not normally require heating.

Smoking should not be allowed when handling cut back bitumen.

4 Distribution of the aggregate (d)

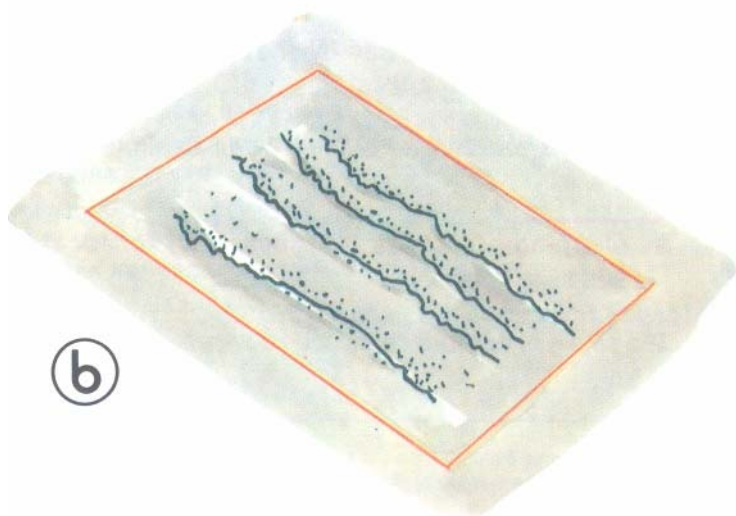
The aggregate is scattered by shovel from the truck or trailer. The material used is:

- coarse sand up to 5 mm, when dealing with cracks,
- chippings (such as 6-10 mm size) for local surfacing repairs.

The whole of the surface must be covered.

* See List of Terms, Volume I.

NOTE: When chippings are applied, they must be compacted with the small roller



CRACK SEALING

This is an alternative treatment used to repair cracks (Page III - 11).

Treatment of closely spaced cracks

The cracks are filled in with a bituminous slurry in four steps:

1 Sweep the area (a)

This is carried out by hand. The road surface **must be clean and dry** following this operation.

2 Mark out the area to be repaired (b)

The area to be repaired is outlined with chalk.



3 Production of the slurry (c)

The slurry is produced by mixing bitumen emulsion with coarse sand, up to 5 mm, in a wheel barrow in the following proportions:

- sand 20 litres
- emulsion 6 litres

The emulsion does not normally require heating. However the emulsion drums will require rolling to thoroughly mix the contents before use.

4 Spreading the slurry (d)

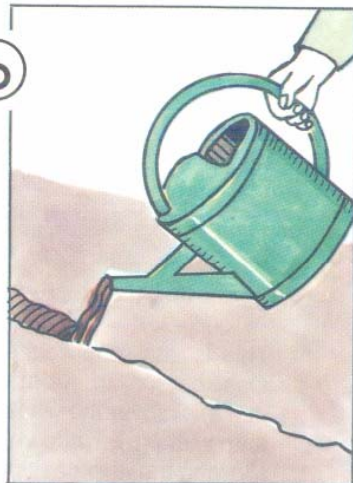
This is carried out with a squeegee*. The material must be spread out in a thin layer, approximately 5 mm thick, over the whole of the marked out area. The slurry. must be allowed to dry completely before allowing traffic to pass over the repair.

* See *List of Terms, Volume I.*

a



b



c



CRACK SEALING (Continued)

Treatment of Isolated Cracks

In these cases the cracks are filled in with a hot cut back bitumen.

1 Sweeping the area (a)

The crack to be filled must be clean following this operation.

2 Heating the binder

Do not overheat the cut back bitumen as this will affect its durability. Use a bitumen thermometer to check the temperature during heating (see Page III - 143).

3 Distribution of the binder (b)

This is carried out using a spray lance or watering can to follow the line of the crack. The nozzle of the spray lance or the spout of the watering can must be held close to the road surface. The width of spread should be kept as small as possible.

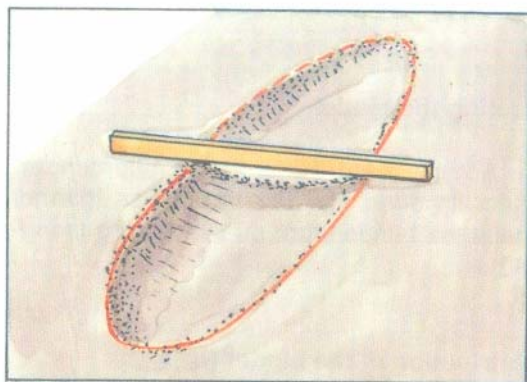
4 Distribution of the sand (c)

Coarse sand is scattered over the strip of binder using a shovel.

a



b



c



FILLING IN DEPRESSIONS

This treatment is applied to deal with subsidence (Page III - 15) and surface irregularities due to shoving (Page III - 25). The depressions are filled with a cold mix asphalt prepared in advance and stored at the depot. The repair is carried out in six steps:

1 Sweep the area (a)

The depressions must be swept out by hand. The surface of the depression must be clean and dry.

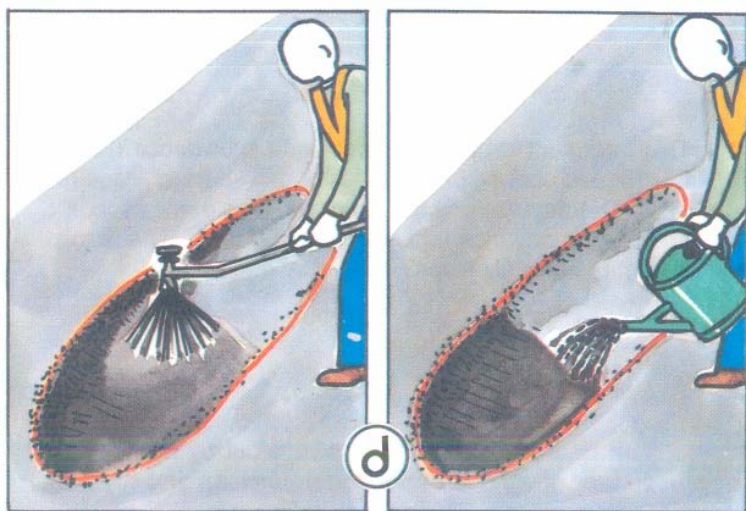
2 Mark out the area to be repaired (b)

The surface area of the depression that is to be filled in must be outlined with chalk.

Remove any high spots with a pick axe.

3 Obtain the cold mix (c)

* See *List of Terms, Volume I.*



4 Application of a tack coat (d)

Hot cut back bitumen is applied with a spray lance or watering can at a rate of about 0.5 kg/m². Do not overheat the cut back bitumen as this will affect its durability. Use a bitumen thermometer to check the temperature during heating.

5 Fill in the depression (e)

The cold mix is placed within the marked outline using a rake and leaving an excess thickness of about one third of the depth of the depression in order to allow for compaction.

6 Compaction of the material (f)

The material is compacted thoroughly using the small vibrating roller, plate or a rammer, until the level is 3 mm proud of the surrounding surface.

7 Resealing

The repair must be sealed to prevent penetration of water (Page III - 53).



SURFACING PATCHING

This treatment is used to repair local aggregate loss (Page III - 21) and is carried out in the following steps:

1 Sweep the area

The area must be swept out by hand. The surface must be clean and dry.

2 Mark out the area to be repaired

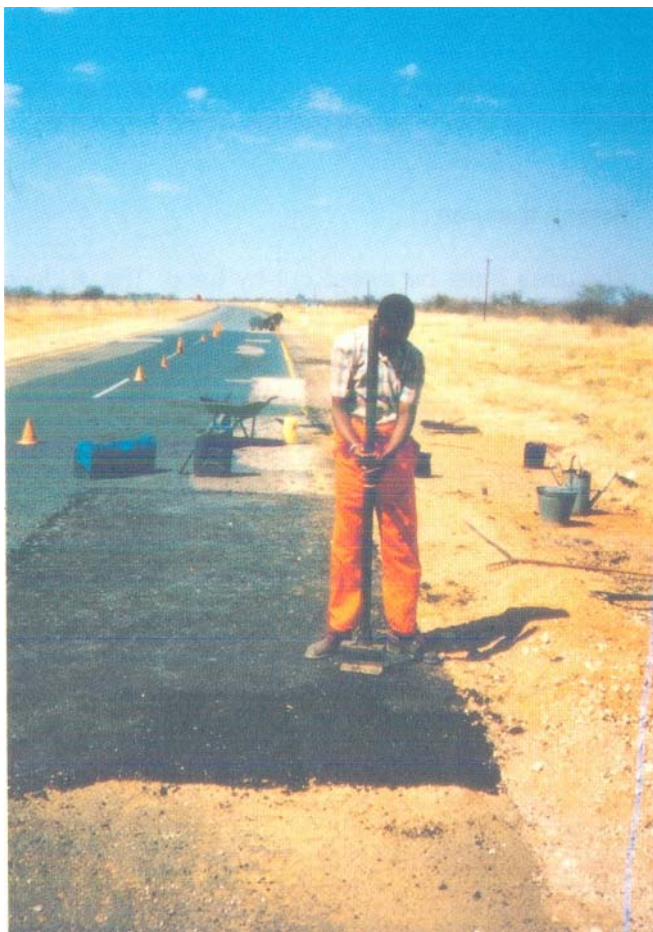
The surfacing that is to be repaired is outlined in chalk.

OPTION 1: SEAL

Use cold emulsion or hot cut back bitumen to seal the area to be repaired and provide a tack coat at the following rates:

- 1.5 kg/m² for bitumen emulsion
- 1.0 kg/m² for cut back bitumen.

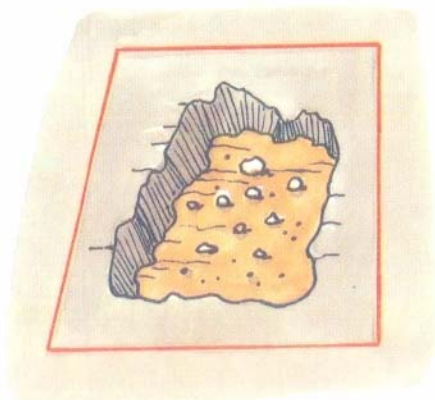
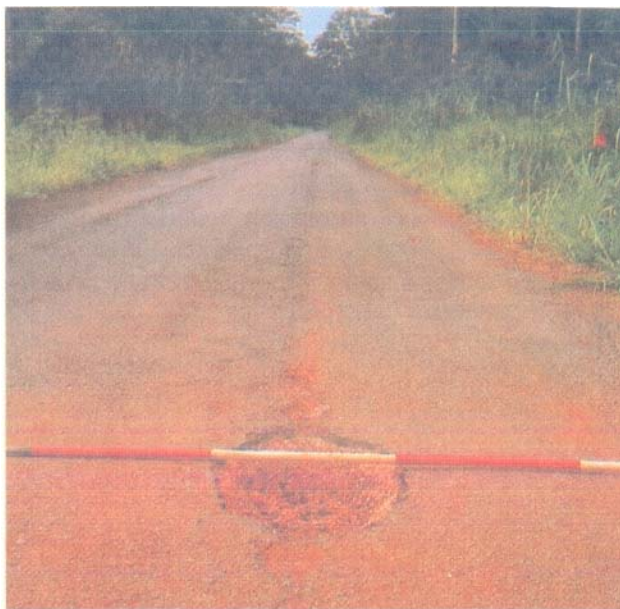
Apply the chippings (such as 6-10 mm size) and ensure a complete coverage. Lightly roll the chippings into the bitumen using a roller or vehicle tyres.



OPTION 2: PREMIX

A hot cut back bitumen is applied to the area of the repair with a spray lance or watering can, at a rate of about 0.5 kg/m² to form a tack coat.

Spread fine cold mix (made from material up to 5 mm size) evenly over the area and compact it level with the surrounding surface using the small vibrating roller or plate, or a rammer.



BASE PATCHING

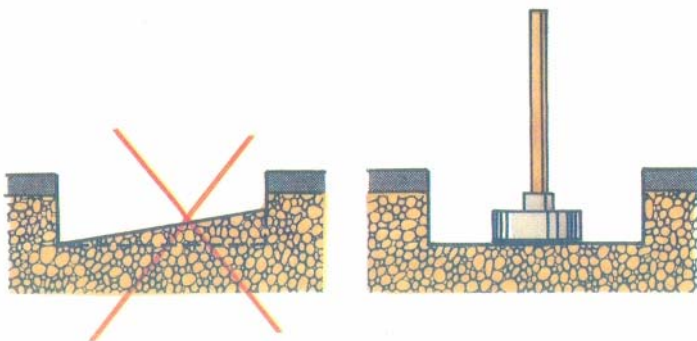
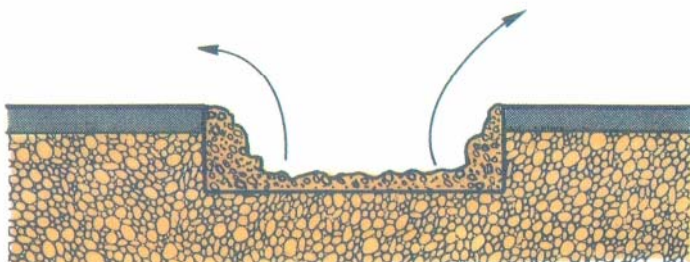
This is the treatment that is used to repair:

- mesh cracking (Page III - 11),
- ruts and depressions (Page III - 15),
- edge subsidence and rutting (Page III - 17),
- edge surface failure (Page III - 19),
- potholes (Page III - 23),
- shoving (Page III - 25).

Four steps are involved:

1 Marking out the area to be repaired

The area to be treated is marked out with chalk by drawing a rectangle around the defects.



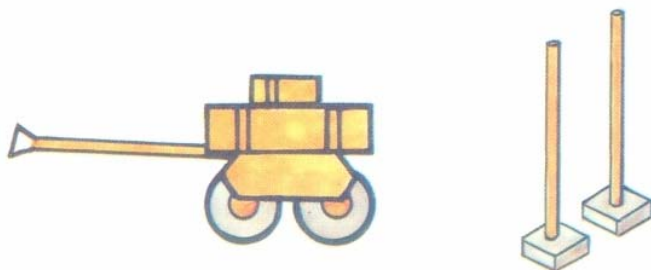
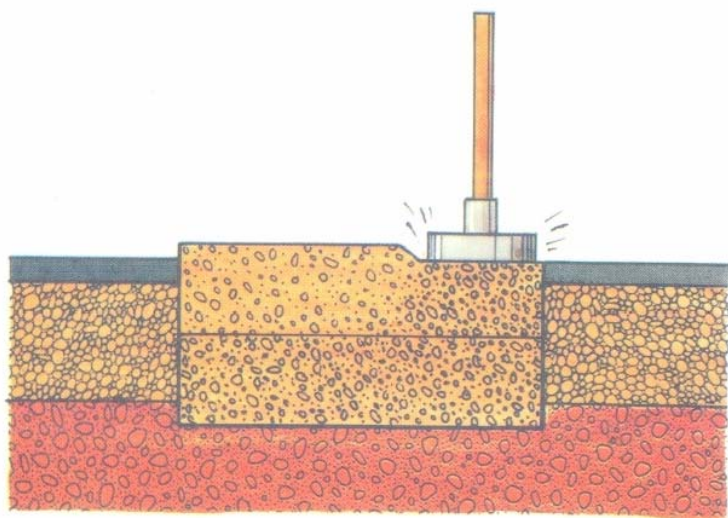
2 Excavation of the area to be repaired

It is necessary to:

- remove all material from within the marked out area of the road surface,

- increase the depth of the hole until firm, dry material is found and then trim the walls of the hole so that they are vertical. If water or excessive moisture is present, then arrangements must be made to drain it away from the pavement foundation.

- trim the bottom of the hole such that it is flat, horizontal and free from loose material then compact it.



3 Backfilling the hole

The hole is filled with a selected well graded material brought to the site in a truck or trailer. This material can consist of:

- a material of the same quality as that of the base layer that is to be repaired,
- or a cold mix asphalt*.

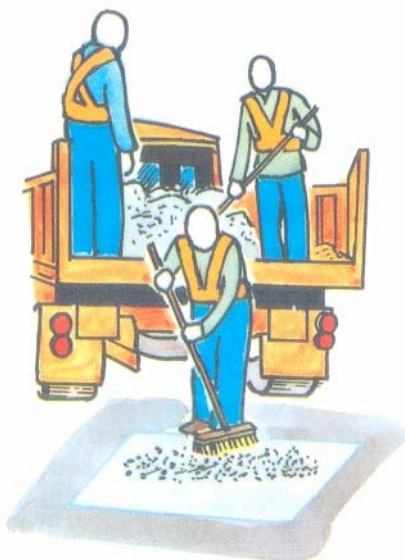
The material is placed in the hole and compacted in one or more layers of regular thickness depending on the depth involved. The last layer, prior to compaction, must have an excess thickness of about 1/5 the depth of the final layer, in order to allow for settlement on compaction.

Compaction is continued depending on the size of the excavation, using the vibrating roller, plate compactor or with a rammer, until the surface is level.

4 Resealing

The repair must be sealed to prevent penetration of water (Page III - 53).

* See *List of Terms, Volume I*.

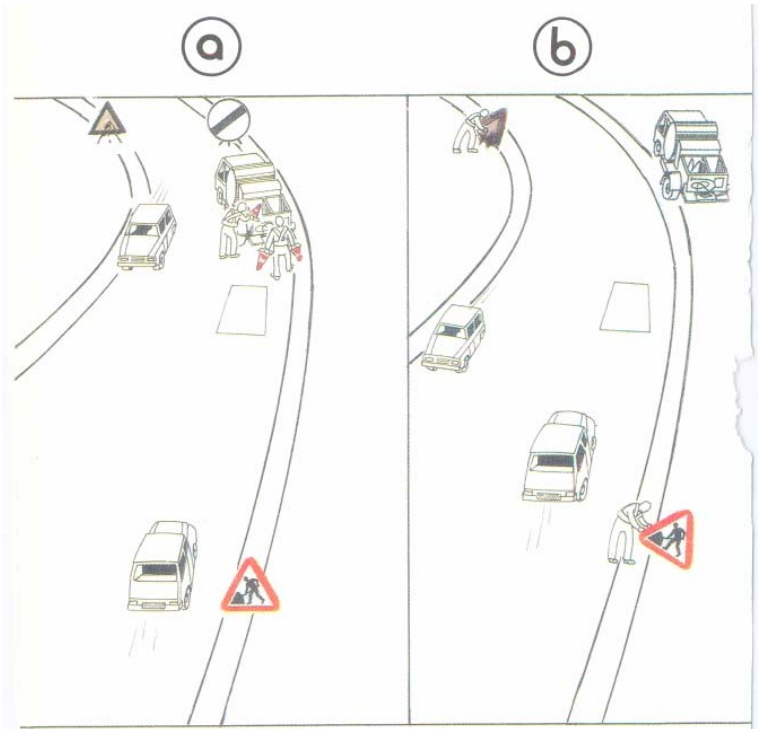


4.4 COMPLETION AND REMOVAL OF TEMPORARY SIGNS

On completing the repairs and before removing the traffic signs which protect the site, the following activities must be carried out:

- remove all excavated material from the road,
- sweep all aggregate from the edges of the repairs,
- sand all areas where too much binder has been applied.

In the days following completion of the work, all areas where the binder has migrated to the road surface must also be sanded again.



NOTE: SHOWN FOR DRIVING ON THE RIGHT

- On completion of the repairs and finishing the work, park the vehicles on the shoulder. The two men who have been responsible for directing the traffic will remove the traffic signs and load them on the truck in the following order:
 - the traffic cones (a),
 - the two "End of Restriction" signs,
 - the two "Men Working" signs (b).

TYPICAL WORK REPORT GENERAL REPAIRS

Work Report No : Date:

District:.....

Zone : Gang:.....

Road No. :from km to km.....

from kmto km.....

from kmto km.....

TYPE OF REPAIR :

Sending ☐ Surface ☐

Local sealing ☐ Base patching ☐

Crack sealing ☐ Resurfacing of shoulders ☐

Filling in depressions ☐

MATERIALS USED:

Type of binder :

Aggregates :.....

Bituminous mixtures:.....

QUANTITIES USED:

Binder:kg

Aggregate :m³

Bituminous mixtures:.....m³

COMMENTS :

.....

.....

.....

Foreman:.....Date:.....

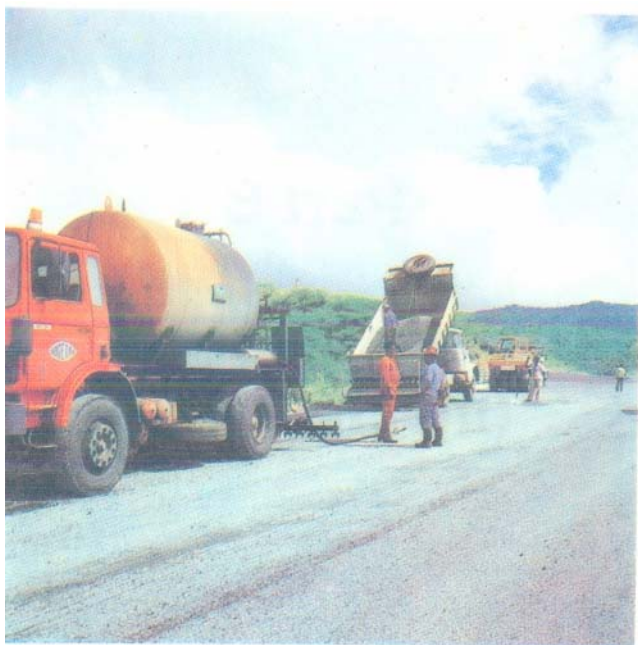
4.5 WORK REPORT

This **report** must be filled in **each day** detailing:

- the work carried out,
- the resources used.

Part B

SURFACE DRESSING (mechanised)



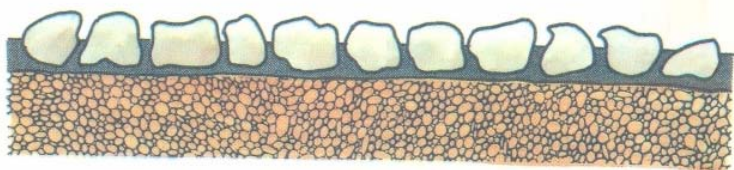
1. THE TASK

SURFACE DRESSING is normally a PERIODIC MAINTENANCE activity.

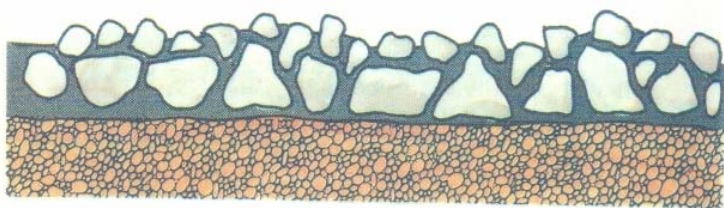
1.1 APPLICATION

- A surface dressing can be used for dealing with a large road surface area where:
 - the surface is extensively worn,
 - the surface has become permeable or cracked allowing water to penetrate the base and cause deterioration,
 - there is inadequate surface texture so that skid resistance is reduced,
- It will usually be necessary to carry out some patching work before proceeding with this operation, particularly where there is base damage, subsidence, potholes, etc.
- The surface dressing is generally applied over the complete width of the pavement (although in some cases, over only a half width) and over lengths of road ranging from a few hundred metres to several kilometres.
- With good planning and organisation, this work can achieve high outputs.
- Surface dressing must be applied only in **dry weather**.
- Surface dressing will **not** correct depressions, and deformation of the road pavement or severe cracking.

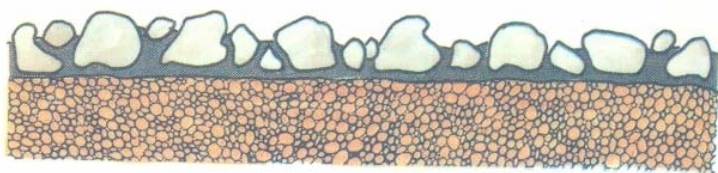
(a)



(b)



(c)



1.2 DIFFERENT TYPES OF SURFACE DRESSING

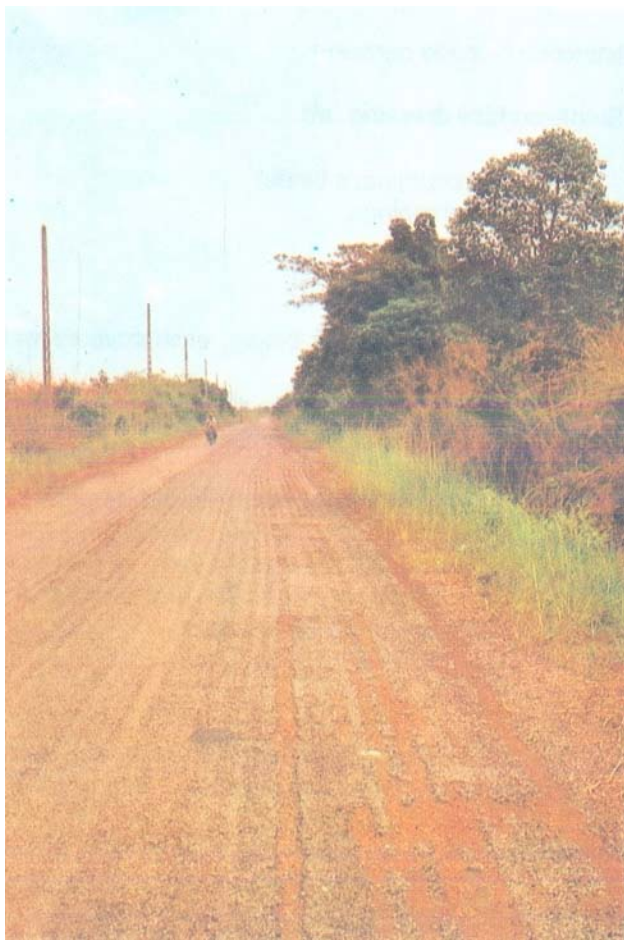
A distinction is made between:

- Single surface dressing (**a**):
 - 1 layer of bituminous binder,
 - 1 layer of chippings.
- Double dressing (**b**):
 - 2 layers of bituminous binder, each covered with a layer of chippings.
- Graded seal (**c**):
 - 1 layer of bituminous binder, followed by either:
 - 2 layers of chippings of different compatible sizes e.g. 10/14 and 4/6, the second layer serving to fill the gaps between the larger first stones and completely cover the road surface,

or

- 1 layer of graded aggregate or gravel with stone graded over a wide size range (e.g. 3 to 17 mm).
- Sandwich seal
 - 1 layer of chippings (e.g. 10/14),
 - 1 layer of bituminous binder,
 - 2nd layer of chippings (e.g. 4/6).

