

PERIODIC AND EMERGENT ROAD MAINTENANCE

1. INTRODUCTION

While routine maintenance comprises small-scale works conducted regularly to prevent premature deterioration of the roads, after a certain period of time, the deterioration of the road becomes so much that, the routine maintenance alone will not be sufficient to keep it in a good condition. In order to preserve the pavement structure from excessive damage, larger effort is needed so that the structural as well as functional integrity of the pavement is maintained. Periodic maintenance, which covers activities at regular and relatively longer intervals, typically 5 to 10 years, on a section of road, aims “to preserve the structural integrity of the road”. This interval depends on traffic levels, pavement type and geographical and climatic conditions. The periodic maintenance requires specific identification, planning and budgeting for implementation.

The periodic maintenance covers periodic renewals to the carriageway to ensure that adequate level of serviceability is maintained. If routine maintenance is carried out regularly starting from the time the roads is constructed or rehabilitated, the interval of the periodic maintenance can be prolonged. The work activities involved are normally larger and require more equipment and specialist skills. As a result, this work is considerably costlier and requires more detailed planning. The most common periodic maintenance activities include renewal works such as bituminous overlays, strengthening of pavements and major repairs of damaged drainage structures etc. Periodic renewal may also require a small percentage of surface area for profile correction. Periodic maintenance is often planned over longer time spans, covering several years, thereby designating individual roads in the network due for such works.

2. NEED FOR PERIODIC MAINTENANCE

The need for periodic maintenance depends on the conventional theory of pavement deterioration, manifested by fatigue at the underside of the pavement or structural deformation, and assumes that deflection increases with time and traffic as the pavement deteriorates from traffic induced stresses. The maintenance demand, in case of well-constructed pavement on strong sub-base and base courses, is generated because of surface decay, affecting the service levels of the pavement.



Road carriageway showing a history of routine maintenance, however now due for re-sealing / periodic renewal

Periodic renewals consist of the provision of a surfacing layer over the pavement at regular intervals, so as to preserve the required characteristics of the pavement and offset the wear and tear caused by traffic and weathering. In effect, periodic renewals represent maintenance, which is needed to prevent deterioration of the pavement characteristics and to ensure that initial surface quality is kept up for future requirements of traffic during the design life of the pavement. Early detection and repair of noticeable defects can prevent a major breakdown of the surface. Activities required on a road section during periodic maintenance are normally large scale and include re-gravelling, resealing and resurfacing.

3. PLANNING AND PROGRAMMING OF RENEWALS

Pavement surface evaluation based on surface condition (i.e. cracking, patching), riding quality (i.e. road roughness) and skid resistance would form basis for taking periodic maintenance decisions for which condition survey at fixed frequency is necessary for determining periodic renewal requirements. For this purpose, the condition survey should be conducted for each stretch of the road as frequently as the situation warrants.

The general practice in the country is to prepare proposed annual renewal programmes and submit demand for funds within the budgetary processes. While the term "periodic renewal" suggests that renewal should be at fixed and pre-determined frequency, it would be neither practicable nor desirable to follow any specified frequency without considering the condition of roads. The type and periodicity of the renewal depend upon the type and quality of materials used in the existing pavement, the climate, terrain, and traffic volume and intensity. Renewal priorities and programme should be based on an assessment of road condition through regular inspections and surveys. Special inspections are also necessary before and after the rains to assess the need for patching and other remedial measures required either in advance of or together with the renewal treatment.

4. PERIODIC SURFACE RENEWAL OF SEALED ROADS WITH 20MM THICK PREMIX CARPET

When the condition survey data reveals the need for surface renewal, 20mm thick premix carpet is generally provided, the procedure of which is given below. Prior to laying a surface renewal, clean the existing surface of all dust and cake mud by wire brushes and brooms.

4.1 Preparation of Surface

This Subsection deals with preparing an existing granular or black-topped surface prior to laying a bituminous course.

Methodology

(a) Preparing an existing granular surface

- Remove all loose and extraneous materials and surface cleaned where a granular profile corrective course is to be provided.
- After cleaning, slightly watered for binding.
- Lay the granular course and compact.

- Clean the surface of all compacted granular layers on which a bituminous course is to be laid of all loose material and dust by air jet or wire brushes or other approved means and should be correct to line, level and camber within the tolerances specified for base course.
- After removal of all loose material and dust prime surface with a suitable bituminous primer.

(b) Scarifying an existing bituminous surface

- Where an existing bituminous layer is required to be removed, it should be done by hand picking without causing undue disturbance to the underlying layers. Any underlying material which may have been disturbed should be removed and fresh base material supplemented, if necessary and compacted.
- The compacted granular surface, finished to line, level and cross-slope should be primed as per specified procedure.

(c) Preparing an existing bituminous surface

- Clean the surface of potholes and cracks before laying bituminous treatment.