This seal is suitable for existing surfaces with extensive bleeding.



2. DEFECTS

2.1 DEFECTS

Defects treated by surface dressing are usually those involving large areas of the road surface:

- wear of the surface layer,
- permeable surface,
- migration of binder to the surface.

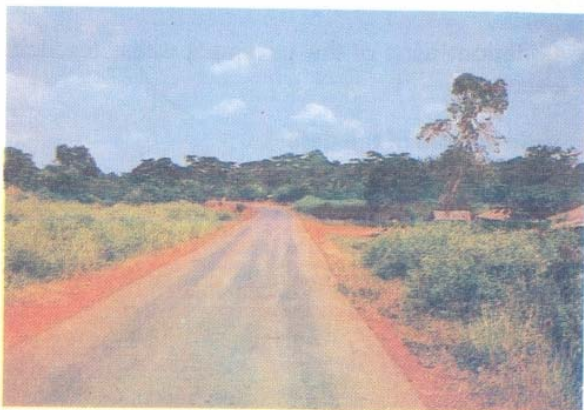
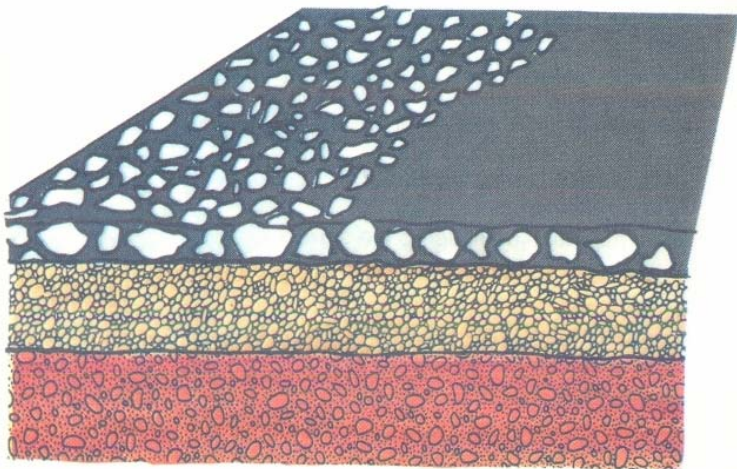
The use of a surface dressing can sometimes prevent any increase in the deformation of the pavement structure (preventive treatment).

2.2 LIST OF DEFECTS

Information follows on the different types of defect with respect to:

- **Location:** parts of the pavement where the defect usually appears,
- **Main causes** of the defect,
- **Development:** consequences if maintenance is not rapidly carried out,
- **Remedies:** usual repair treatment.

PART B – SURFACE DRESSING (mechanized)



DEFECT: **BLEEDING***

Location

May involve part or the whole of the road surface.

Main causes

- too much binder,
- unsuitable binder.

Development, if neglected

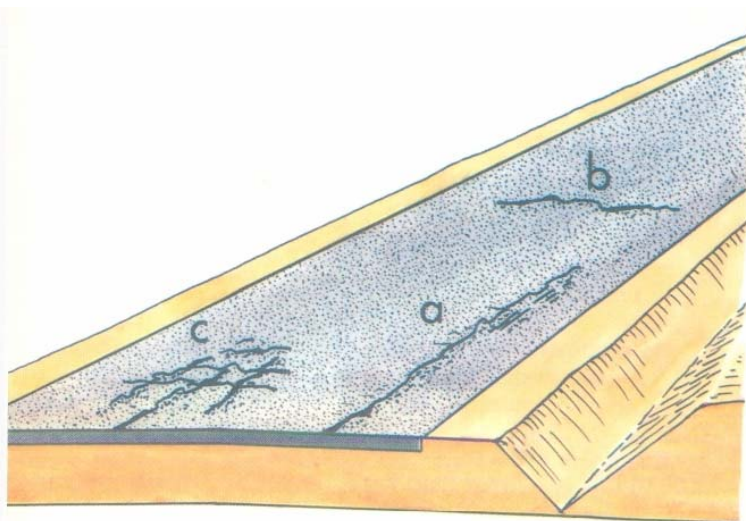
- separation and breakaway of surface layer under the action of traffic,

Remedies

- sanding (see Page III - 51),
- surface dressing.

* See *List of Terms, Volume I.*

PART B – SURFACE DRESSING (mechanized)



DEFECT: CRACKS
(in the surface and the body of the pavement)

Location

- a. longitudinal: parallel to the centre line (often along the wheel tracks or along the edges of the road).
- b. transverse: perpendicular to the road direction (across the whole or part of the cross-section).
- c. mesh cracks: intersecting cracks dividing the pavement surface into isolated elements of different sizes down to the small elements involved in crazing.

Main causes

- poor quality materials,
- poor workmanship,
- insufficient pavement thickness for the traffic being carried,
- shrinkage (see Note),
- pavement age.

NOTE: Shrinkage : cement treatment of road base results in a reduction in volume after the cement has set.

PART B – SURFACE DRESSING (mechanized)

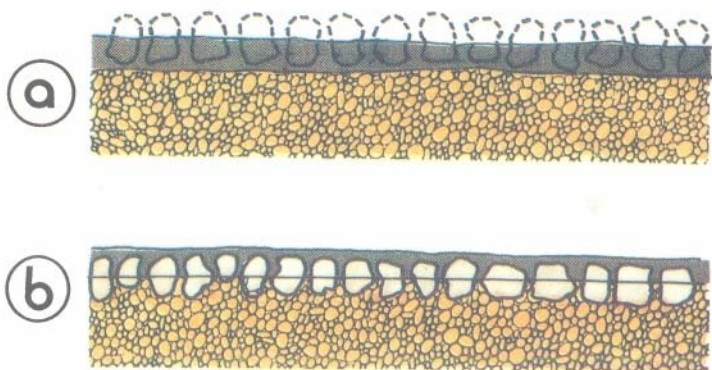


Development, if neglected

- a general or local disintegration of the pavement.

Remedies

- surface cracking: application of a surface dressing,
- severe cracks in the pavement structure: patching (Page III - 71) followed by the application of the surface dressing.



DEFECT: **GLAZING***

Location

The pavement surface in general.

Main causes

- wear but no removal of the surface chippings (a), -
embedment of the chippings into the base (b).

Development, if neglected

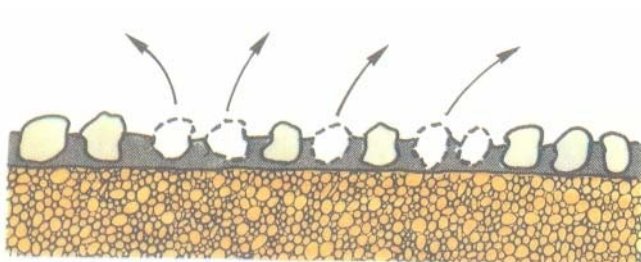
- continued wear of the chippings resulting in the pavement surface becoming more and more slippery, particularly when wet.

Remedies

- application of a surface dressing,
- application of a thin bituminous overlay (see Part D).

* See *List of Terms, Volume I*.

PART B – SURFACE DRESSING (mechanized)



**DEFECT: LOSS OF SURFACE AGGREGATE
(Stripping/fretting)***

Location

On surfacee dressing or premix surfacing. Usually in wheel tracks.

Main causes

Breakaway of surface aggregate or seal due to:

- poor adhesion of the surface dressing to the base,
- aggregate dirty when laid,
- insufficient penetration of aggregate,
- poor premix quality or workmanship,
- insufficient or erratic distribution of binder.

Development, if neglected

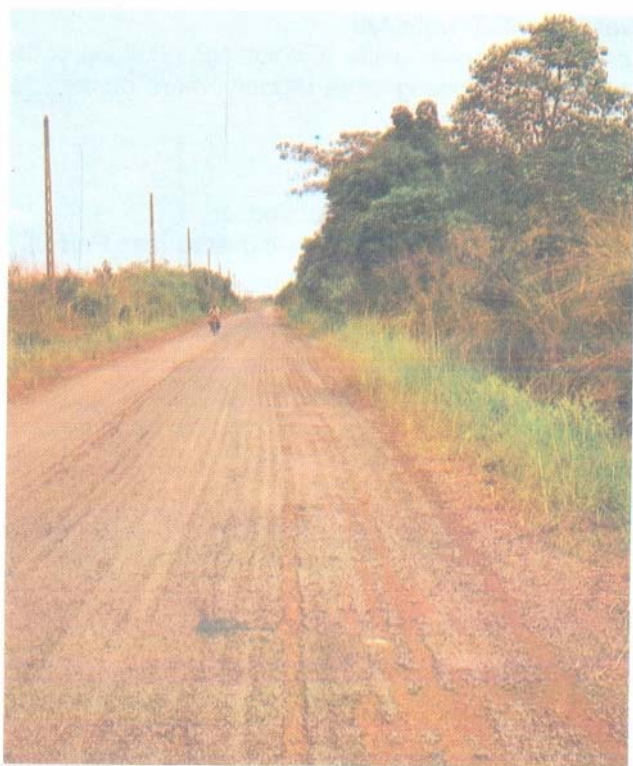
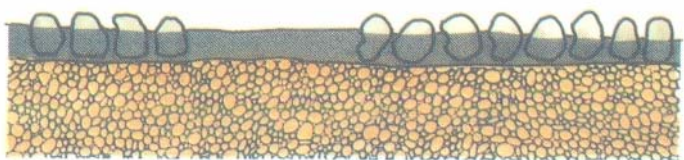
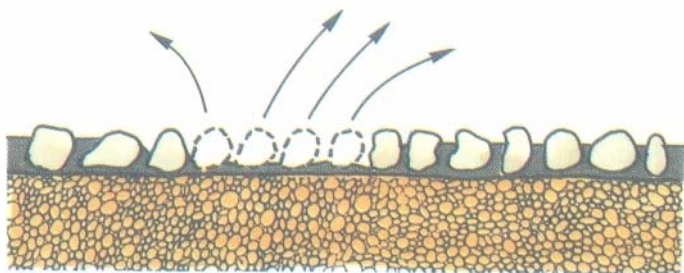
- progressive break-away of chippings resulting in the surfacing becoming more slippery, more permeable, or worn out by traffic.

Remedies

- application of a surface dressing, or,
- application of a thin bituminous overlay (see Part D).

* See *List of Terms, Volume I*.

PART B – SURFACE DRESSING (mechanized)



DEFECT: **STREAKING***

Location

Parallel to the centre line and extending over appreciable lengths.

Main cause

- faulty operation of the spraying equipment applying the surface dressing, giving rise to streaks of insufficient binder.

Development, if neglected

- the surface will become more permeable and potholes or deformation will probably occur.

Remedies

- application of a surface dressing,
- application of a thin bituminous overlay (see Part D).

* See *List of Terms, Volume I*.

PART B – SURFACE DRESSING (mechanized)



DEFECT: **DEFORMATION**

Location

Various forms of local settlement of the pavement, usually along the wheel tracks, or along the edges of the road.

Main Causes

- insufficient strength of the pavement structure or foundation,
- inadequate stability of the surface layer (bituminous mixture).

Development, if neglected

- rapid increase in the settlement during the rainy season and a break up of the pavement if water penetrates the base.

Remedies

Slight subsidence:

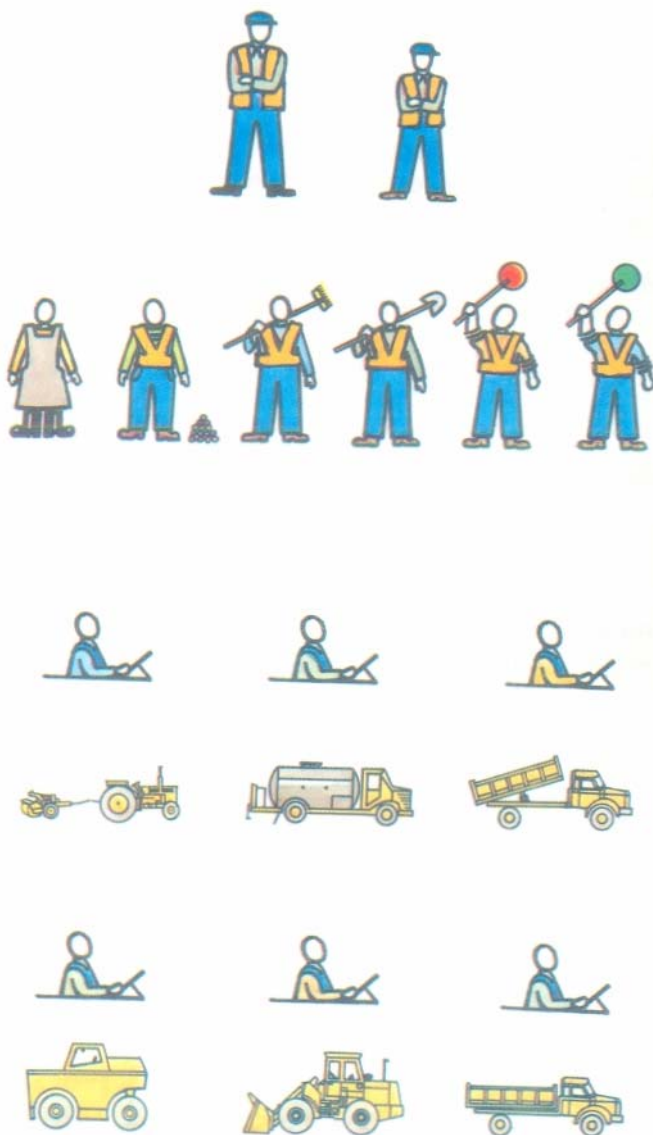
- application of a surface dressing as a preventive measure.

Appreciable subsidence:

- patching (Page III - 71) followed by the application of a surface dressing or a thin overlay (see Part D).

NOTE: A slurry seal (Part C) can be applied in place of a surface dressing when the subsidence is not excessive

PART B – SURFACE DRESSING (mechanized)



3. RESOURCES

3.1 PERSONNEL

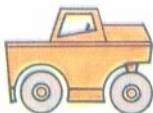
▪ Working Force

- 1 foreman,
- 1 overseer,
- 1 spray bar operator,
- 1 attendant for aggregate trucks,
- 2 - 4 chip spreading labourers,
- 2 traffic controllers.

▪ Plant Operators and Drivers

- 1 mechanical broom operator,
- 1 bitumen distributor driver,
- 3 or 4 aggregate truck drivers,
- 2 roller operators,
- 1 loader operator (for the loading of chippings),
- 1 truck driver,
- 1 light vehicle driver.

PART B – SURFACE DRESSING (mechanized)



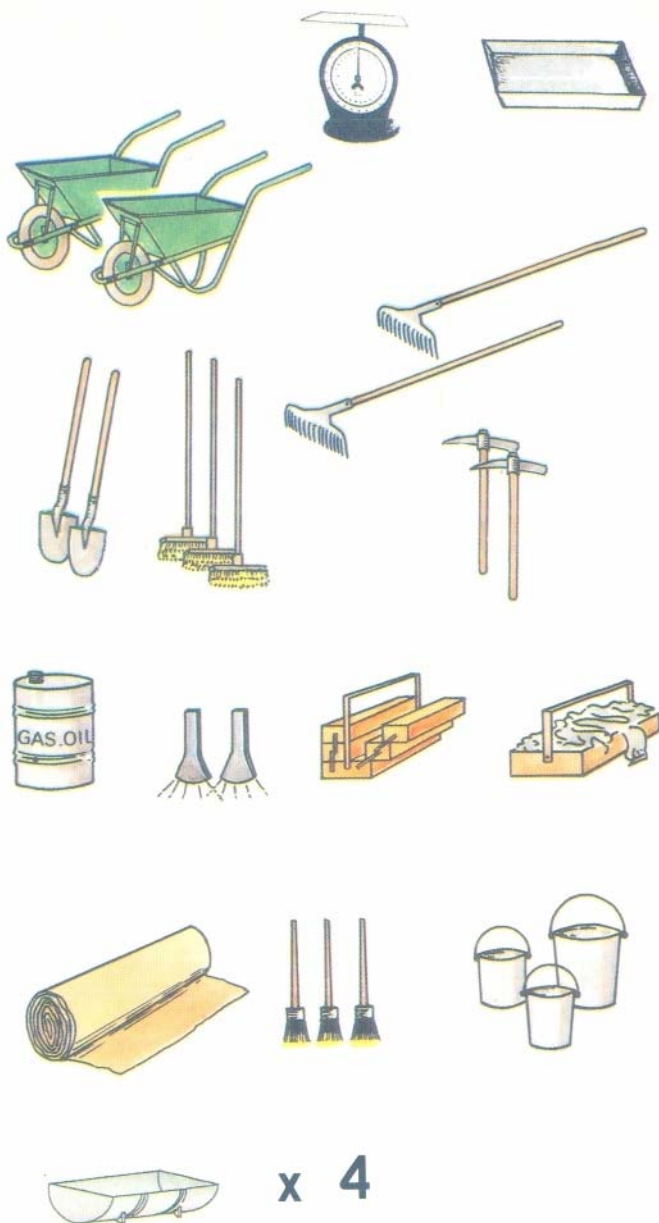
3.2 PLANT AND TOOLS

- 1 mechanical broom,
- 1 bitumen distributor of 5,000 to 8,000 litres capacity, with **working thermometer**,
- 3 or 4 aggregate trucks each of 5 to 6 m³ capacity and fitted with tailgate gritters*,
- 2 rubber tyred rollers with tyres inflated to a pressure of 6 kg/cm²,
- 1 wheeled loader,
- 1 light vehicle,
- 1 tipper truck.

NOTE: If a self propelled chipping spreader is available, the aggregate trucks will not require tailgate gritters.

* See List of Terms, Volume I.

PART B – SURFACE DRESSING (mechanized)

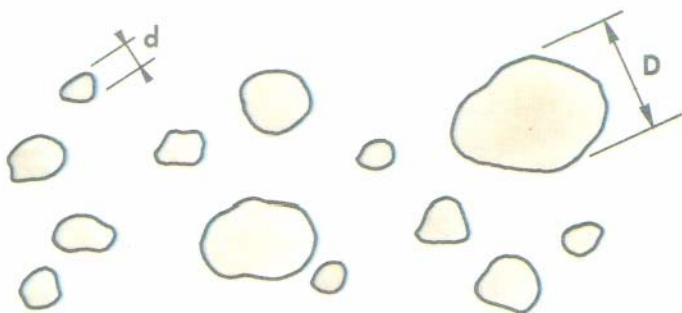
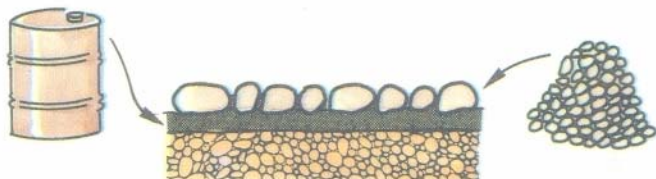


- Test Equipment
 - calibration tray and test equipment for measuring bitumen rate of spread.

- Small Items of Equipment
 - 2-4 shovels,
 - 3 brooms, - 2 rakes,
 - 2 pickaxes,
 - 2 wheelbarrows.

- Tools and Supplies
 - rolls of strong paper (at least 50 cm wide),
 - 1 drum of diesel oil to clean the spray bar and tools,
 - a number of spare spray bar jets,
 - 1 box of tools for use in dismantling the spray bar jets and adjusting the chipping equipment,
 - oil drums cut along their axis to collect bitumen during testing of spray bar,
 - box of rags,
 - paint brushes,
 - metal buckets,
 - chalk or paint for marking,
 - stringlines,
 - half drums for testing spray bar jets.

PART B – SURFACE DRESSING (mechanized)



4/6
 $d = 4 \text{ mm}$
 $D = 6 \text{ mm}$



6/10
 $d = 6 \text{ mm}$
 $D = 10 \text{ mm}$



10/14
 $d = 10 \text{ mm}$
 $D = 14 \text{ mm}$

3.3 MATERIALS

The materials required for surface dressing usually consist of:

- one or several types of aggregate* (chippings),
- a bituminous binder*.

- Aggregates

Aggregates are obtained from approved sources and the material has usually been crushed. It is normally delivered to the work site as a uniformly graded material where:

d: is the size of the smallest particles in millimetres,

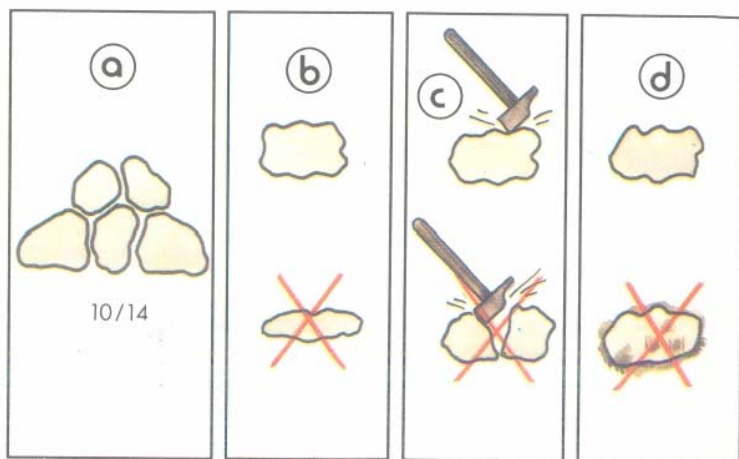
D: is the size of the largest particles, again in millimetres.

The most commonly employed d/D gradings are as follows:

4/6 - 6/10 - 10/14

Sometimes a "graded seal" is used by making two applications of aggregate of two different sizes, or one application of a continuously graded aggregate.

* See List of Terms, Volume I.



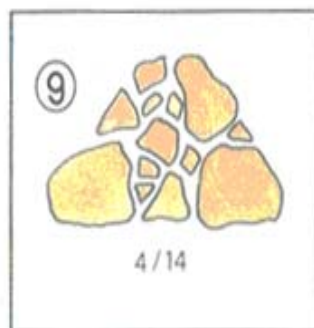
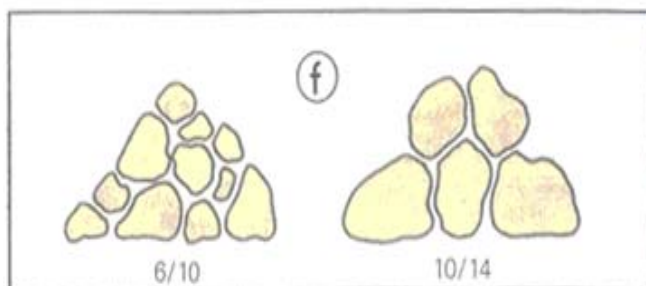
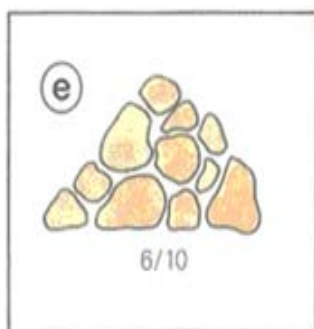
Aggregates to be used for surface dressing must conform to the specifications and:

- have a given grading (as specified on the work sheet) **(a)**,
- be of a suitable shape, preferably cubical **(b)**,
- be strong enough so that they will not crush under traffic, **(c)**,
- be sufficiently clean. Dirty or dusty aggregate will not adhere to the bitumen, **(d)**.

If aggregates are dusty they should be:

- washed, or
- lightly sprayed with diesel, creosote or kerosene before use (pretreating).

This will promote bonding with the bitumen. The pretreating can be achieved by mixing at the stockpile, by spraying on a belt conveyor or by using a concrete mixer.

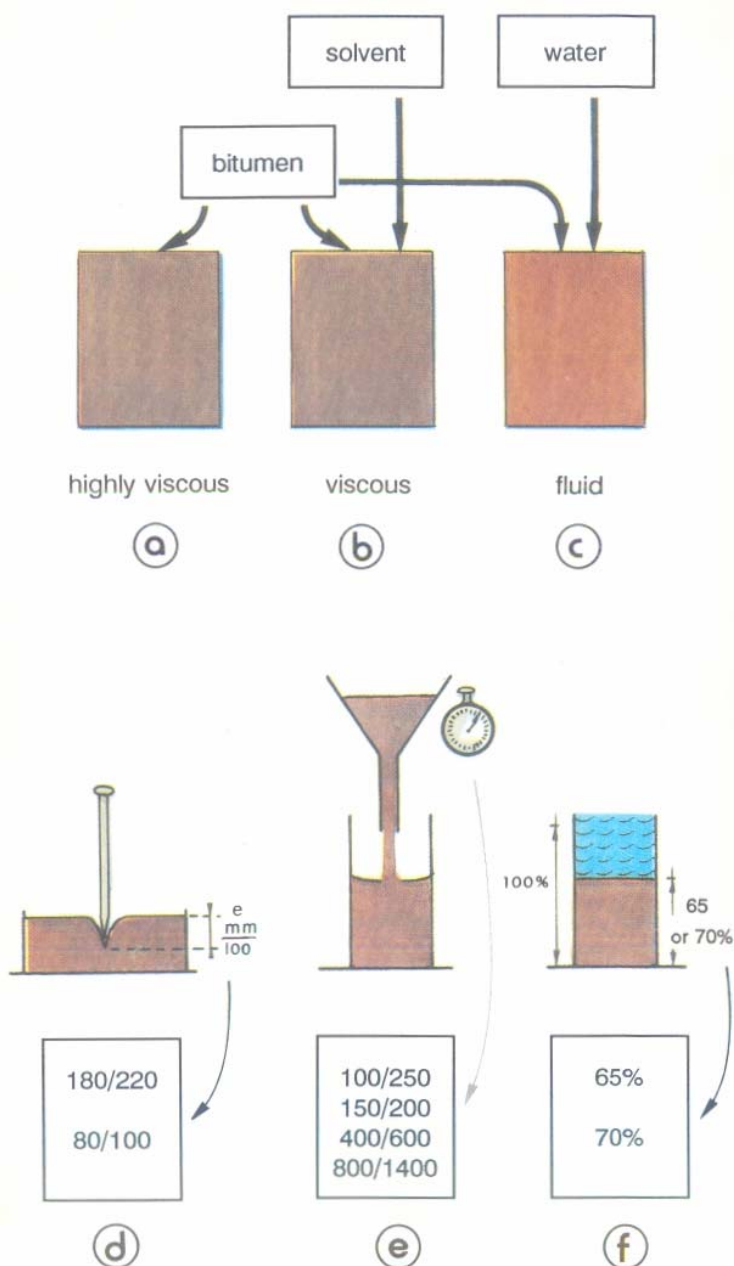


Use is made of:

- a single uniformly graded aggregate in the case of a single surface dressing (**e**), or
- two uniformly graded aggregates in the case of a double surface dressing, or
- a single surface dressing with two layers of chippings (**f**), or
- a single continuously graded aggregate in the case of a "graded seal" (**g**),

NOTE: The grading classification of the aggregate and the shape, strength and cleanliness of the aggregate particles will be the subjects of laboratory tests prior to making use of the material.

PART B – SURFACE DRESSING (mechanized)



▪ Bituminous Binders^{*}

Different types of bituminous binder are available:

- penetration grade bitumens (**a**),
- cut back bitumens (**b**),
- bitumen emulsions (**c**).

These three different types of binder are classified in the laboratory in terms of:

- the **penetration** in the case of the penetration grade bitumens (**d**),
- the **viscosity** in the case of the cut back bitumens (**e**),
- the **bitumen content and breaking speed** in the case of the emulsions (**f**).

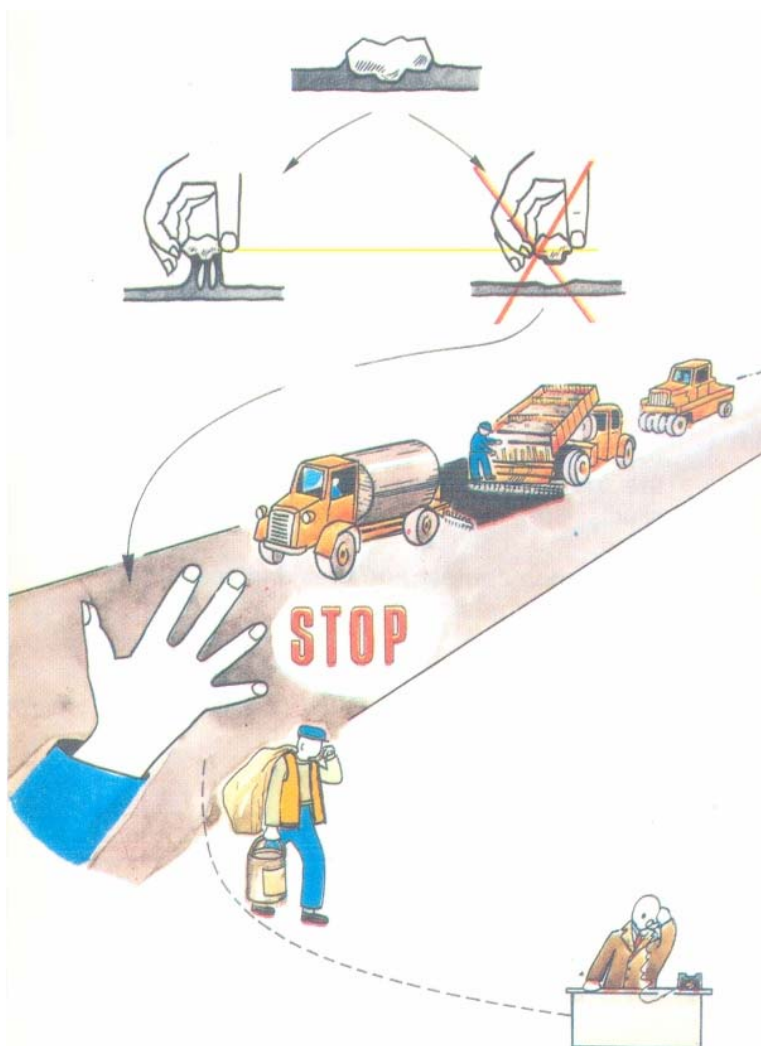
These classifications are determined by carrying out tests illustrated opposite.

^{*} See List of Terms, Volume I.

NOTE: The type of binder to be used is determined as a function of:

- *the road temperature,*
- *The climate (dry or wet weather),*
- *The heating facilities available,*
- *The type of aggregate to be used.*

PART B – SURFACE DRESSING (mechanized)



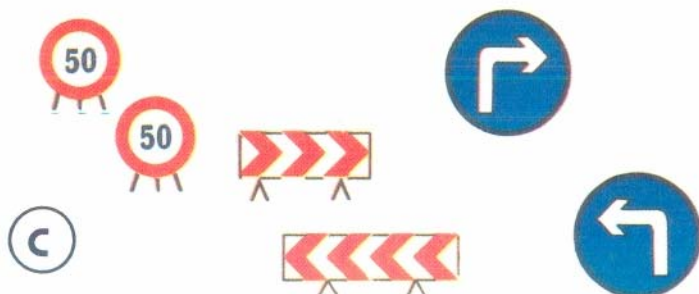
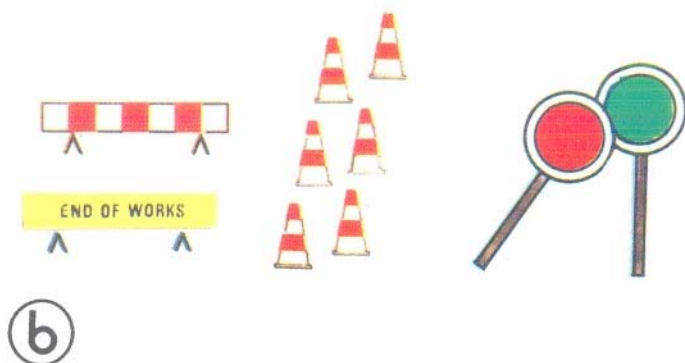
Successful surface dressing depends on the degree to which the binder adheres to the aggregate (good bonding characteristics).

The binder and aggregates must be selected according to the results of a laboratory study aimed at establishing the suitability of the aggregates and the binder for surface dressing.

In some cases an additive may be mixed with the binder to improve bonding.

If on site it is found that the binder does not adhere well to the aggregate (poor bonding characteristics), then it will be necessary to:

- stop work,
- inform the responsible person,
- collect samples of the binder and aggregate for use in carrying out further laboratory tests.



3.3 SIGNS AND SAFETY EQUIPMENT

▪ Advance Warning Signs (a)

The following signs are to be placed on the shoulder for both directions of traffic:

- 2 "Men Working" signs,
- 2 "Road Narrows" signs, (one each hand),
- 2 "Loose Chippings" signs,
- 2 "No Overtaking" signs,
- 2 "Speed Limit" signs (50 km/hr).

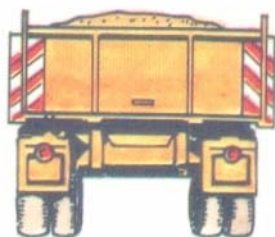
▪ Site Protection Equipment (b)

The following signs are to be erected on the road to define the boundary of the roadworks:

- 2 "Lane Closed" barriers with "End of Roadworks" written on the reverse side,
- 100 traffic cones per kilometre length of roadworks,
- 2 reversible "Stop/Go" signs.

NOTE: When the surface dressing is to be applied in one pass over the full width of the road, it will be necessary to divert the traffic and to make use of the warning and diversion signs shown opposite (c).

d



e



▪ **End of Restriction Signs (d)**

The following signs are to be placed on the shoulder for each direction of traffic:

- 2 "End of Restriction" sign:

▪ **Safety Equipment (e)**

Use is to be made of the following equipment for personnel and vehicles:

- yellow shoulder belts for each of the traffic control operators located at the beginning and end of the roadworks, and all workmen,
- signs marked with alternate red and white diagonal strips for mounting on the vehicles,
- if possible, a triangular sign fitted with three flashing lights for mounting on the roof of the light vehicle.

A fire extinguisher should be provided for each vehicle working with or near heated bitumen.

TYPICAL WORKSHEET

GENERAL REPAIRS

Worksheet No : Date:

District:

Zone:..... Gang:

Road No. : from:.....to :

Section: from km:..... to km:..... inm width

Type of binder : Rates of spread:

..... 1st layerkg/m²

..... 2nd layerkg/m²

Type of aggregate: 1st layer..... 2nd layer

Rates of spread (l/m²): 1st layer..... 2nd layer

Binder t

QUANTITIES REQUIRED: Aggregate :.....m³ of.....

Aggregate :.....m³ of.....

STOCK:

Binder:..... t

Aggregat:..... m³

..... m³

4. MAINTENANCE METHODS

4.1 PRELIMINARY TASKS

To achieve successful results it is essential to properly plan, prepare and organise surface dressing activities.

There are four preparation activities:

1 Refer to the Work Sheet

This contains all the information needed to plan and organise the work.

PART B – SURFACE DRESSING (mechanized)



2 Equipment Check

One week before work is to start, a check should be made to ensure:

- that all items of equipment to be used are in good condition,

- that arrangements have been made for providing the vehicles with fuel,

- that arrangements have been made for carrying out maintenance work on the equipment,

- that all personnel are available (Page III - 105),

PART B – SURFACE DRESSING (mechanized)

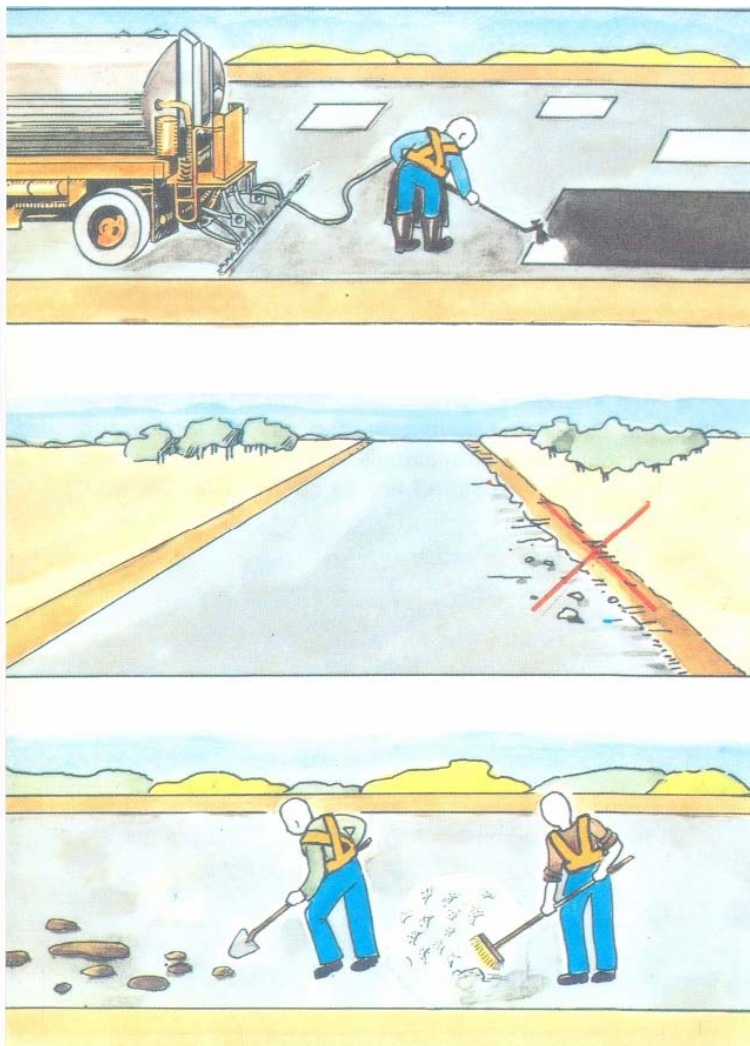


- that all hand tools and traffic signs are available,

- that arrangements have been made for the supply of the binder and aggregate, and that the quality and quantity of these materials and the locations where they are to be stored are as specified on the work sheet,

- that all bitumen heating equipment and pumps are available.

PART B – SURFACE DRESSING (mechanized)



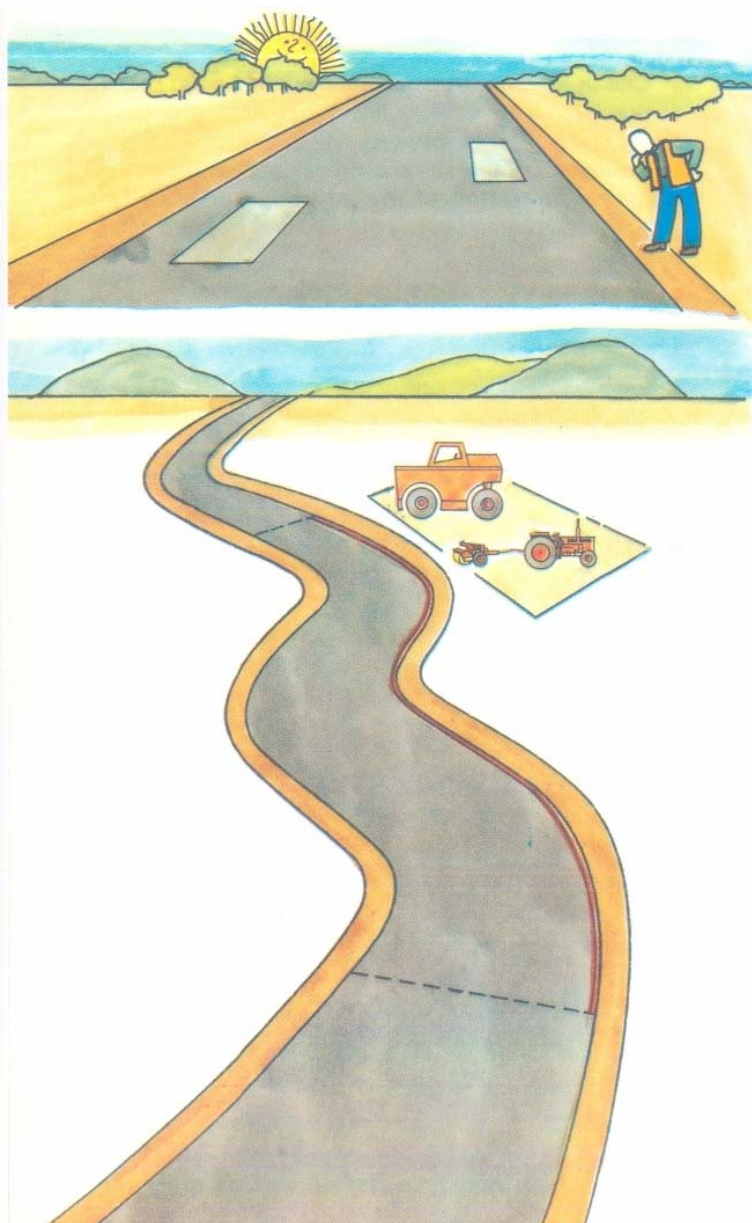
3 Check that the Preparatory Work has been carried out

The success of the surface dressing depends on the proper preparation of the existing surface. This preparation is carried out by the General Repairs gang.

A week before work is to start it is necessary to ensure:

- that all potholes have been repaired (see Part A),
- that the edges of the road have been repaired (see Part A),
- that the existing surface is clean and free of dirt, or other debris that would affect the bond of the new surface dressing (clean if necessary).

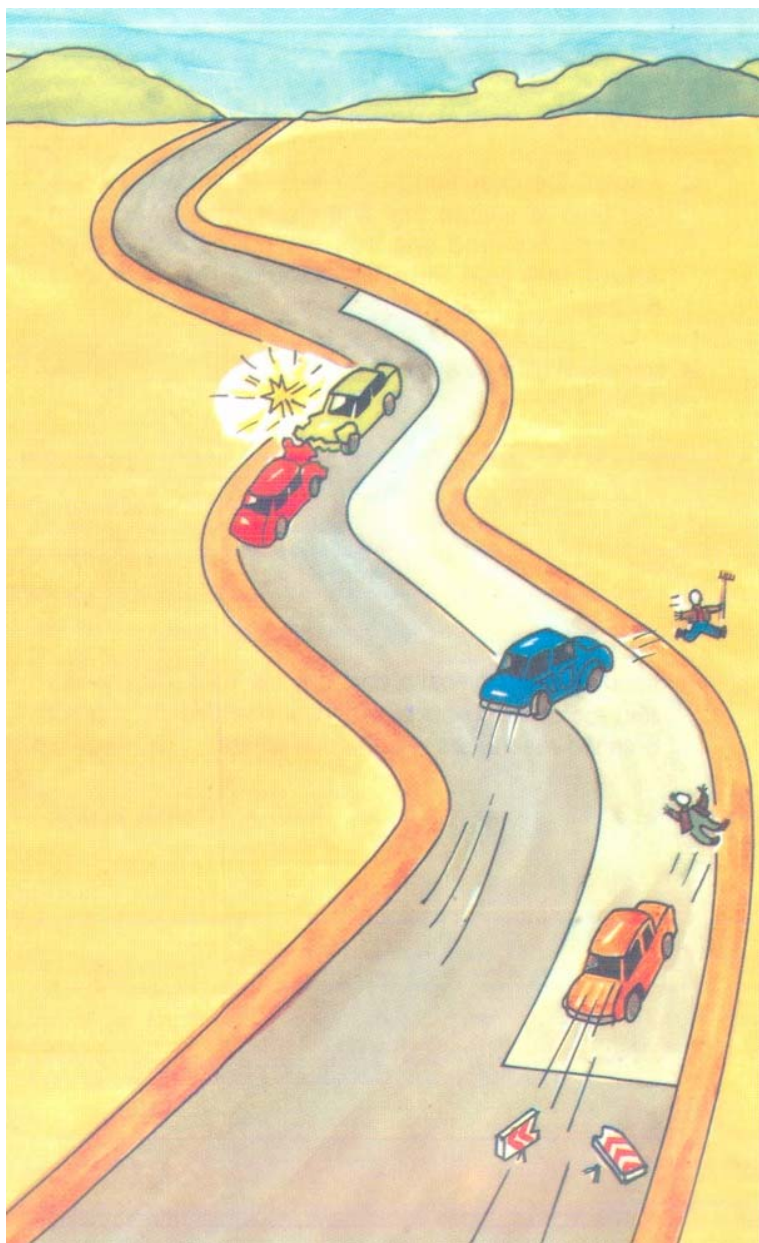
PART B – SURFACE DRESSING (mechanized)



4 Organise the Work

The day before work starts, the foreman must:

- inspect the condition of the existing surface for the last time to ensure that it is clean, that it has been properly repaired and that the edges of the road where they join onto the shoulder are properly defined,
- assess likelihood of good weather,
- send the mechanical broom and the rollers to the site and locate them off the road, if possible, to protect both the road users and the equipment.



4.2 TEMPORARY SIGNPOSTING

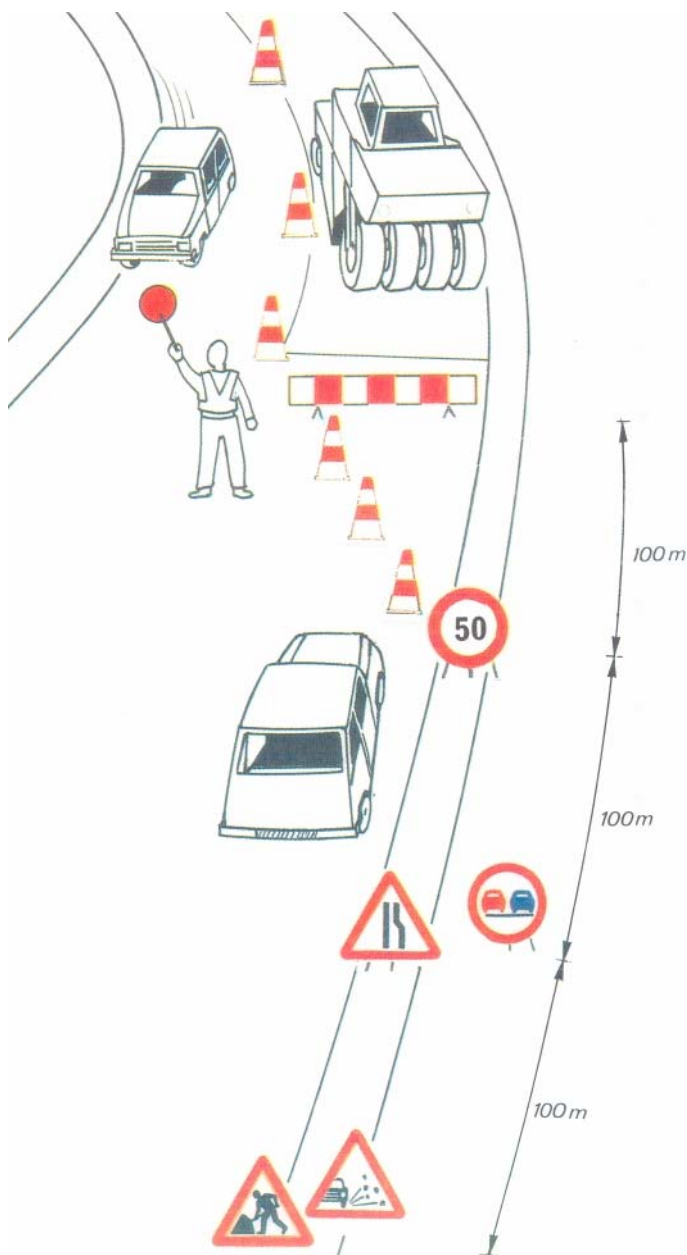
Traffic signs conforming to the regulations must be correctly placed before starting any work. This is to ensure the safety:

- of the road users,
- of the personnel working on the site,
- of the vehicles and equipment to be used on the site.

The traffic signs must be located:

- **ahead** of the worksite (in both traffic directions) to give advance warning of danger,
- **along** the length of the roadworks to protect the site from traffic when it is not possible to build a diversion,
- **at the end** of the roadworks as an indication that there is no further restriction.

PART B – SURFACE DRESSING (mechanized)



NOTE: SHOWN FOR DRIVING ON THE RIGHT

Traffic signs will consist of:

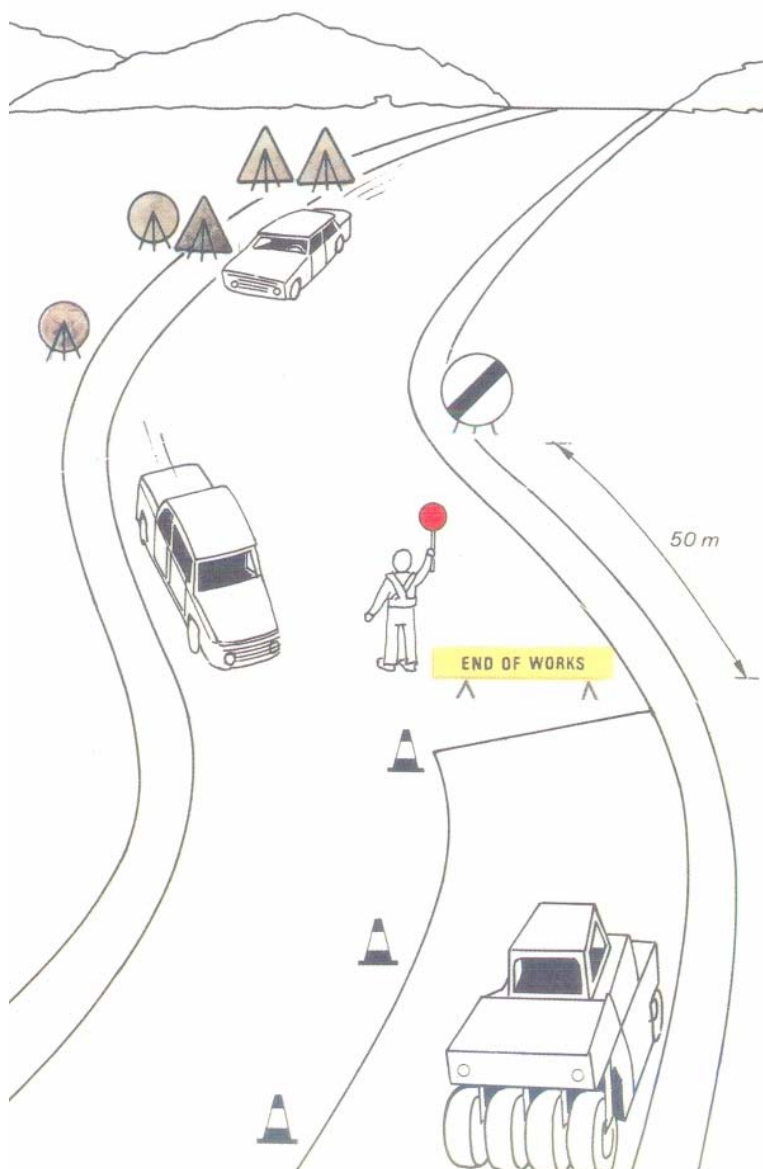
- **Ahead of the Roadworks** (for both directions of traffic), on the shoulder on the side of the approaching traffic:
 - "Men Working",
 - "Loose Chippings",
 - "Road Narrows",
 - "No Overtaking",
 - "Speed Limit" (50 km/hr).

- **On the half-width of road where work is taking place**, at each end of the works:
 - 1 traffic barrier,
 - 1 man controlling successive flows of traffic in alternate directions.

- **Along the length of the roadworks:**
 - traffic cones.

On long works sections intermediate traffic controllers may be required to transfer "Stop/Go" instructions. Alternatively portable traffic lights or hand radio sets should be used.

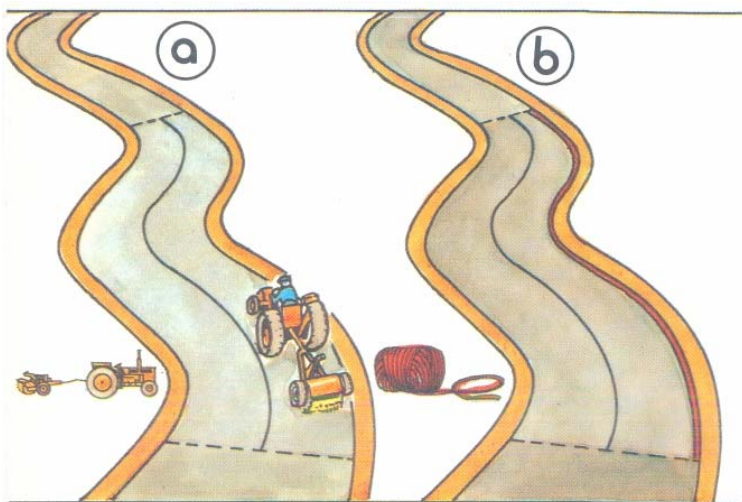
PART B – SURFACE DRESSING (mechanized)



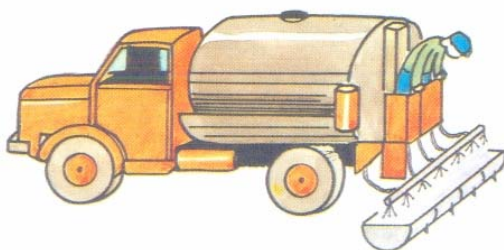
NOTE: SHOWN FOR DRIVING ON THE RIGHT

- **At the end of the roadworks** (for both directions traffic).
 - on the shoulder on the side of the approach traffic an: "End of Speed Restriction" sign should be placed 50 metres beyond the traffic barrier.

PART B – SURFACE DRESSING (mechanized)



(c)



4.3 EXECUTION OF THE WORK

A surface dressing is usually applied to half the width of the road at a time.

There are seven steps:

- 1 Sweep the complete road surface** where the binder is to be applied so that it is perfectly clean **(a)**.

- 2 Mark out the road surface**

A string-line is run along the edge of the carriageway where work starts to ensure good alignment of the edge of the surface dressing **(b)**.

- 3 Check and adjust the binder distributor**

- **Off the road:**
 - check the temperature of the binder (Refer to the chart on Page III - 143, or other guidelines).
 - check that all the spray bar jets are operating properly **(c)**. Use split oil drums to collect binder.

PART B – SURFACE DRESSING (mechanized)



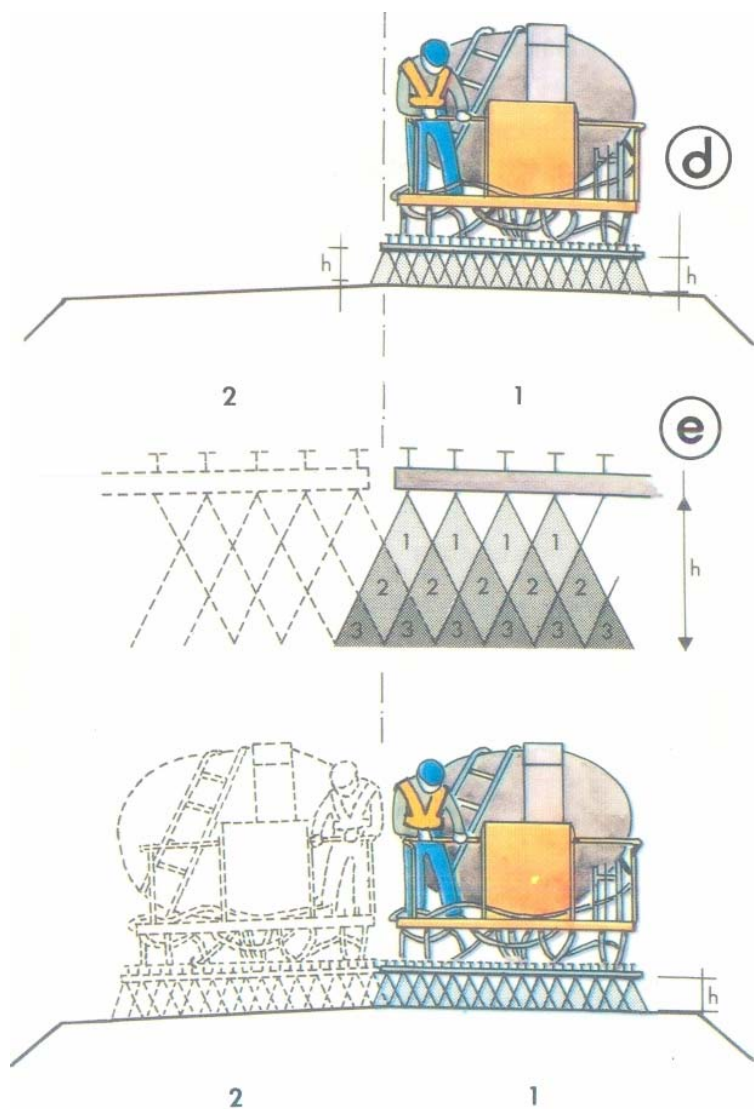
Spraying temperatures for binders

CUTBACK GRADES (US ASPHALT INSTITUTE)	WHIRLING SPRAY JETS		SLOT JETS	
	MIN °C	MAX °C	MIN °C	MAX °C
MC 30	50	60	40	50
RC/MC 70	65	80	55	70
RC/MC 250	95	115	80	90
RC/MC 800	115	135	105	115
RC/MC 3000	135	150	120	130
PENETRATION GRADES				
400/500	160	170	140	150
280/320	165	175	150	160
180/200	170	190	155	165
80/100	180	200	165	175

NOTE: *Because of the inflammable nature of the solvent used in RCtype cutbacks, application temperatures for RC grades should be restricted to the lower parts of the ranges given above.*

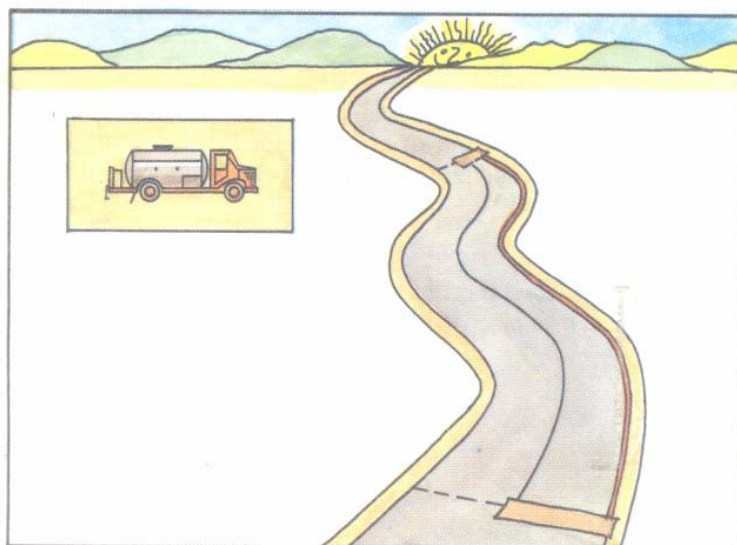
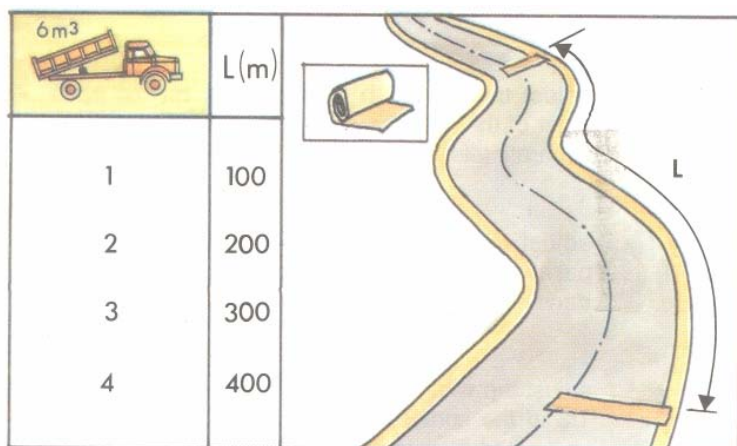
Attention is also drawn to the need to extinguish flames and prohibit smoking when heating, pumping or spraying all cutbacks. Fire extinguishers should always be readily at hand.

PART B – SURFACE DRESSING (mechanized)



- On the road:
 - adjust the height "h" of the spray bar so each point of the road is sprayed by binder from three separate jets,
 - adjust the angle of the spray bar so that it is parallel to the road surface to obtain a good transverse distribution of the binder (**d**),
 - adjust the width covered by the spray bar so that 1/3 of the spray coming from the last jet on the spray bar overlaps the centre line of the road. This will ensure that the correct amount of binder will be deposited along the centre of the road following the second pass of the binder distributor (**e**).
- Carry out a rate of spread test for the bitumen distributor and provide a driver's chart (rate of spread calibration).
- The second pass of the distributor on the other lane must take place in the same direction.

PART B – SURFACE DRESSING (mechanized)



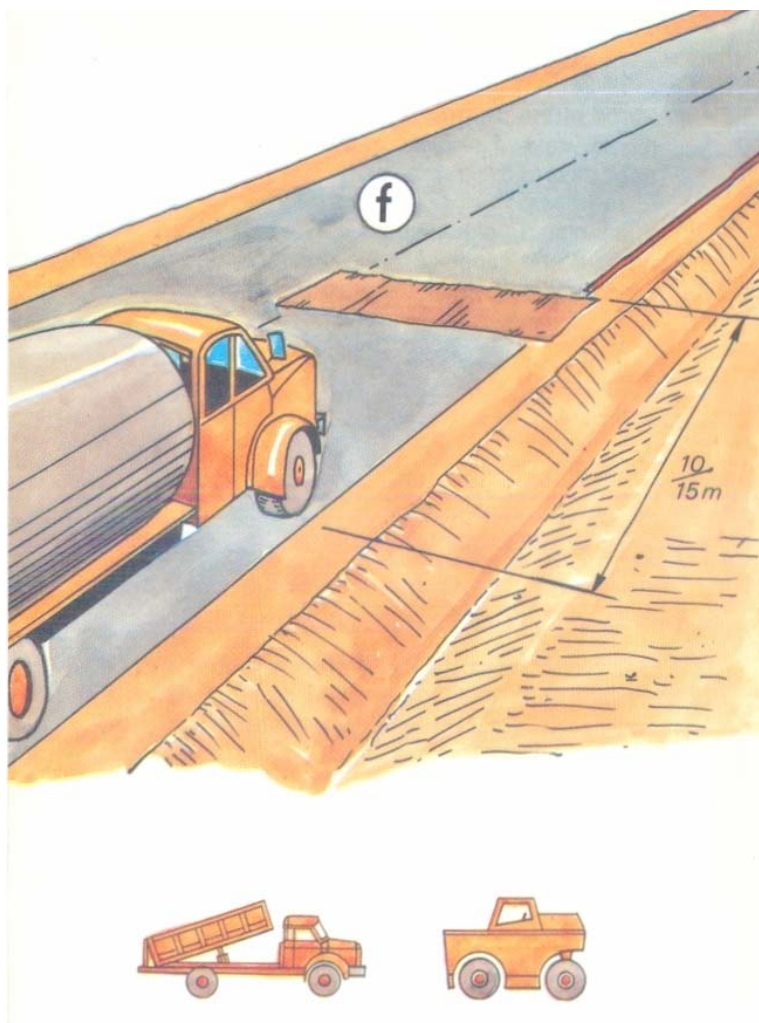
- 4 Place strips of strong paper in position** to ensure regular transverse joints at the beginning and end of each pass of the distributor.

The length "L" of each pass will be determined by the number and capacity of the gritting lorries (see the typical values given in the table shown opposite).

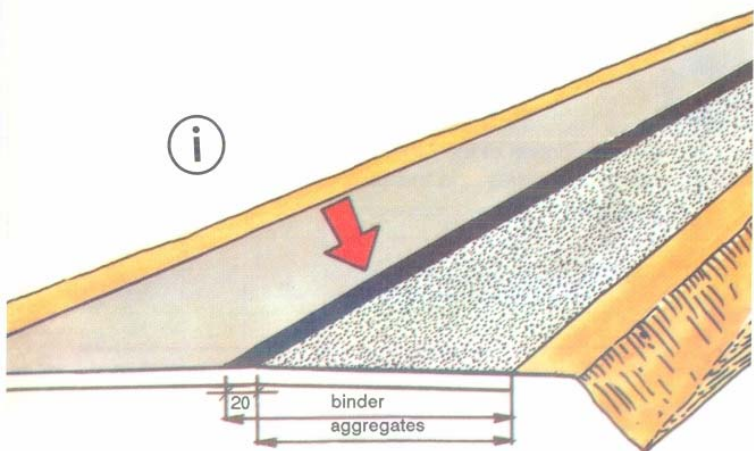
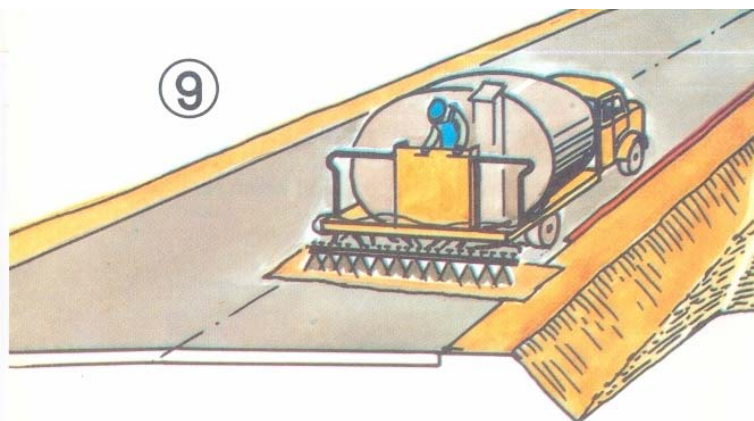
- 5 Distribute the binder**

The binder must only be applied to a completely dry surface (application of surface dressing during the rainy season should therefore be avoided if possible).

PART B – SURFACE DRESSING (mechanized)



PART B – SURFACE DRESSING (mechanized)



The distributor jets are opened over the first strip of paper and closed over the strip at the end of the run (g).

A test of the rate of spread of bitumen should be carried out during the spraying operation.

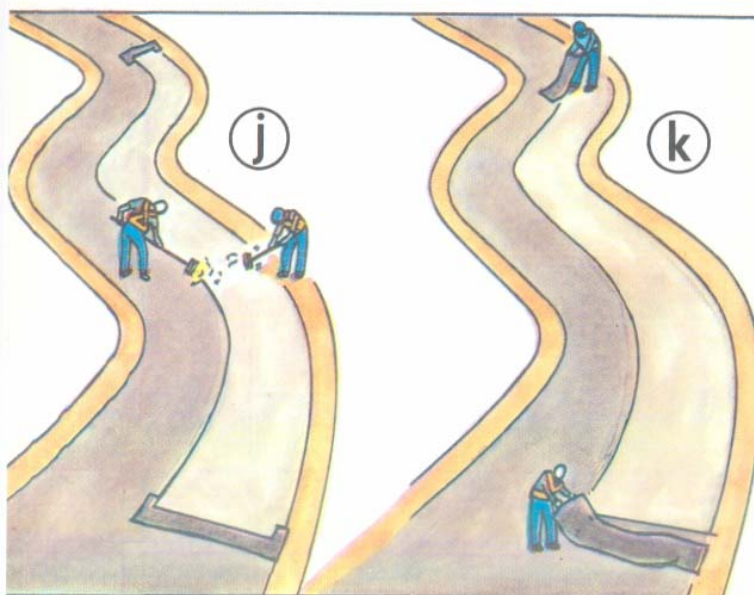
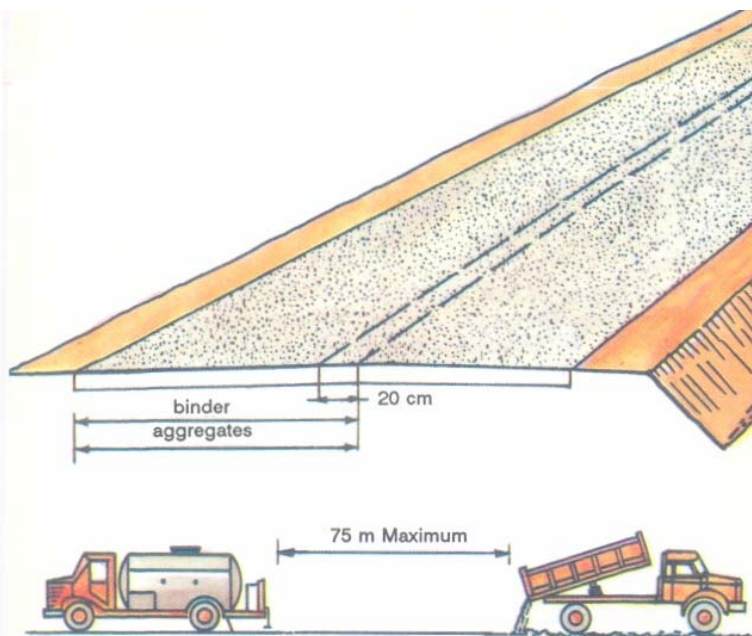
No person or vehicle must be allowed onto the surface_ sprayed with binder.

6 Distribute the Aggregate

The aggregate is distributed by driving the gritting trucks backwards (h) as follows:

- **for the first half-width of the road**, aggregate is spread over the binder leaving a 20 cm strip uncovered along the centre line (i),

PART B – SURFACE DRESSING (mechanized)



- **for the second half-width of the road**, aggregate is spread over the remaining width of the binder including the strip left un-covered.

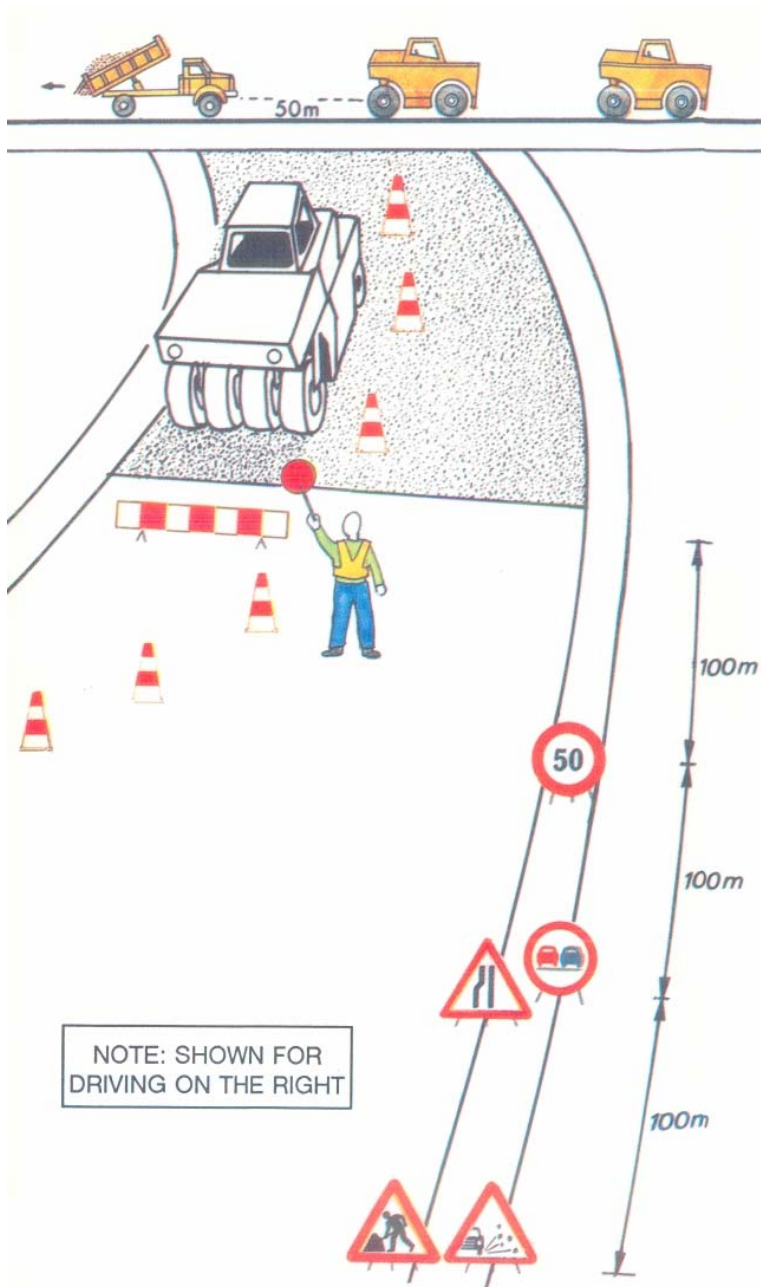
Any adjustments to gritting width are made by opening or closing the appropriate tailgate flaps. If the sprayed width is wider than the full truck gritting width, then a second gritting truck must follow immediately covering the rest of the binder.

The distribution of the clippings is started immediately after the application of the binder such that the distance between the binder distributor and the gritting truck never exceeds 75 metres (preferably 30 metres).

Following the initial passage of the gritting truck, check that the complete surface has been covered with aggregate adding additional stone by hand if necessary, and then:

- use brooms to sweep back any aggregate that may have fallen onto the uncovered strip of binder or beyond the edge of the road (j),
- remove the strong paper laid at the beginning and end of the road section being treated (k).

PART B – SURFACE DRESSING (mechanized)



7 Roll the Dressing

Rolling is carried out using two rollers running backwards and forwards at a distance of at least 50 metres from the gritting trucks at speeds of not more than 8 km/hr. A number of passes (usually 5) of the rollers should be made over the complete surface.

When the rolling has been completed, providing it does not rain, the treated section of road is opened to traffic with a 50 km/hr speed limit.

To do this remove:

- the traffic barrier,
- the traffic cones, using vehicle with headlights to warn oncoming traffic and to protect workmen.

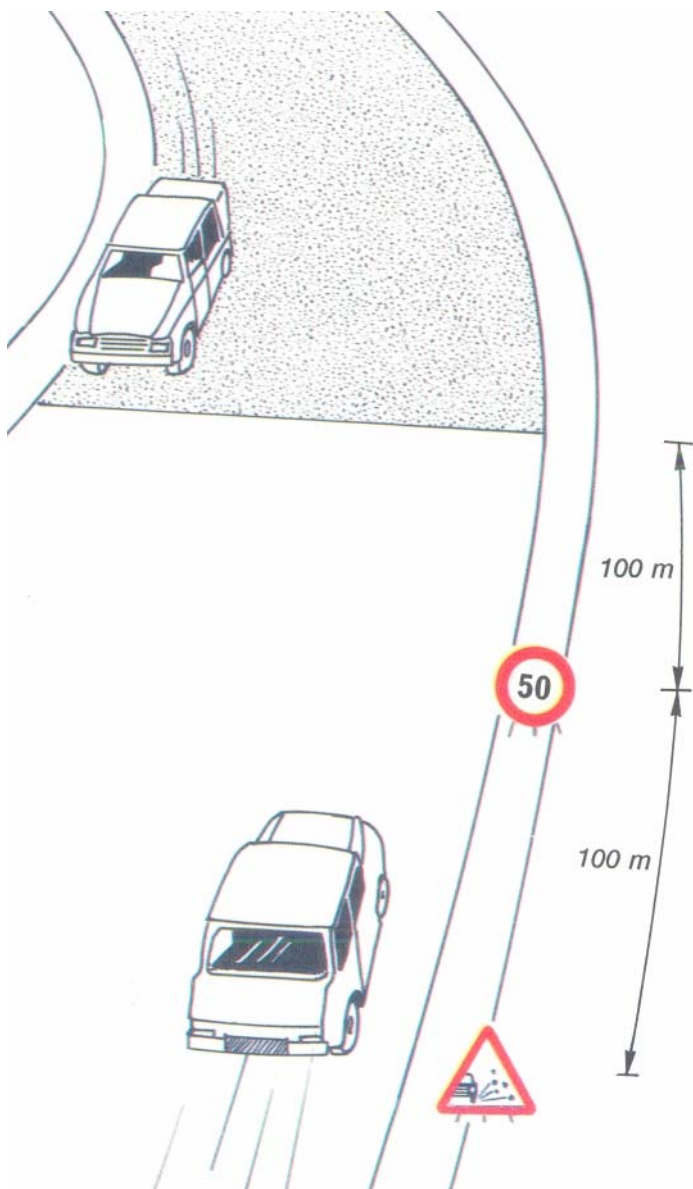
If traffic discipline is poor, convoy vehicles can be used to restrict speed for the first 2 hours.

IMPORTANT NOTE: At the end of the day, the surface dressing must be completed over the whole width of the road section.

All spraying equipment and tools must be thoroughly cleaned at the end of the day.

Spray bars and nozzles should be flushed out with diesel.

PART B – SURFACE DRESSING (mechanized)



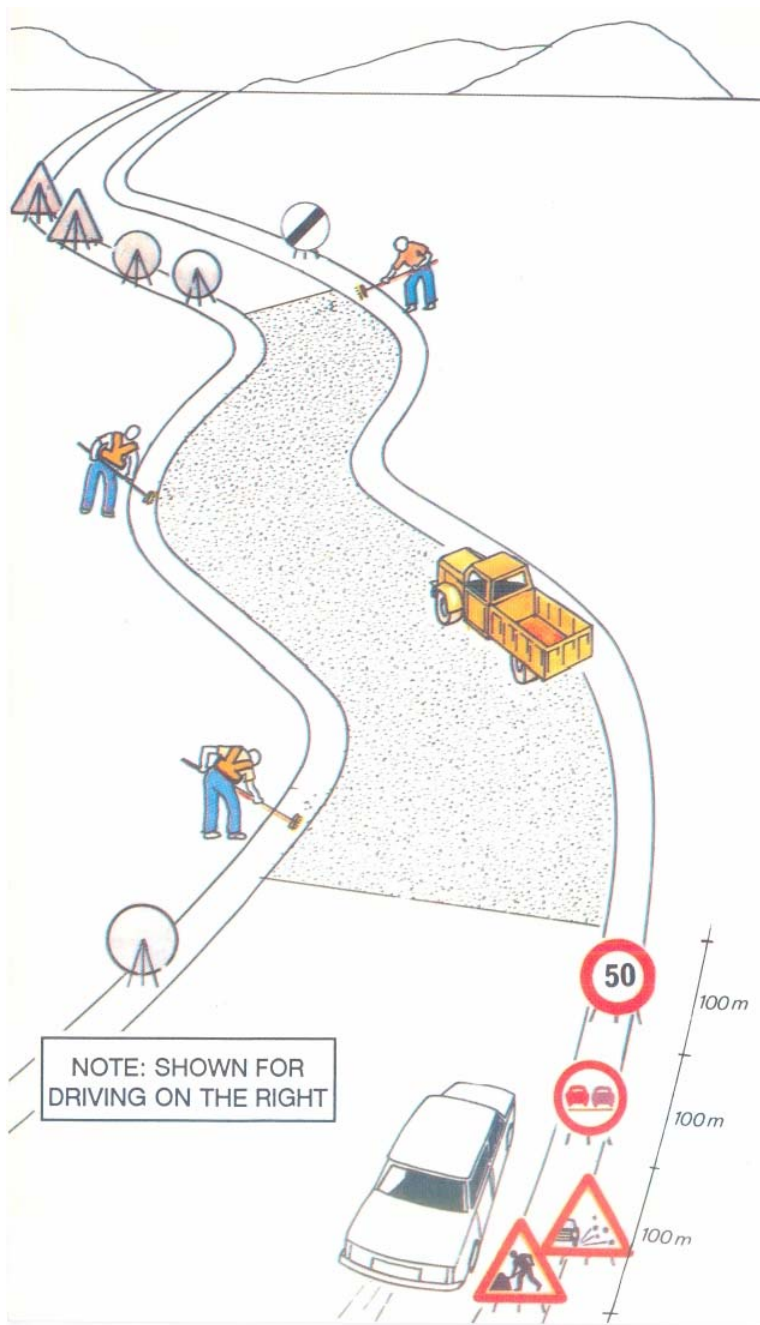
NOTE: SHOWN FOR DRIVING ON THE RIGHT

4.4 COMPLETION AND REMOVAL OF TEMPORARY SIGNPOSTING

The road is left open to traffic at the end of the day leaving the following signs in place at the ends of the treated section of road:

- "50 km/hr Speed Limit" sign,
- "Loose Chippings" sign.

PART B – SURFACE DRESSING (mechanized)



Finishing work is carried out during the week following the application of the surface dressing.

There are four activities required:

1 Place the traffic signs in position

The following traffic signs must be placed on the shoulder for both directions of traffic:

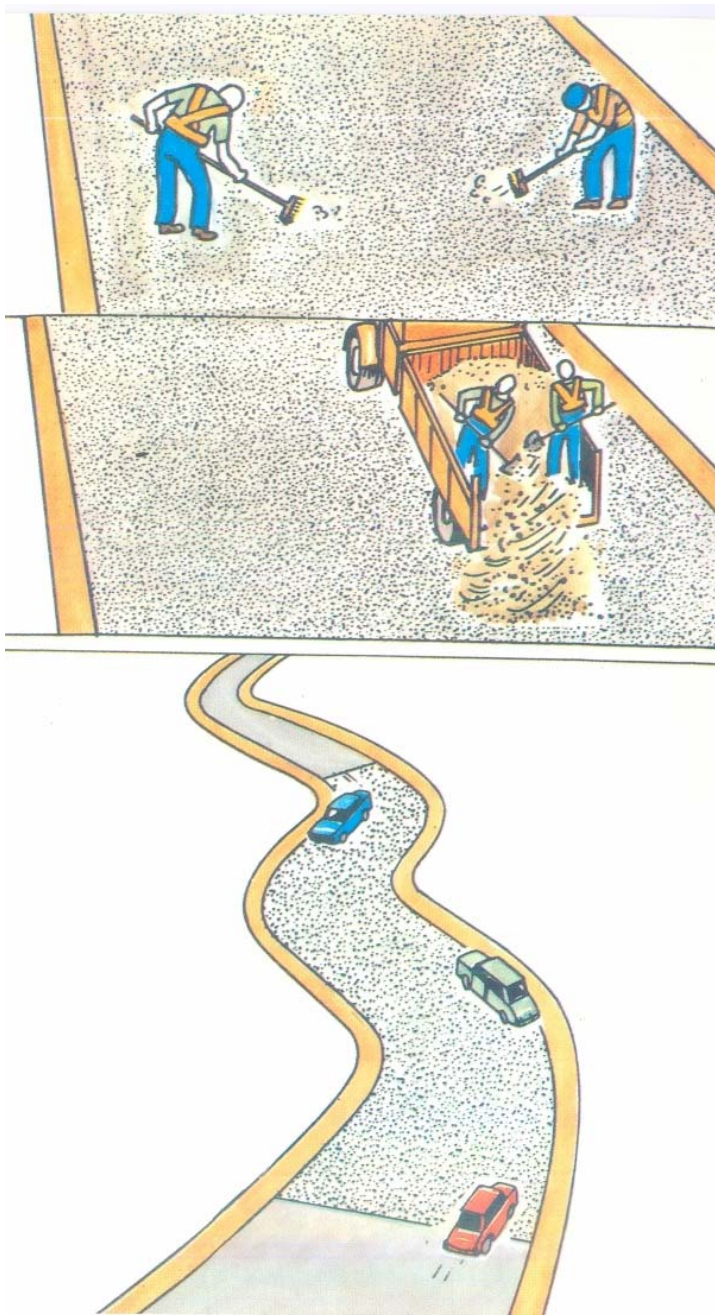
- "Men Working",
- "Loose Chippings",
- "No Overtaking",
- "50 km/hr Speed Limit",

At the end of the roadworks,

- "End of Speed Restriction".

If traffic is heavy, barriers, cones and traffic control should also be used.

PART B – SURFACE DRESSING (mechanized)



2 Remove excess material as soon as possible

Excess chippings are removed by sweeping lightly by hand or with a mechanical broom. If left on the road they can damage vehicles and shatter windscreens.

3 Sand any areas where bleeding^{*} has occurred

This is done by throwing coarse sand over the affected areas (Page III - 51).

4 Remove the traffic signs

All traffic signs are removed on completing the final work.

^{*} See *List of Terms, Volume I*.

TYPICAL WORK REPORT

SURFACE DRESSING

Work Report No : Date:

District: Road No:

Zone: Gang:

Section: from: to :

AGGREGATE STOCKPILE:

Location: Haul Distance:

SURFACE DRESSING:

Length: Width: Area:

WORKING TIME:

From: to: Reason for stoppages:

.....

WEATHER: Sunny ☐ Cloudy ☐ Rain ☐

CHIPPINGS: 2 - 6mm / 4 – 6mm / 6 – 10mm / 10-14mm/

Sources of Supply:

BINDER:

Type: Viscosity: Source:

Temperature: On arrival: On emptying tank:

WORK: Single seal / Double seal / Double Chipping Layer

Rate of Spread: Binder	}	1st layer	kg/m^2
	}	2st layer	kg/m^2
Rate of Spread: Chippings	}	1st layer	kg/m^2
	}	2st layer	kg/m^2

(Separate manpower and equipment reports)

COMMENTS:

Foreman: Date:

4.5 WORK REPORT

The report must be filled in **each day**, detailing:

- the work carried out,
- the resources used.

Part C

**RESEALING
OPTIONS**



1. THE OPTION

Mechanised SURFACE DRESSING, described in Part B, is the most common type of treatment for the PERIODIC MAINTENANCE reseal of a bituminous pavement.

However, in certain circumstances the maintenance needs or available resources make other reseal options more appropriate.

These options are:

- LABOUR BASED SURFACE DRESSING
- FOG SPRAY*
- SLURRY SEAL*

Although the planning, procedures and safety requirements for these alternative treatments are similar to those for SURFACE DRESSING, this Part of the Handbook describes the principal differences.

For all common arrangements, such as traffic and safety measures, refer to Part B.

* See *List of Terms, Volume I*.



2. LABOUR BASED SURFACE DRESSING

In remote locations, for limited areas (such as shoulders) or when the specialist equipment is too expensive or is not available, surface dressing may be carried out by labour based methods. The quality of work will be just as good as by mechanised methods if the works are properly managed.

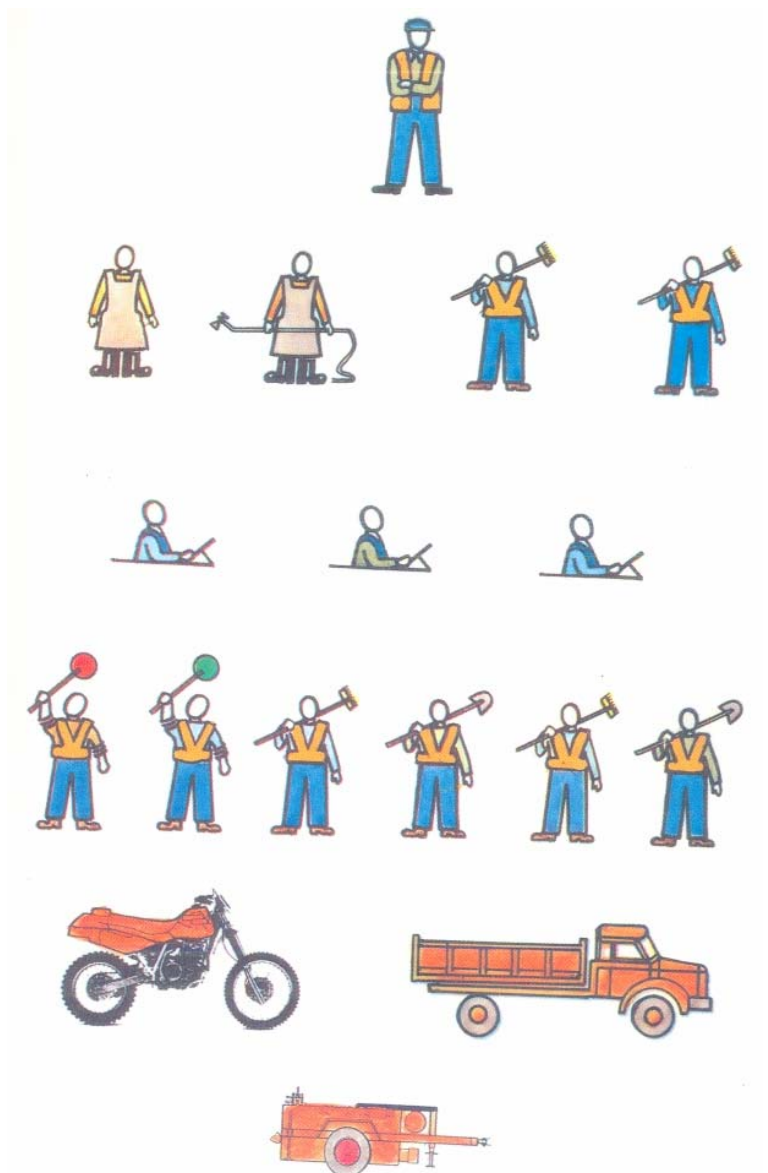
Labour based surface dressing may be carried out using bitumen emulsion or cut back bitumen. Materials specifications are the same as for mechanised surface dressing.

The activities that need particular attention are:

- heating and temperature control of the bitumen when cut back bitumen is used.
- applying the bitumen at the correct rate of spread.
- complete coverage of the binder by the chippings before the binder cools/breaks.

Up to 800 m² per day of labour based surface dressing can be achieved by one crew.

PART C – RESEALING OPTIONS



2.1 RESOURCES REQUIRED

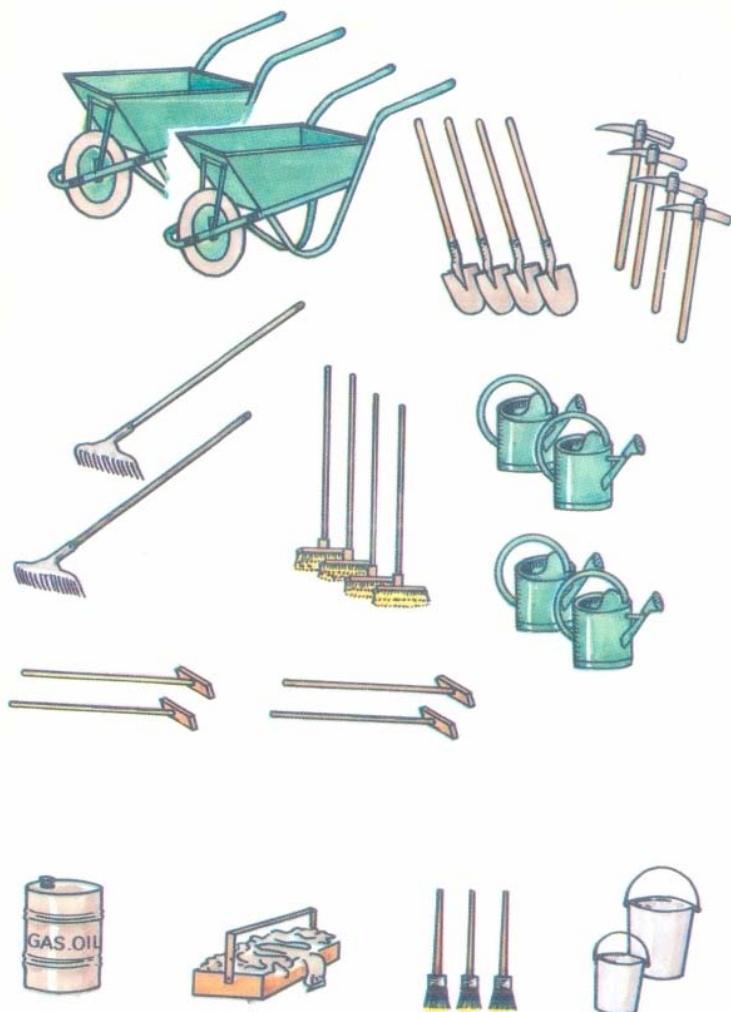
▪ Personnel

- 1 foreman,
- 1 bitumen heater operator,
- 1 - 2 bitumen layers/spray lance operators, - 2 squeegee operators,
- 3 drivers,
- 2 traffic controllers,
- 4-6 workmen.

▪ Plant and Tools

- 1 bitumen heater and towing/carrying vehicle,
- 1 spray lance if available,
- 1 truck for transporting aggregates,
- 1 light vehicle for supervision and general duties,
- 1 bitumen thermometer.

PART C – RESEALING OPTIONS

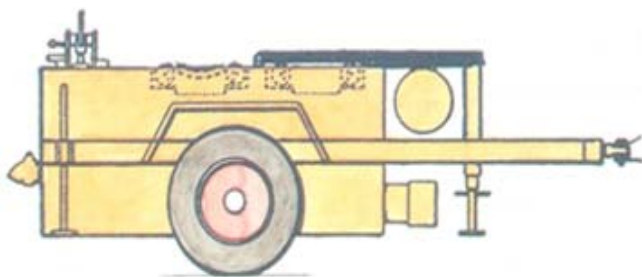


- **Small Items of Equipment**

- 2 wheel barrows,
- 4 shovels,
- 4 pickaxes,
- 2 rakes,
- 4 brooms,
- 4 watering cans or other bitumen dispensers,
- 4 squeegees.

- **Tools and Supplies**

- 1 drum of diesel oil for use in cleaning the tools and equipment,
- rags, number of paint brushes,
- 2 metal buckets,
- chalk, or paint for marking,
- stringlines.



2.2 HEATING THE BINDER

(for cut back bitumen)

The binder will normally be delivered to site in drums. It should be decanted into a suitable bitumen heater which may be:

- towed,
- static, or
- vehicle mounted.

The heating may be carried out by:

- diesel burners,
- wood,
- coal or other fuel.

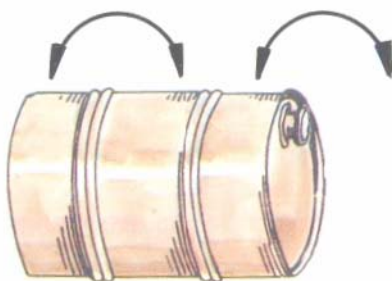
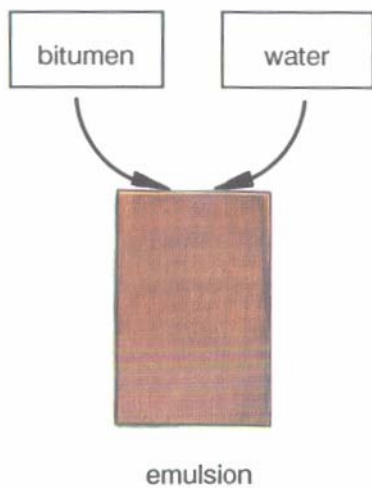
If necessary the specified amount of diesel should be added to achieve the required viscosity of cutback.

Care must be taken to ensure that the materials:

- are well mixed,
- are not overheated.

It is IMPORTANT to use a bitumen thermometer.

Bitumen application temperature ranges are shown on Page III - 143.



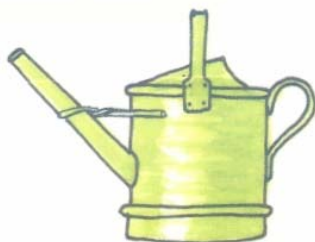
2.3 USING BITUMEN EMULSION

If bitumen emulsion is used as the binder it will not normally require heating*.

Emulsions consist of bitumen droplets mixed with water in such a way that, when applied, the water evaporates leaving the bitumen to "break" and to perform as a normal penetration grade. The choice of emulsions should be made with regard to the type of stone being used and reference to the suppliers.

It should be noted that bitumen emulsions have a limited storage life. They should normally be used within 6 months of purchase. Drums should be rolled to mix the contents thoroughly before use.

* Cationic emulsion will need to be heated.



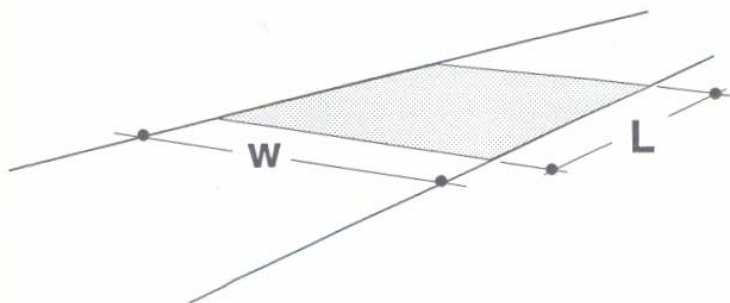
Volume: **V** litres

Width of area: **W** metres

Rate of spread: **r** l/m²

Then,

$$\mathbf{L = \text{Length of Area(m)} = \frac{V}{w \times r}}$$



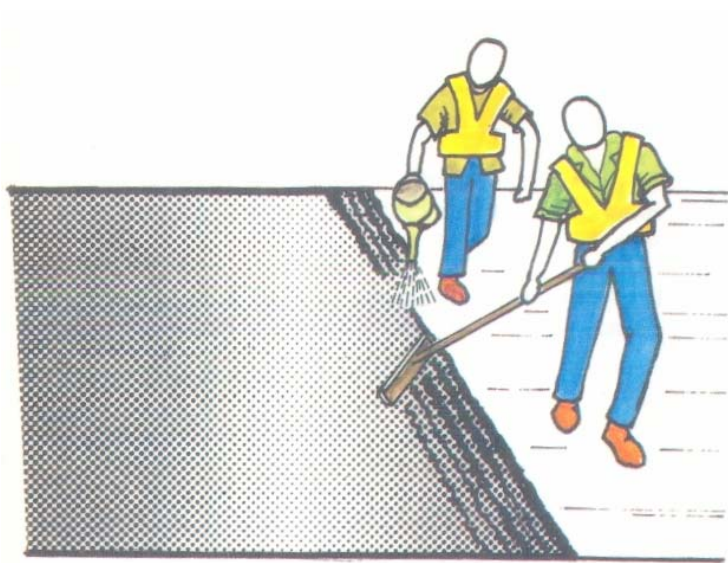
2.4 SETTING OUT THE WORK

Robust containers, such as watering cans, must be used for carrying and applying the hot cut back or emulsion to the road surface. Each container must have a fixed volume mark of known quantity.

The area of road to be covered by one container can be calculated using the specified rate of spread of binder.

To achieve the length of road to be covered by one container divide the volume by the width of road to be sealed and the rate of spread.

Using stringlines, mark the cleaned area of the road surface with chalk for each container of binder.



2.5 APPLYING THE BINDER

When the binder has reached the required temperature it is poured into the containers and carefully carried to the placement site^{*}.

Emulsions will normally be used directly from the drums after thorough mixing.

The binder is poured over the marked area as evenly as possible. The squeegees are used immediately to ensure even distribution.

The personnel handling hot bitumen must be supplied with protective clothing and footwear.

If a hand lance is available this may be used to apply the binder. However practice and skill are required to evenly apply the correct amount of binder.

^{*} *Beware of the build up of cold bitumen on the inside of the containers.*

a



2.6 APPLYING THE CHIPPINGS

The chippings should be applied as soon as possible after the binder is distributed.

This may be done by:

- spreading the chippings by hand from stockpiles previously placed on the road shoulder,
- casting the chippings by hand from the rear of a truck reversing slowly over the previously laid stone.

Care must be taken to ensure as complete a coverage as possible without over applying chippings.

Workmen can follow up with a wheel barrow to top up areas where the chippings are spread too thinly.

The finished work is carefully rolled with the empty chipping truck as soon as the chippings are spread.



3. FOG SPRAY

A fog spray is a very light film of binder which is sprayed onto a "dry" or "hungry" road surface to bind together and hold in place stone particles that otherwise would be picked off by traffic.

Typically a fog spray is used to help retain chippings on a new surface dressing that may be poorly held for some reason, or to enrich the surface of an old lean bituminous surface.

The binder used is normally a bitumen emulsion, which should be sprayed at a rate of 0.7 to 0.9 kg/m² (for a 60 percent emulsion), to achieve a residual bitumen application of 0.4 to 0.6 kg/m².

Where "pick up" of the binder by vehicle tyres is likely to occur, the surface may be blinded with a light sprinkling of fine sand or crusher dust.



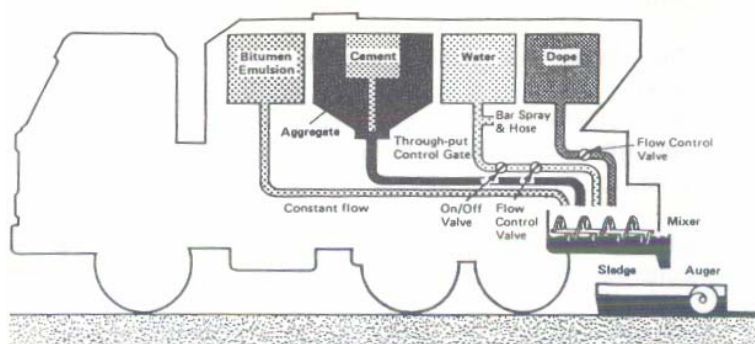
4. SLURRY SEAL

In this process a fine, graded, aggregate is mixed at ambient temperature with water, dope (an additive) and a bitumen emulsion, having a relatively high bitumen content. Some cement is also usually added.

The mixture is applied to the road surface as a freeflowing slurry in a layer 5 mm to 10 mm thick. The mixture penetrates and seals surface voids and cracks very effectively; hence the process is particularly well suited to the maintenance of old bitumen surfaces.

Slurry seals may not resist reflection cracking in asphalt concrete surfacing.

When the emulsion "breaks" an impermeable bitumenrich surface results. The skid resistance of such a surface can be rather low and hence slurry seals are often used as a second treatment on top of a single surface dressing. In this way the tops of the chippings will penetrate through the slurry seal and provide skid resistance. The slurry holds the chippings very securely and provides a durable, impervious and non-skid surface.



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Slurry seal machine; (diagrammatic)

The aggregates used in slurry seals are normally not greater than 6 mm in size but some specifications include material up to 10 mm in size.

Slurry seals can be made with simple, slow breaking, (stable) anionic emulsions in a static mixing plant (such as a cement mixer) and then spread on the road by hand or by simple drag spreaders. However, the normal technique is to use mechanised mixer/spreader units which enable faster breaking cationic emulsions to be used.

These units are self-propelled and have storage capacity for the bitumen emulsion, the aggregate, the cement and water. One machine can spread approximately 8,000 m² of slurry seal per day.

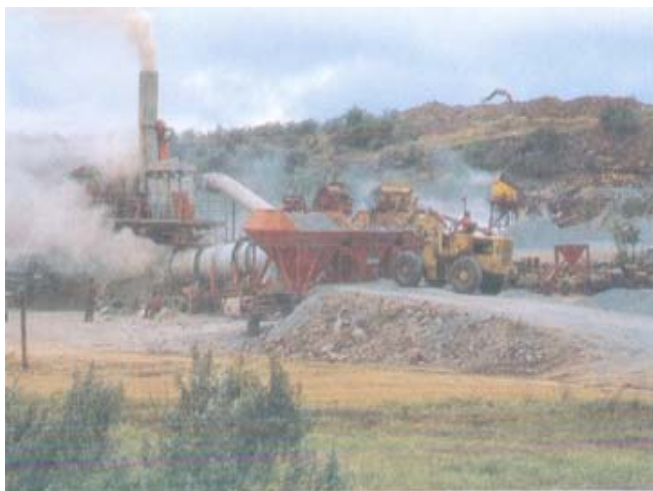
When spread the slurry needs little, if any, compaction and on a busy road, traffic compaction alone will suffice once the emulsion has "broken". On lightly trafficked roads a pneumatic-tyred roller should be used. In heavy traffic, where the road cannot be closed for long, chemical agents may be incorporated in the slurry to control the "break" of the emulsion so that traffic can pass over the new slurry seal within 20 to 30 minutes of laying.

Mechanised slurry sealing is normally carried out by a specialist contractor.

The Road Authority should set a specification for slurry seal mixing and laying.

Part D

THIN OVERLAYS



1. THE TASK

OVERLAYING is normally a PERIODIC MAINTENANCE or IMPROVEMENT activity.

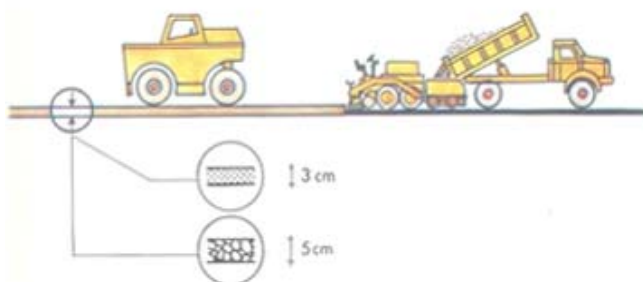
1.1 APPLICATION

- Thin overlays applied over large areas can be used to:
 - fill small surface deformations which are uncomfortable and dangerous to traffic,
 - improve insufficient surface texture which is dangerous for traffic,
 - seal permeable surfaces which allow water to penetrate the base and cause deterioration.
- They are usually more durable than surface dressings.
- Overlays are usually applied to important roads with heavy traffic and high speeds.
- When deformation is severe, the overlay work must be preceded by the levelling of depressions and ruts, and repairs to potholes (Volume III, Part A).
- This work may also be accompanied by the restoration of shoulders and ditches (see Volume I).
- Overlays must be applied during dry weather.



- Thin overlays must NOT be applied to a severely cracked pavement without a detailed pavement investigation.
- Thick overlays (more than 5 cm) which add substantially to the strength of the pavement, require detailed investigation and design, and are outside the scope of this Handbook. However many of the guidelines are also applicable to thick overlays.

NOTE: Overlays work are normally carried out by contract.



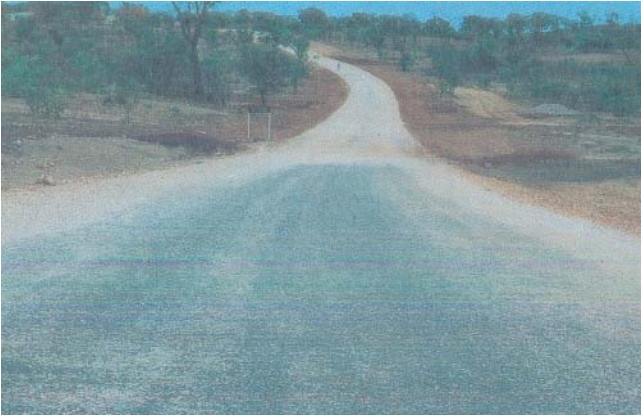
1.2 DIFFERENT TYPES OF THIN OVERLAY

- Overlays always consist of hot plant mixed bitumen coated aggregate and a bituminous binder.

Thin overlay types are: (Aggregate size):

- 0/5 bituminous mortars
 - 0/6 to 0/12 bituminous macadams
 - 0/6 to 0/12 bituminous concretes
-
- They are spread by a paving machine in a single layer of maximum thickness:
 - 3 cm for bituminous mortars,
 - 5 cm for bituminous macadams and bituminous (asphaltic) concretes.
-
- Plant mixes are sometimes known as asphalts^{*}.

^{*} See *List of Terms, Volume I*.



2. DEFECTS

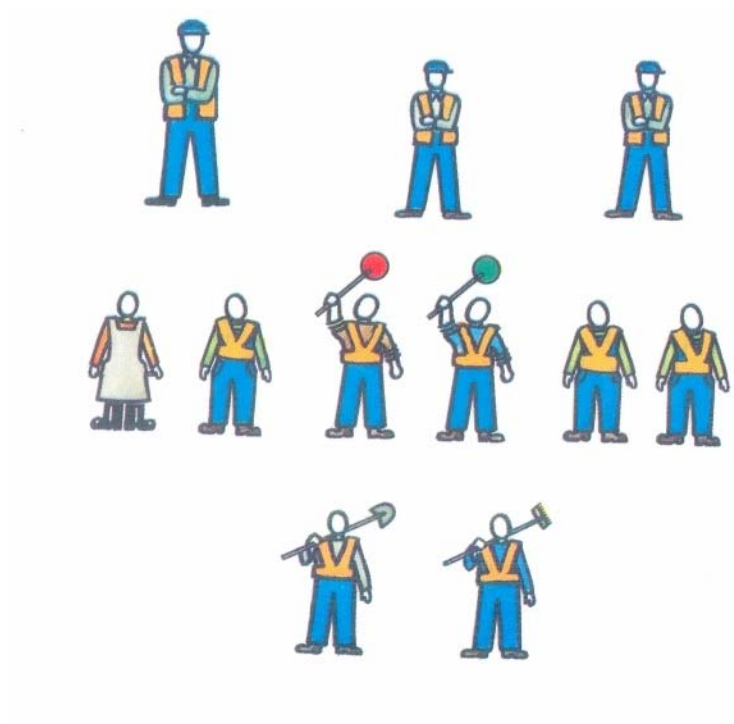
Defects requiring thin overlay treatment generally involve fairly large areas.

These defects can concern:

- the surface:
 - wear (glazing*, cracking*, streaking*),
 - surfacing failure (cracking),
 - excess binder (bleeding*).
- the pavement structure:
 - minor deformation (0 - 10 mm).

* See *List of Terms, Volume I*.

PART D – THIN OVERLAYS



3. RESOURCES

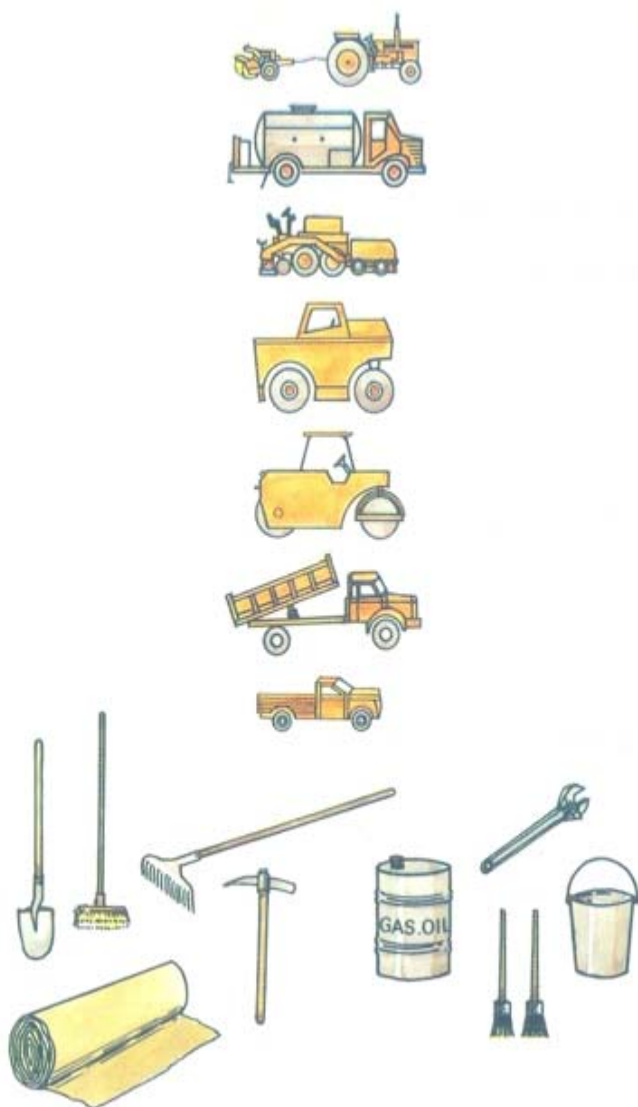
3.1 PERSONNEL

- **Site Work**

- 1 foreman,
- 1 overseer for traffic control,
- 1 overseer for the works,
- 1 spray bar operator,
- 1 paver attendant,
- 2 traffic controllers,
- 2 labourers for spreading,
- 2 labourers for finishing.

- **Plant Operators and Drivers**

- 1 mechanical broom operator,
- 1 bitumen distributor driver,
- 1 paver operator,
- 1 steel wheel roller operator,
- 1 rubber tyred roller operator,
- 1 driver for each tipper truck,
- 1 night watchman,
- 1 light vehicle driver.



3.2 PLANT AND TOOLS

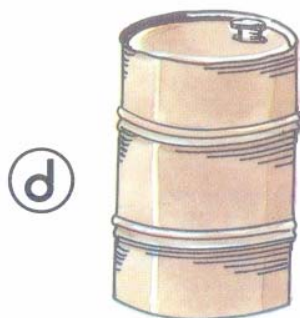
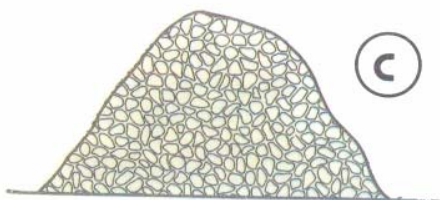
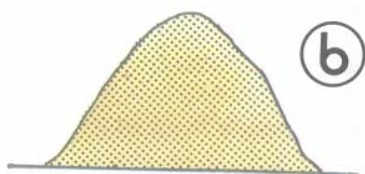
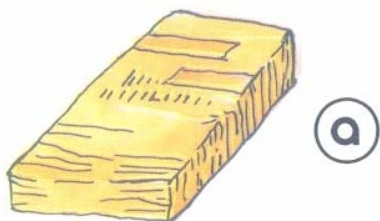
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3.3 MATERIALS

It is important to be aware of the:

- materials used for producing the plant mix,
- different types of plant mix,
- binder content,
- materials required for the application.



MATERIALS USED FOR PRODUCING THE PLANT MIX

These are:

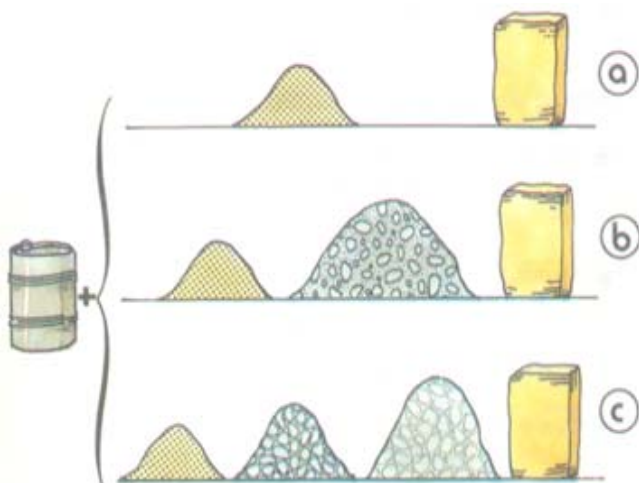
- aggregates constituting the "mineral framework",
- bituminous binder.

Aggregates (fines, sands, stone)

- **Fines** (or fillers) (a) mineral powders from sound rock. A fraction of the fines can consist of cement or lime in certain cases.
- **Sands (b):**
 - fine (dune, sea, river or pit sand),
 - coarse (most often from crushing).
- **Stone (c)** crushed hard rock sieved to conform to a grading in the following range: retained on a 2, 4 or 6 mm sieve and passing an 8, 10 or 12 mm sieve.

Bituminous binder

A penetration grade bitumen (d): usually one of 80/100, 60/70 or 40/50. 60/70 bitumen is usually preferred however 80/100 is more commonly available.



DIFFERENT TYPES OF PLANT MIX

There are three broad classes of mixes:

- bituminous mortars (a)
- bituminous macadams (b)
- bituminous concretes (c)

Bituminous mortars consist of a mixture of:

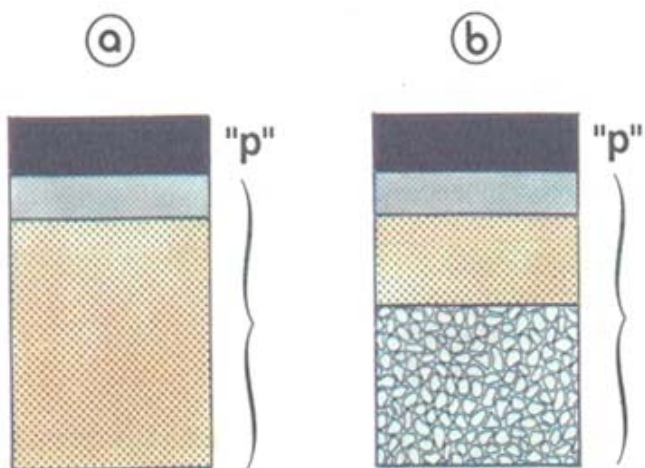
- fines (or fillers),
- one or more sands,
- bituminous binder.

Bituminous macadams and bituminous concrete comprise in addition, one or more sizes of stone.

Bituminous concretes are surfacings of the highest quality and meeting the strictest specifications.

NOTES:

- *The thickness of the overlay must not be less than 2.5 cm, and should be at least 1.5 times the maximum stones size*
- *Bituminous macadams may be either dense or open mixtures*



BINDER CONTENT

The binder content of the plant mix is given by

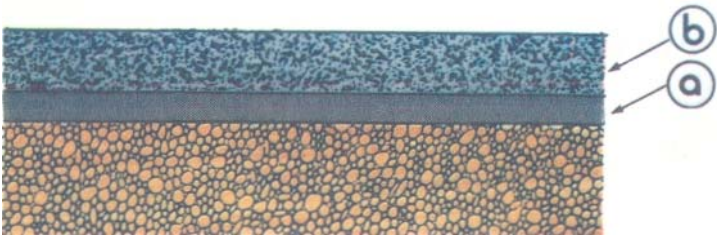
$$p = \frac{\text{weight of bitumen} \times 100}{\text{total weight of mix}}$$

This varies for each mix type with:

- the fines content,
- the grading.

Binder contents are given below:

Type of Plant Mix	Binder Content "p"
▪ bituminous mortar (a)	6-10%
▪ bituminous macadam: (b) dense open	4-7% 4-5%
▪ bituminous concrete: (b)	5-8%



TACK COAT

BINDER	CLASS (p.111 - 117)	TYPICAL RATES OF SPREAD
CUT BACK BITUMEN	50/100 - 150/200 400/600 - 100/250	0.1 kg/m ² TO 0.4 kg/m ²
- MEDIUM CURING		
- RAPID CURING		
COAL TAR	RT4 TO RT9	
BITUMEN EMULSION	65 TO 70 %	

MATERIALS REQUIRED FOR THE APPLICATION

▪ **Tack Coat (a)**

The binder to be employed may consist of:

- a rapid or medium cut back bitumen (hot),
- a tar (hot),
- a rapid breaking bitumen emulsion (hot or cold)*.

The amount of binder to be used depends on the condition of the surface.

The main types of binder together with the average rates of spread are listed in the table opposite.

▪ **Plant Mix (b)**

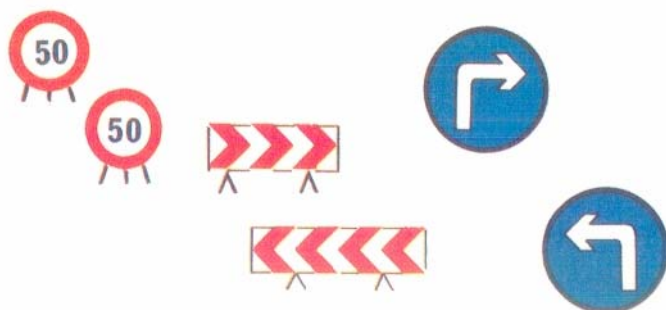
* Cationic emulsion will need to be heated.



a



b



3.4 SIGNS AND SAFETY EQUIPMENT

Apply the recommendations of Part B (Pages III - 121 and III - 123) with the following amendment:

- Traffic Control Equipment
(the "Loose Chippings" sign is not needed for this operation).

TYPICAL WORKSHEET

THIN OVERLAYS

Worksheet No : Date:

District: Road No:

Zone: Gang:

Section from km: to km: width.....m.

PREPARATORY WORK:Potholes ☐ Depressions ☐ Edge damage ☐**TRACK COAT:**Binder: Rate of spread:kg/m²**OVERLAY:**

Binder:

Aggregate:

Coverage:kg/m²

Nominal thickness:cm

Minimum laying temperature:°C

LOCATION OF MIXING PLANT:

Haul distance: Time:

TRANSPORT: Truck:t

4. MAINTENANCE METHODS

It is essential to properly plan, prepare and organise overlay activities to achieve successful results.

4.1 PRELIMINARY TASKS

There are four preparation activities:

1 Refer to the Work Sheet

This contains all the information needed to plan and organise the work.

PART D – THIN OVERLAYS



2 Equipment Check

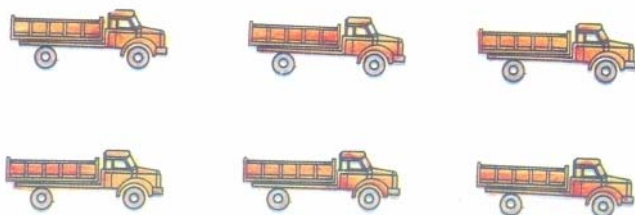
One week before start of the work a check should be made to ensure:

- that all the equipment required is available and in good working order,

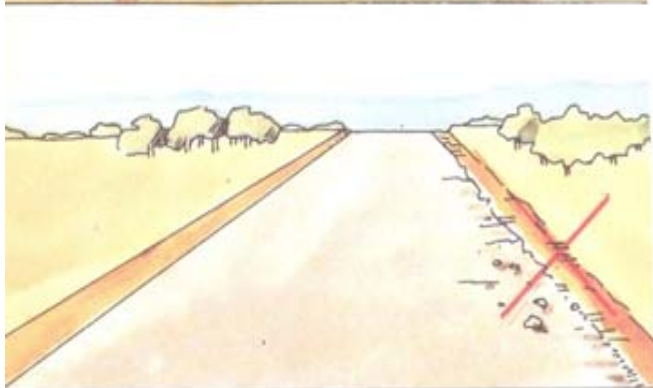
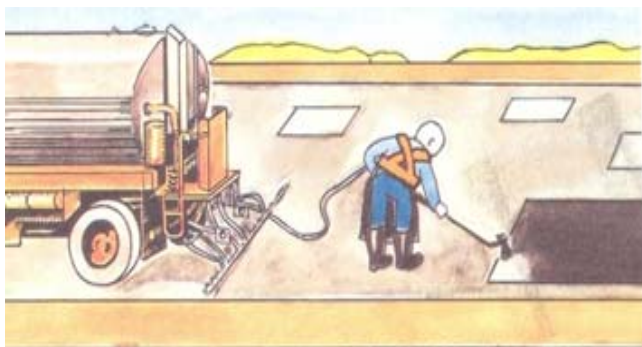
- that arrangements have been made for fuel for the equipment, and its maintenance,

- that all personnel are available (Page III - 201),

PART D – THIN OVERLAYS



- that hand tools and traffic signs are available,
- that there is sufficient transport for the premixed materials, to ensure a continuous laying operation.



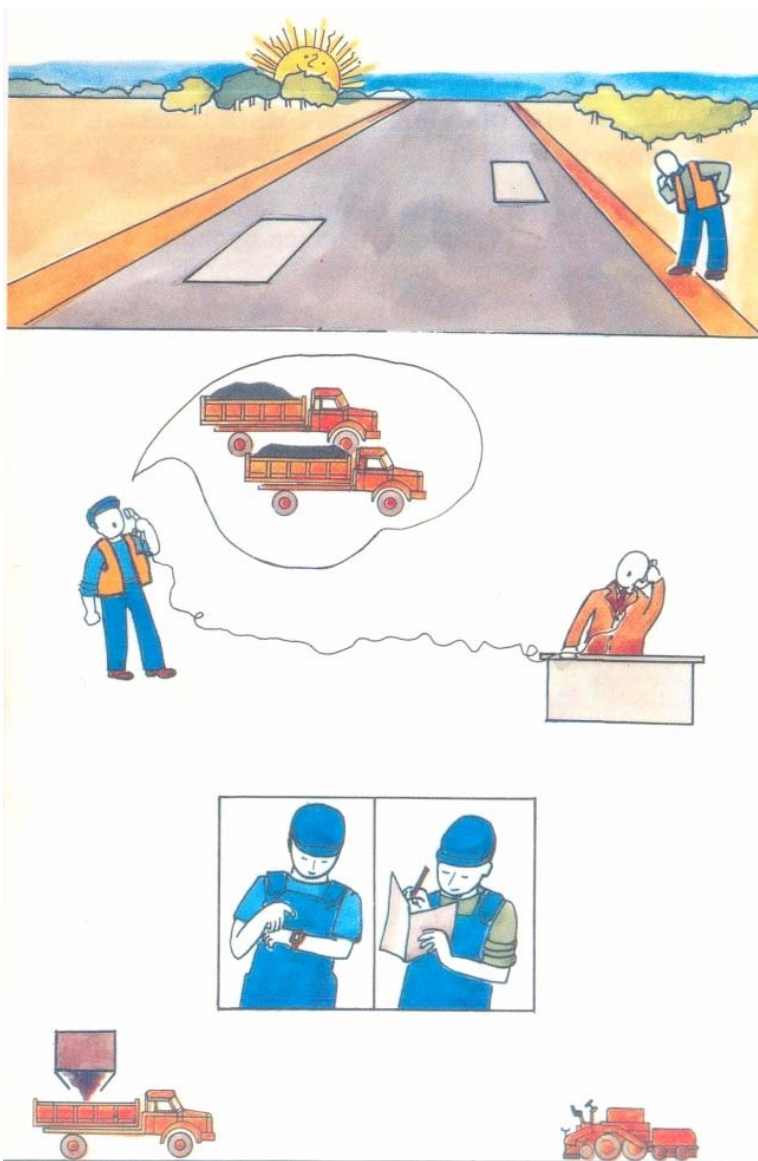
3 Check that the preparatory work has been properly carried out

The success of the thin overlay depends on the preparation of the existing surface by the routine maintenance gang (see Part A).

One week before the overlay the following must be checked:

- that all potholes have been repaired (see Part A),
 - that road edges have been repaired (see Part A).
-
- that the existing surface is clean and free of dirt, or other debris that would affect the bond of the new surfacing (clean it if necessary).

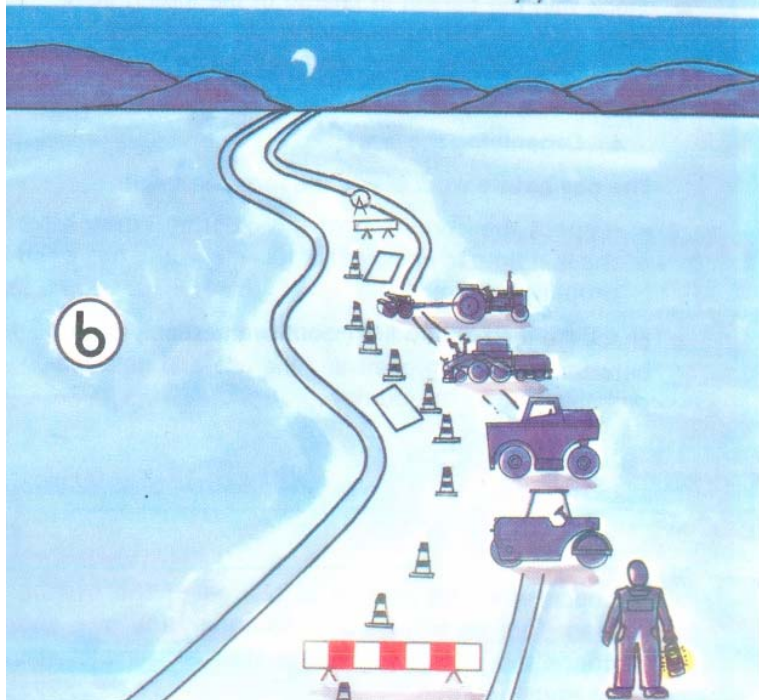
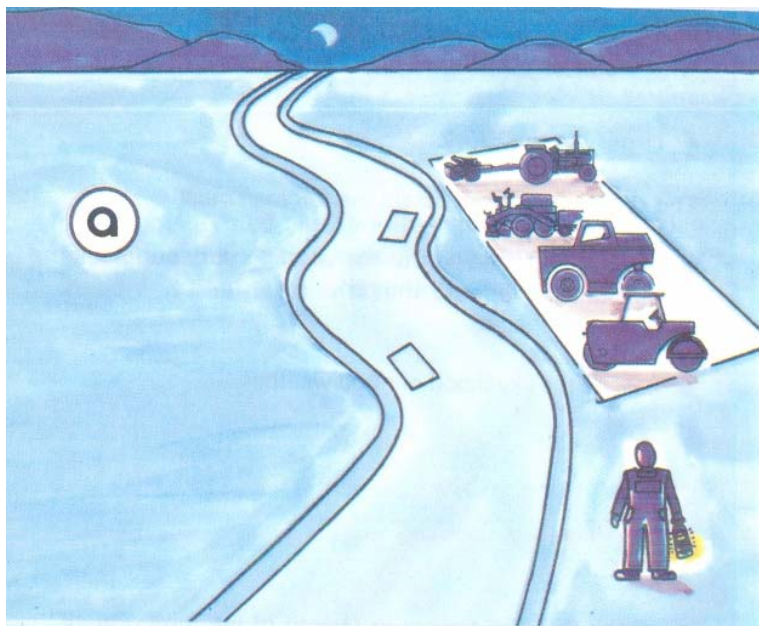
PART D – THIN OVERLAYS



4 Organise the Work

The day before work starts the foreman must:

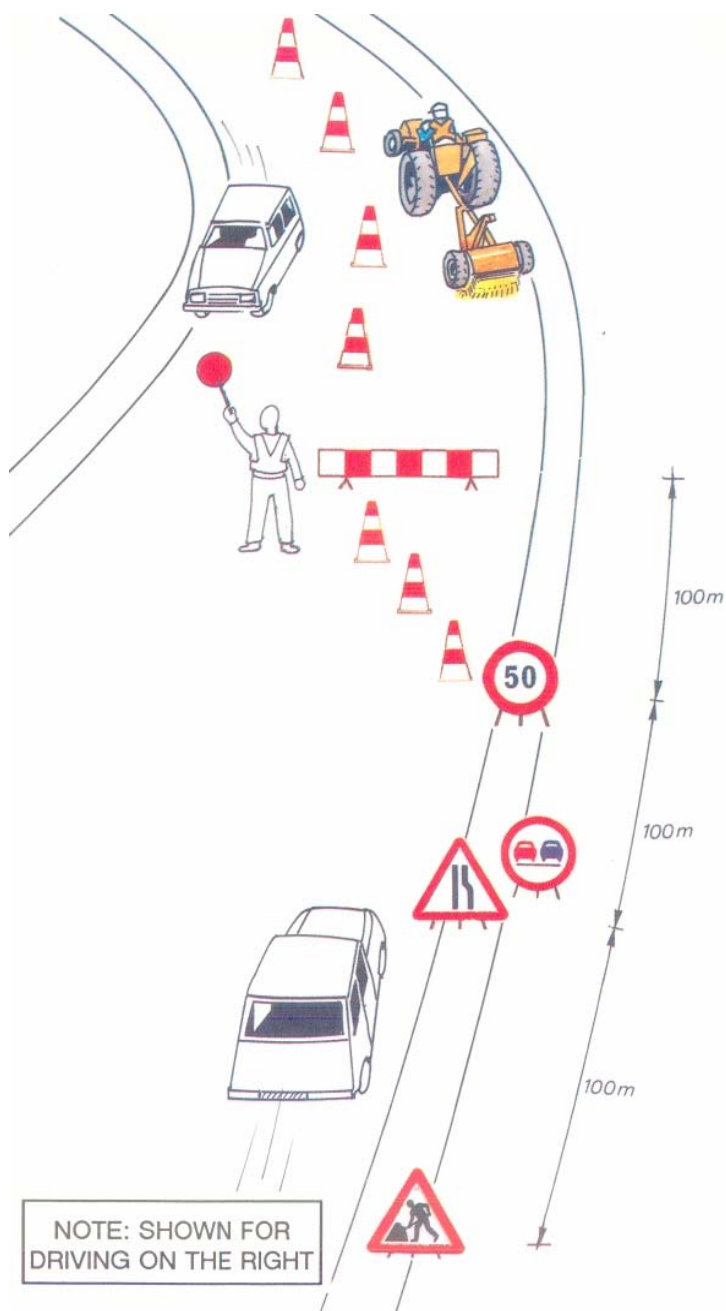
- inspect the condition of the existing surface for the last time to ensure that it is clean and has been properly repaired.
- assess the likelihood of good weather.
- check with the person in charge of the mixing plant that he will be able to supply the site and check the timetable for the start and end of the mixing operation.
- check the route that will be used by the supply trucks between the mixing plant and the site and note the probable time for the journey.



- send to the site:
 - the mechanical broom,
 - the paver finisher,
 - the rubber tyred roller,
 - the steel wheeled roller (and ensure a water supply for it),
 - signs and safety equipment.

- arrange a night watchman for the equipment that is left overnight and ensure that correct traffic signs are erected to safeguard any equipment left on the road. Equipment can be left:
 - off the road (**a**) - this is preferable as it is safer for both the road users and the equipment,
 - at the roadside (**b**), **ONLY** if proper warning signs are provided (Page III - 229).

PART D – THIN OVERLAYS



4.2 TEMPORARY SIGNPOSTING

Traffic signs conforming to the regulations must be correctly placed before starting any work. This is to ensure the safety:

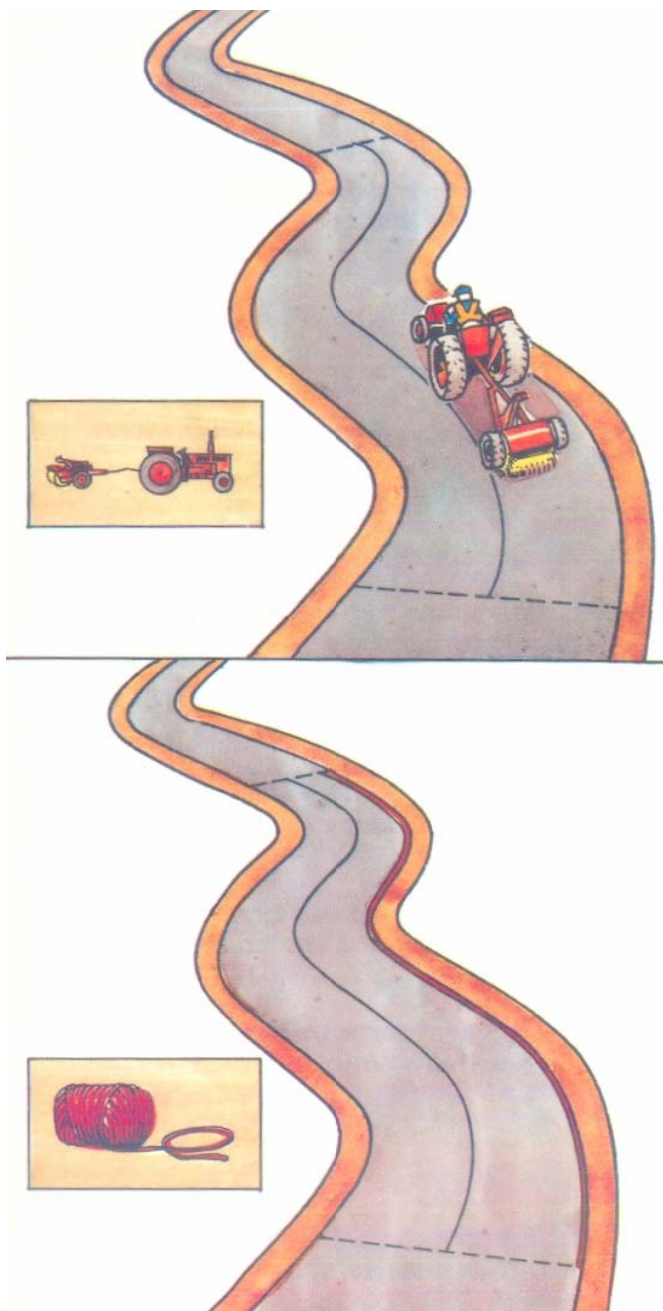
- of the road users,
- of the personnel working on the site,
- of the vehicles and equipment to be used on the site.

The traffic signs must be located:

- ahead of the worksite (in both traffic directions) to give advance warning of danger,
- along the length of the roadworks to protect the site from traffic when it is not possible to build a diversion,
- at the end of the roadworks as an indication that there is no further restriction.

Details of signs to be used and their locations are given in Part B, Pages III - 136 to 139. The "Loose Chippings" signs are not required.

Flashing warning lights must be used if any part of the carriageway is closed off overnight.



4.3 EXECUTION OF THE WORK

Overlays are generally laid over half the width of the carriageway at a time.

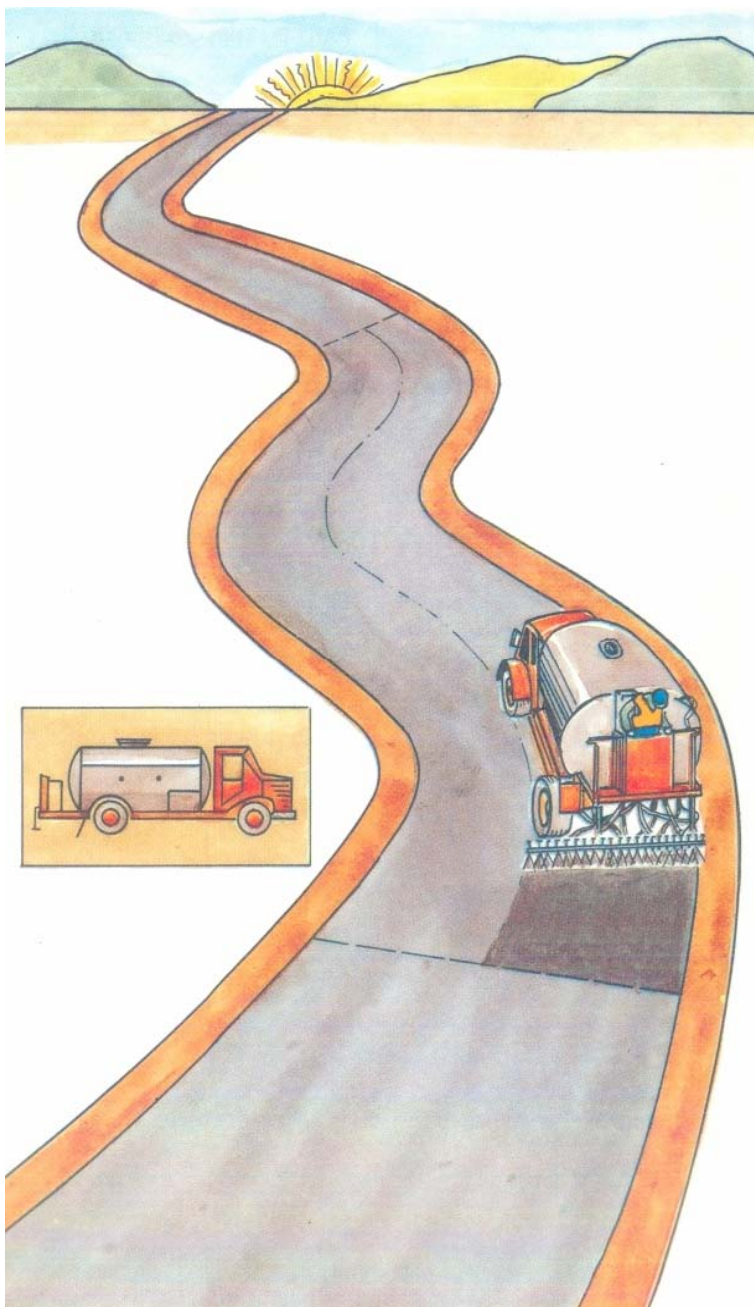
There are eight steps:

1 Sweep the Surface

So that it is perfectly clean before laying the tack coat.

2 Mark the Carriageway

A stringline is run along the edge of the carriageway where work starts to ensure good alignment of the edge of the tack coat.



3 Apply the Tack Coat

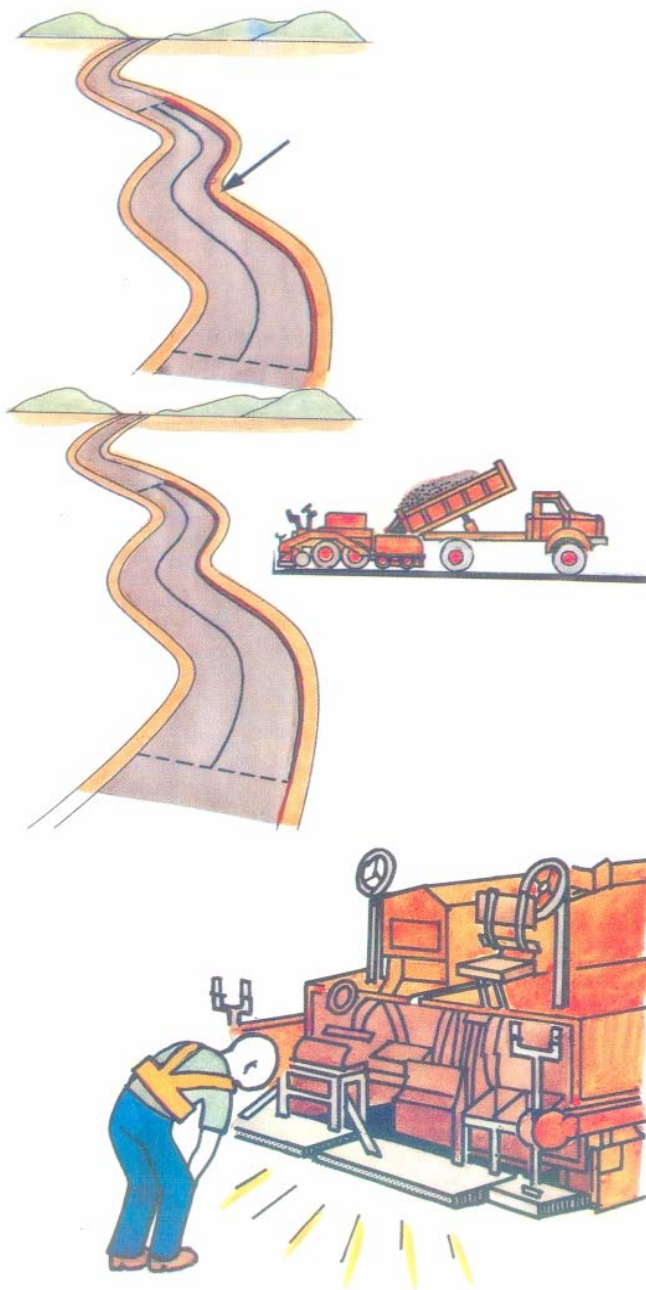
Making sure that the carriageway is dry, use the distributor to spray half the width of the road observing all the precautions and provisions described on Pages III - 141 to 151.

Working from the rate of spread specified in the work sheet, inform the distributor driver of the speed to be observed.

If a vehicle mounted bitumen distributor is not available the tack coat may be applied by hand as described in Part C.

NOTE: The overlay material should not be placed too soon after the tack coat, as this will prevent the break of the emulsion or evaporation of the cutting agent in the cut back.

Traffic must not be allowed to drive on the tack coat.



4 Set up the guide system for the paver

The paver works with its adjusting screws set so that the material can be placed in a layer of constant thickness.

It follows the stringline at the edge of the first half of the carriageway.

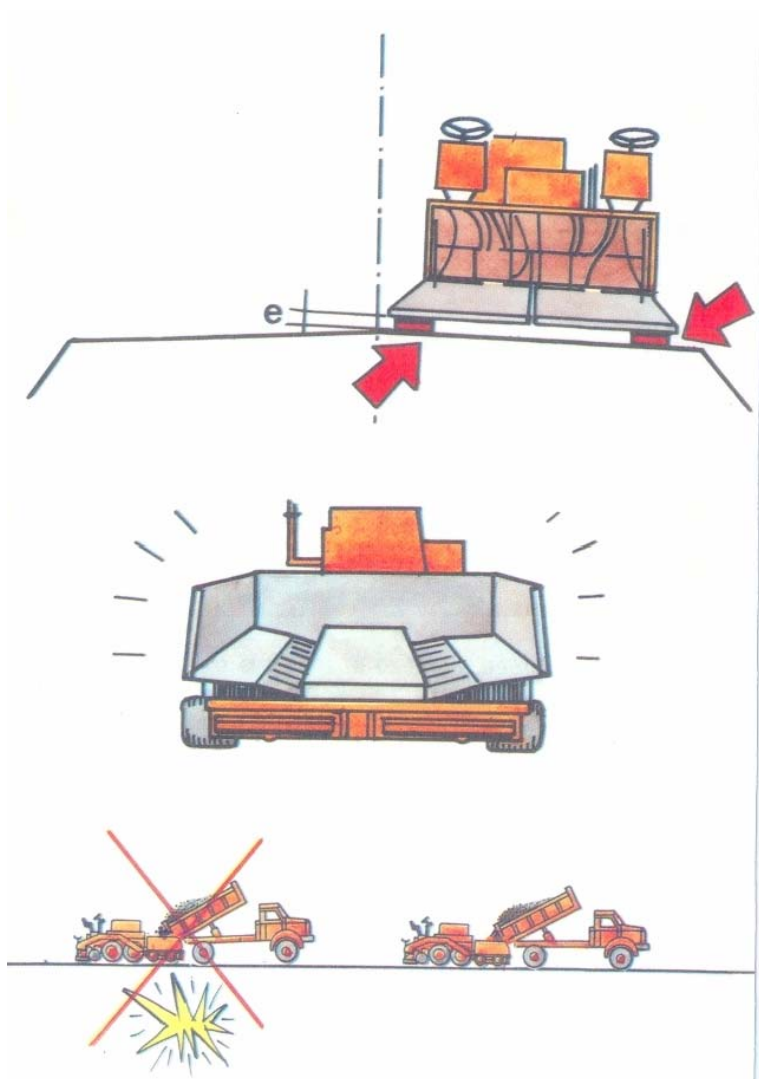
5 Prepare the equipment

The paver is set up to spread the plant mix over half the width of the carriageway.

The paver finisher:

Check the screed plate^{*} to ensure it is clean to avoid defects in the surfacing. It must also be heated so that the material does not stick at the start of spreading,

^{*} See *List of Terms, Volume I*.



adjust the height of the screed plate by placing spacer blocks of thickness "e",

ensure that the hopper* of the paver is clean, dry and contains no cold material.

6 Placing the mix

In the case of rain, work must be stopped.

When the tipper trucks are backing onto the paver, care must be taken that they do not bump it,

* See *List of Terms, Volume I*.

PART D – THIN OVERLAYS



ensure that the material is not spilled whilst the hopper is being filled,

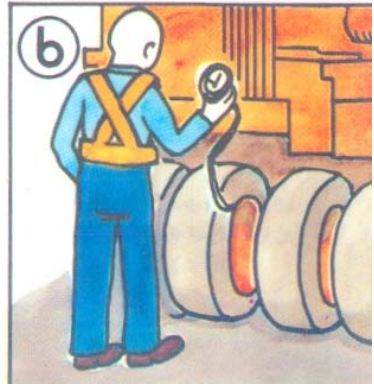
place the truck's gear lever in neutral so that it can be pushed by the paver until its body is empty,

ensure that in addition to the tipper truck supplying the paver, the next truck is waiting so that the paver can work continuously.

When an emulsion tack coat is used the mix must not be laid before the emulsion breaks.

PART D – THIN OVERLAYS

BINDER	(°C) MINIMUM PLACING TEMPERATURE
BITUMEN 80/100	125
BITUMEN 60/70	130
BITUMEN 40/50	135



The temperature of mix:

The table opposite shows the minimum temperature of the mix (in the hopper) when it is laid.

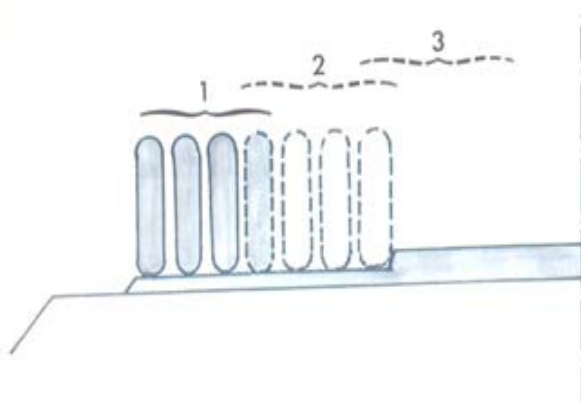
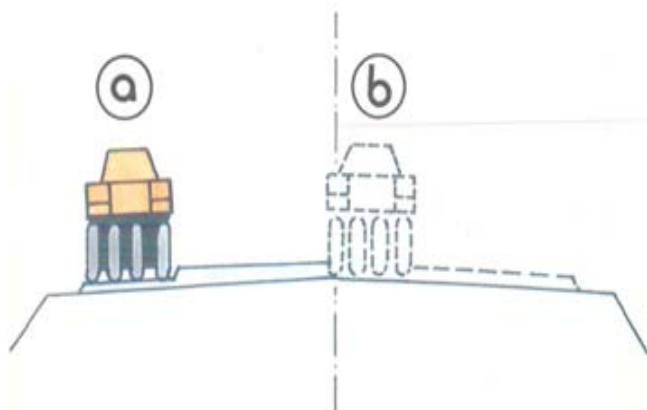
Check mat thickness:

Check the thickness of the uncompacted mat regularly with a probe and adjust the paver screed plates if necessary.

7 Compaction

Initial compaction is carried out with the rubber tired roller (see Note Page III - 247). Using this machine it is important to:

- check that the tyres are clean to avoid picking up the asphalt from the surface **(a)**,
- check the tyre pressures which must all be the same and equal to 6 kg/cm² when warm **(b)**.



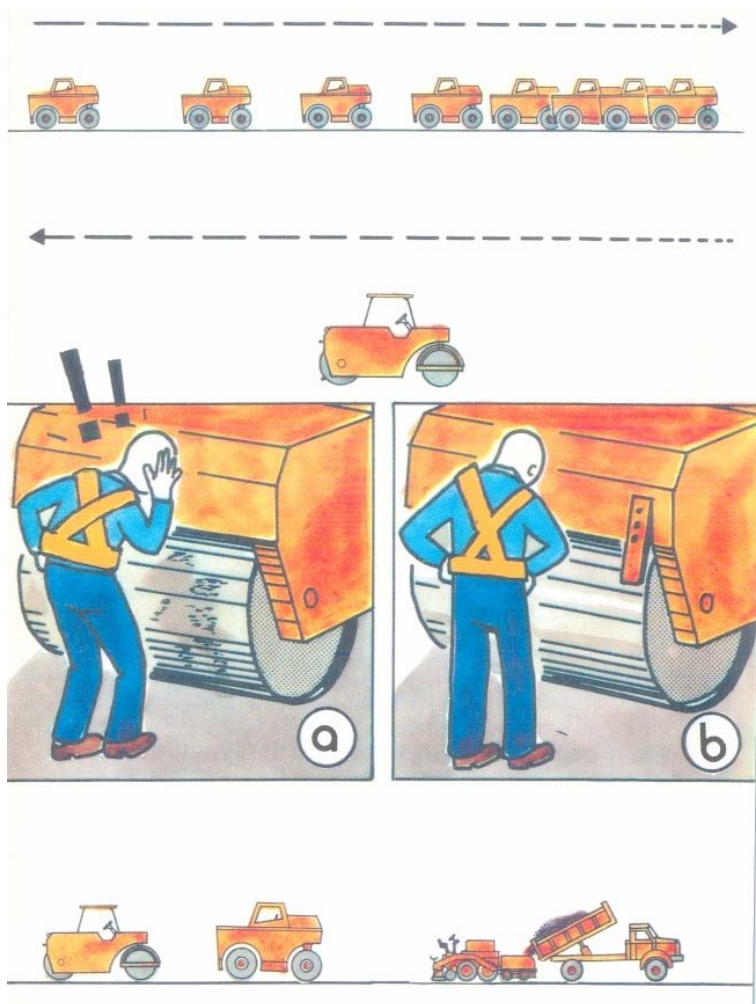
For good compaction, the roller must:

- work as close to the paver as possible,
- be operated with its driven wheels closest to the paver.

Make parallel passes beginning:

- for the first half of the carriageway at the edge (a),
- for the second half of the carriageway at the centre line (b).

Each compacted strip must partially overlap the preceding one.



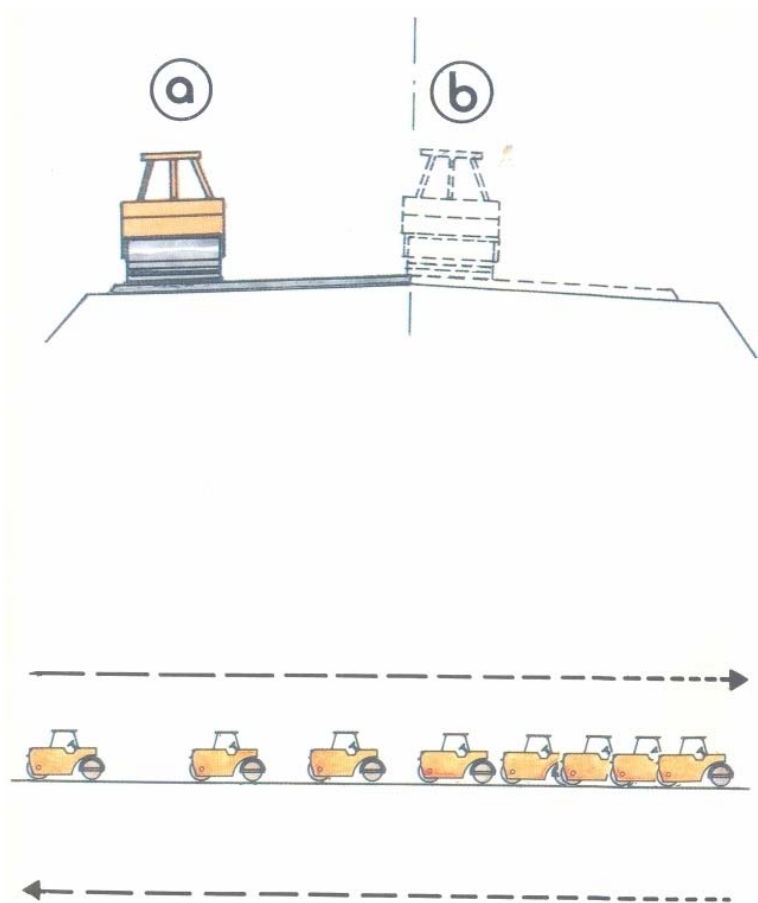
At the end of a pass, speed is gradually reduced so that the roller can reverse without jerking.

The second stage of compaction, is carried out with a 6-8 tonne steel wheel roller (see Note Page III - 247). When using this machine:

- check that the rollers are clean to avoid marking the surface **(a)**,
- ensure that the spray system contains water and is in working order **(b)**.

For good compaction, the roller must work:

- as close as possible to the rubber tyred roller,



- make parallel passes beginning:

for the first half of the carriageway at the edge **(a)**,
for the second half of the carriageway at the centre line **(b)**.

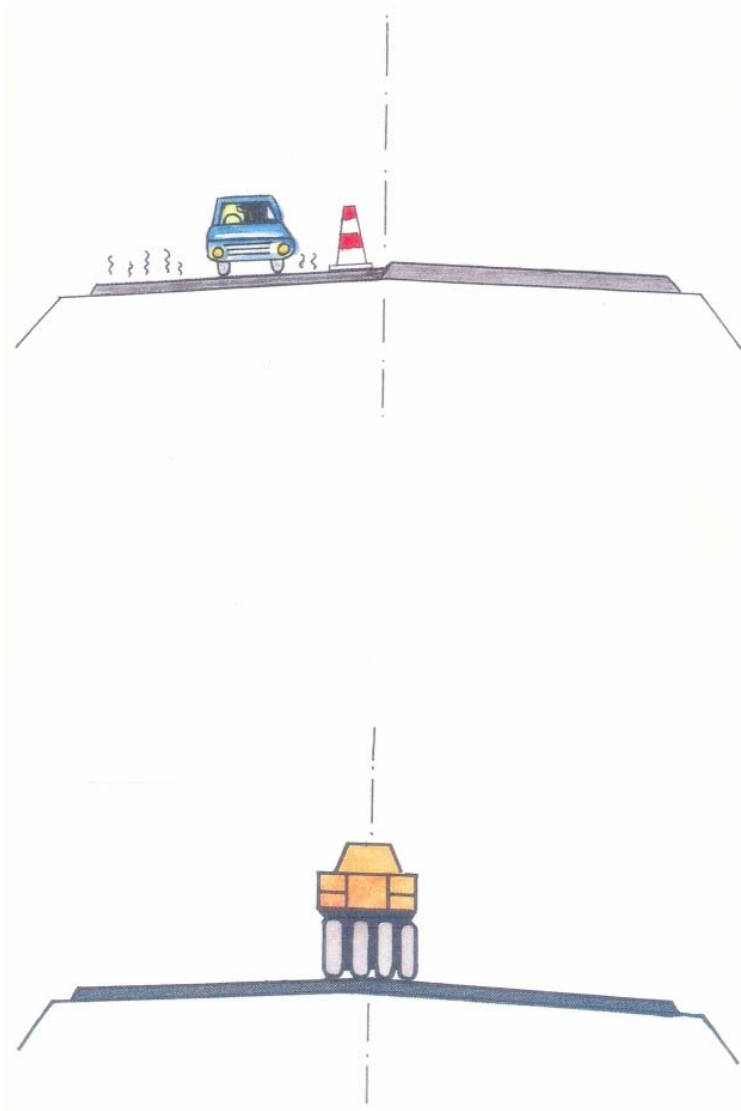
At the end of each pass, speed is gradually reduced so that the roller can reverse without jerking.

Compaction must be completed before the material cools too much.

NOTE: For each roller, the number of passes needed depends on the type of material and the thickness of the layer: the number will be determined by the engineer.

However all traces left by the rubber tyred roller must be removed by the steel wheel roller.

Compaction trials should be carried out at the start of each overlay job.



8 Jointing

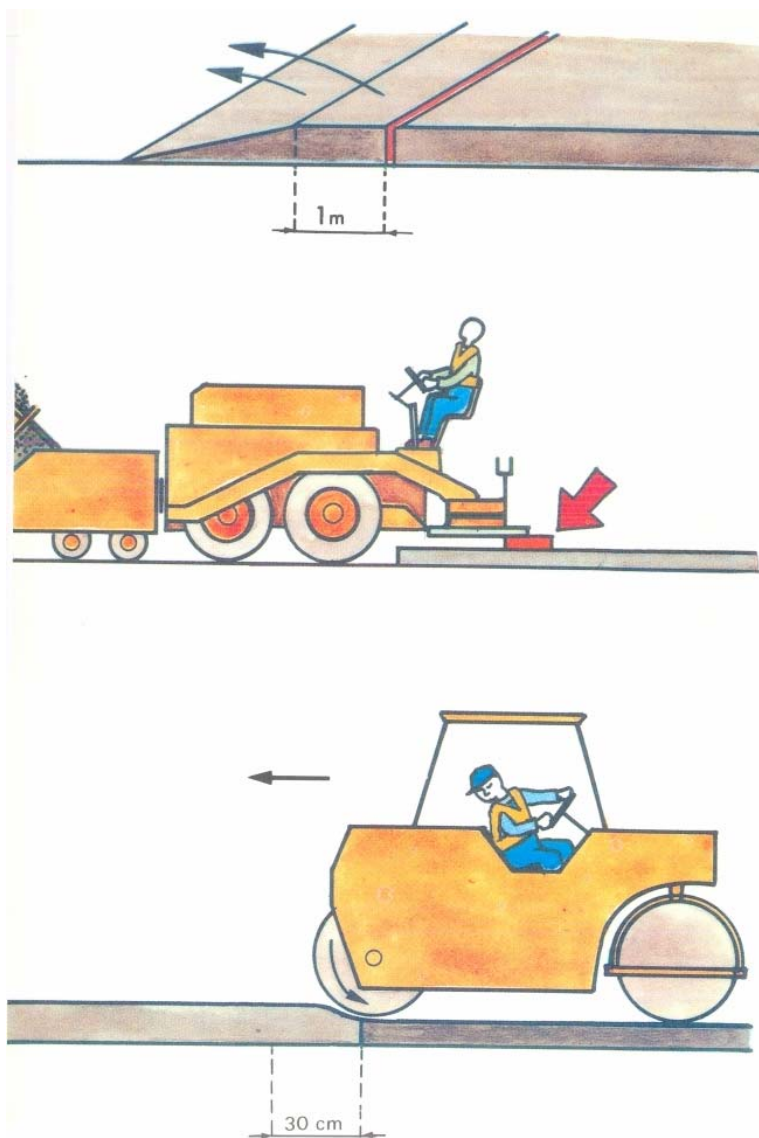
Joints should be made with care. A joint will affect:

- the impermeability of the surface,
- the durability of the overlay,
- the finished appearance and roughness of the road.

▪ The longitudinal joint

The correct procedure is as follows:

- spread the material on the second half of the carriageway while the material on the first half is still hot,
- rake back in a straight line any excess material spilled on the first half of the road when laying material on the second half,
- compact the second half of the carriageway covering the whole joint area.



▪ **The transverse joint***

The correct procedure is as follows:

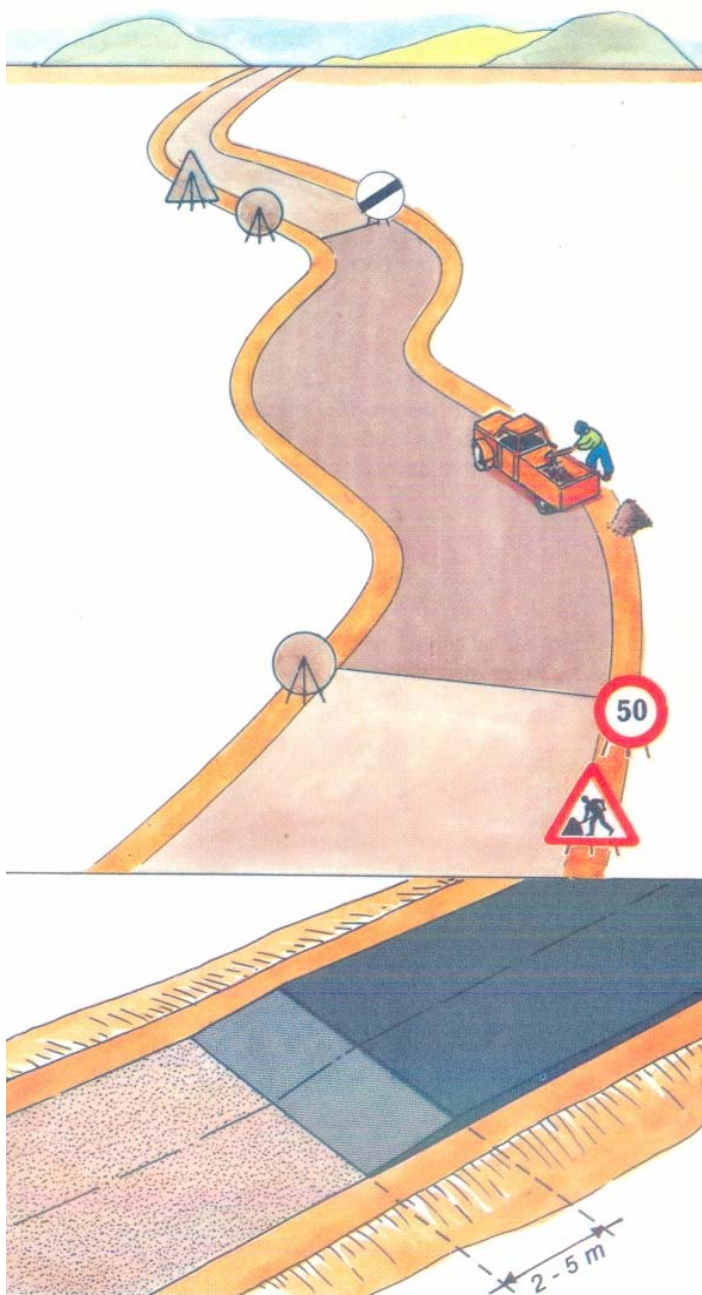
- remove a strip of compacted material about 1 metre wide with a neat vertical cut,
- before restarting work, place a block of equal thickness to the amount of compaction settlement between the screed plate and the compacted surface,
- compact the joint over a length of 30-40 cm with the steel wheeled roller, working backwards.

9 Checks

- the transverse slope is checked using a straight edge and spirit level,
- the other material tests should be carried out by the laboratory technicians.

* See *List of Terms, Volume I.*

PART D – THIN OVERLAYS



4.4 COMPLETION AND REMOVAL OF TEMPORARY SIGNS

As soon as the overlay has been completed. There are two activities required:

1 Clean the work area

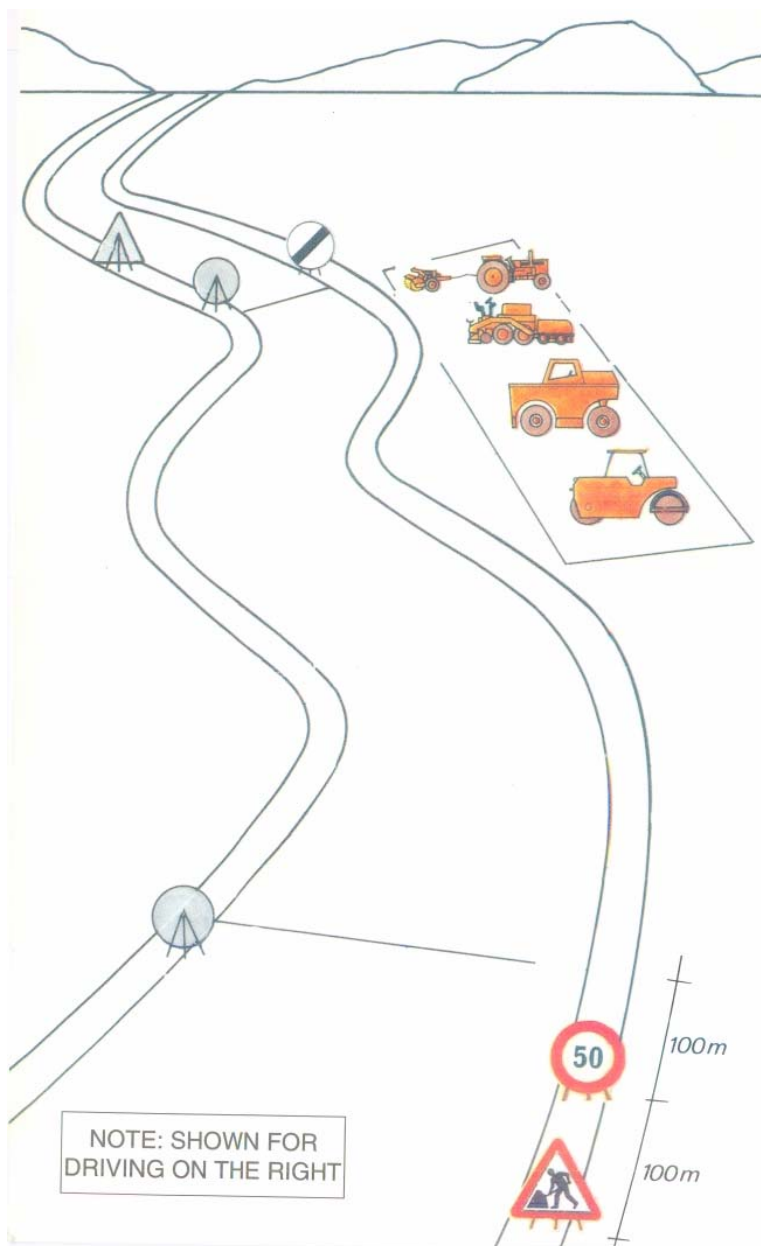
Each day before moving the traffic signs, it is necessary to remove all excess material left over after making the transverse joints.

2 Provide Ramps

Where the overlay will be used by traffic between workdays, temporary ramps must be provided at the end of each day's work. This is done by tapering out the overlay mat over a distance of 10-20 cm. These ramps must be cut back to a transverse joint (see Page III - 250) before work restarts.

At the completion of the works, the overlay must be smoothly run into the existing road surface by excavating the existing surface and replacing it with overlay premix material over a length of 2-5 metres.

PART D – THIN OVERLAYS



- **At the end of each day**, the road is opened to traffic, but the following signs must be retained at the ends of the new section:
 - "Men Working" sign,
 - "50 km/hr Speed Limit" sign,
 - "End of Restriction" sign.
- **When all work has finished**, the road is opened to traffic without restriction.

All the signs are then removed in the following order:

- the traffic barriers,
- the traffic cones, using vehicle with headlights to warn oncoming traffic and to protect workmen,
- the two "End of Restriction" signs,
- the two "Speed Limit" signs,
- the two "Road Narrows" signs,
- the two "No Overtaking" signs,
- the two "Men Working" signs.

TYPICAL WORK REPORT

THIN OVERLAYS

Worksheet No : Date:

District: Road No:

Section from km: to km:

TACK COAT:

Binder:

Total Area: mx m =m²

Quantity used: tonnes

Rate of spread: kg/m²

PLANT MIX:

Type:

Total Area: mx m =m²

Quantity used: tonnes

Rate of spread: kg/m²WEATHER: Sunny ☐ Cloudy ☐ Rain ☐

(Separate manpower and equipment report)

COMMENTS:

Foreman: Date:

4.5 WORK REPORT

The report must be filled in each day by the foreman detailing:

- the work carried out,
- the resources used.

[illegible]

User of this Handbook :

NAME :

ADDRESS :

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DATE :

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ACKNOWLEDGEMENTS

The contents of this handbook draw on many sources, past and present, and it would be impossible to acknowledge them all individually. Much of the material is an updating of the UN/ECA Maintenance Handbook for Africa, compiled by experts from France, Germany and the United Kingdom, and published in 1982. Its three volumes encapsulated the broad experience of highway engineers, maintenance managers, consultants and researchers from many different countries.

The present revision was undertaken by Mr R.C. Petts of Intech Associates, in close association with the Overseas Centre of the Transport Research Laboratory. The work was funded by the UK Overseas Development Administration and supported and guided by a subcommittee drawn from the PIARC Committee on Technology Transfer and Development (C3). It benefited from the collective wisdom of that committee and the countries represented within it. These included Australia, Algeria, Belgium, Brazil, Burkino Faso, France, Germany, India, Italy, Morocco, Poland, Portugal, Senegal, Spain, Turkey, the United States of America, the United Kingdom and the World Bank.

On behalf of the subcommittee I would like to record our sincere thanks to all those who contributed, in whatever way, to the production of this second version of the Maintenance Handbook and to making it more valuable to a wider international audience. I am sure it will fulfil its intended purpose of strengthening the capabilities of maintenance workforces and giving them a stronger sense of professional pride in the vital work they are doing.

ACKNOWLEDGEMENTS continued

Any revision of this kind is an ongoing process, and comments or suggestions for further improvements should be made known to the PIARC Central Office at 27 rue Guenegaud, 75006, PARIS, France. Fax: +33 (1) 46 33 84 60.

A handwritten signature in dark ink, appearing to read "J. Stuart Yerrell", with a horizontal line drawn underneath the name.

J. Stuart Yerrell
Chairman, Subcommittee C3-6d

WHAT IS PIARC?

Founded in 1909 following the 1St International Road Congress held in Paris in 1908, the Permanent International Association of Road Congresses (PIARC) is the oldest of the international associations concerned with roads and road engineering.

The general aim of the Association is to improve international cooperation and to foster progress in:

- the formulation of road transport policies,
- the planning, construction, improvement and maintenance of roads,
- the operation and management of road systems,

within the context of wider policies towards transport.

To achieve these aims PIARC:

- organises a World Road Congress every four years and various technically oriented events,
- creates and co-ordinates Committees,
- publishes a number of documents including a periodical bulletin.

It is assisted in its task by National Committees. PIARC is a non political and non-profit association.

It was granted consultative status, category II, to the Economic and Social Council of the United Nations in 1970.

The official languages of PIARC are French and English.

There are several categories of members: Governments, regional authorities, public bodies, collective members and individual members.

As of 1 January 1994, PIARC has 72 member Governments and 2,100 members in 100 countries.

PIARC has strong links with several regional organisations and is in favour of networking between countries dealing with similar questions. PIARC may help to create and/or develop such networks.

PIARC Committees and Working Groups are composed of engineers and experts appointed by member countries. They act on a continuous basis between each Congress and participate in international meetings dealing with subjects within their competence.

On average they hold two plenary meetings a year. As of 1 January 1994, Committees and Working Groups gather approximately 700 engineers and experts from 40 countries.

Thirteen Committees and four Working Groups are active (period 1991 - 1995).

- **COMMITTEES**

- C1 - Technical Committee on Surface Characteristics
- C3 - Committee on Technological Exchanges and Development
- C4 - Committee on Interurban Roads
- C5 - Committee on Road Tunnels
- C6 - Committee on Road Management
- C7 - Technical Committee on Concrete Roads
- C8 - Technical Committee on Flexible Roads
- C9 - Economic and Finance Committee
- C10 - Committee on Urban Areas
- C11 - Committee on Road Bridges
- C12 - Technical Committee on Earthworks, Drainage, Subgrade
- C13 - Committee on Road Safety
- C14 - Committee on the Environment

- **WORKING GROUPS**

- G1 - PIARC Winter Road Congress
- G2 - Natural Disaster Reduction
- G3 - Modern Traffic Control and Management
- G4 - Heavy Freight Vehicle Issues

- **PIARC PUBLICATIONS** - Committees and Working Groups publish synthetic documents, recommendations and state of the art. These documents, intended for decision makers, design and field engineers and researchers, are based on wide international consensus.

- **CONGRESS DOCUMENTS** - The documents published on the occasion of World Road Congresses are an invaluable source of information and experts agree on the fact that they are most interesting and unique.
- **PERIODICAL BULLETIN "Routes/Roads"** - The Association Bulletin was issued for the first time in 1911. It features comprehensive files on road matters in various countries, articles written by members of Committees and Working Groups and news of interest to the world road community. Its issues of a hundred pages are published three to four times a year.
- **TECHNICAL DICTIONARY OF ROAD TERMS AND LEXICON** - The first edition of the **DICTIONARY** was issued in 1931. The sixth edition (French/English) was published in 1990. The Dictionary is published with the financial support of UNESCO and is translated into eighteen languages: Arabic, Chinese, Croatian, Czech, Danish, Dutch, German, Greek, Hungarian, Italian, Japanese, Lithuanian, Polish, Portuguese, Romanian, Russian, Spanish and Slovak. The **Lexicon** contains over

All these documents are published in French and English. PIARC publications catalogue is free of charge and can be ordered through:

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Volume IV : Maintenance of Structures and Traffic
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The Road Maintenance Handbook is also being
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languages are under consideration. For more details,
please contact PIARC Central Office

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