Pothole and Patch Repairs

- Inspect the existing bituminous surface ensuring the pothole and patch areas made free of any loose, defective material.
- Cut/trim the edges of all potholes using hand tools vertically to form rectangular shape and remove all loose materials.
- Thoroughly clean the excavated surface with wire brush, compressed air or other approved means. Remove all dust and loose materials from site.
- Replace layers below the level of bituminous construction using material of equivalent specification to the original construction and degree of compaction. Fill and compact the layers not more than 10cm per layer by plate rammer/compactor or hand rammer.
- The area of bituminous construction including the sides of excavated position should be primed and/or tacked with an emulsion.
- The bituminous patching material should be either a hot mix or a cold mix, adopting the respective specification. The bituminous mixture, prepared in a plant (or hand mixed on site for cold mix) of suitable capacity should be placed in layers of not more than 100mm (loose) and compacted in layers with plate compactor / pedestrian roller / hand rammer to the desired compaction standard.

Crack Sealing

- In the final layer, spread the mix slightly proud (about 10mm) of the surface so that after compaction, the surface will flush with the adjoining surface.
- Where required, apply a Seal Coat as per the specified procedure. Check the surface levels using a 3m straight edge that there is no depression where water can settle.
- Prior to this treatment, clean the surface thoroughly, preferably with compressed air.
- For fine cracks (less than 3mm in width), seal by Fog Spray to specification using an approved hand-held sprayer.

- For wider cracks (more than 3mm in width), fill with crusher dust or other approved fine material passing 4.75mm sieve to a level about 5mm below the road surface level.
- After sweeping the surface clear of dust, pour into cracks slow setting emulsion, minimizing any spillage. If spillage does occur, apply crusher dust to blot the spillage.
- In isolated areas, with wide cracks, cut and patch as described earlier under pothole and patch repairs.

Profile Corrective Course

- Prepare the surface as explained above.
- Apply tack coat over a primed granular surface or an existing bituminous surface.
- Provide profile corrective course with the specified material, as specified by the engineer-in-charge, and compact to the requirements of the particular specification.
- Correct short sags or depressions in the surface by laying profile corrective course in the form of flat wedges (layers). The thickness of layer at any point should not be more than 100mm. Where more than one layer of the profile corrective course is laid, successive layers should completely extend over and fully cover the underlying layer.

Do's	Don'ts
<ul style="list-style-type: none"> ✓ Remove dust from the surface being prepared by using air jet or other approved means. ✓ Where required, scarify existing bituminous layer carefully without undue disturbance to the underlying layers. ✓ The edges of all potholes should be trimmed/ cut vertically. ✓ In the final layer, the mix should be spread slightly proud of the surface. ✓ After back filling an excavated pothole in layers, ensure the compaction of each layer by a pedestrian roller, a plate compactor or at least a hand rammer. 	<ul style="list-style-type: none"> ✗ Do not lay any bituminous layer without properly preparing the surface. ✗ Do not use a bituminous mixture to fill the portion below the level of bituminous construction while filling a pothole. ✗ Do not allow any spillage of binder on the surface while pouring the binder into wide cracks. ✗ Do not allow traffic over profile correction course.

4.2 Surface Dressing

Methodology

- Design the surface dressing following the guidelines given in IRC 10:2005 to determine the rate of spread of binder and stone chippings for actual conditions covering traffic level, type and size of chippings, existing surface and climate. Get approval for any deviation between the quantities and spread rates as specified in the contract and those as per actual design from the competent authority before making any change during construction.
- Prepare the base on type of surface dressing is to be laid to the specified lines, grade and cross-section as per Sub- section 4.1.
- Apply binder as per approved specification uniformly over the prepared base, with self propelled or towed sprayer.

- Immediately after application of binder, spread clean dry stone aggregate at the specified rate or as designed with the help of a mechanically operated chip spreader, in a single layer. In case of emulsion as a binder, the aggregate may be slightly damp.
- Immediately after spreading of aggregates, roll the surface with suitable rollers starting from the edges and progress towards the centre except in super elevated portions where it shall proceed from the lower edge to the higher edge. Ensure each pass has an overlap of not less than one-third of the track made in the preceding pass and roller marks are eliminated. Spread additional stone chips to make up irregularities, if any. Continue rolling until all aggregate particles are firmly embedded in the bituminous binder and present a uniform closed surface.
- Where two-coat surface dressing is specified, the second coat should be applied after the first coat is exposed to traffic for 2 to 3 weeks. Procedures stated here-in-above will apply. The road may be opened to traffic within 24 hours after the work of rolling is complete. In exceptional circumstances, traffic may be allowed immediately after rolling provided the traffic speed is limited to 20km/h until the following day.
- Where use of pre-coated chips is specified, the stone chips will be heated to 160°C and mixed with 0.75% to 1% of paving bitumen by weight heated to its application temperature. The pre-coated chips shall be cured for one week or until such time as they become non-sticky.

Do's	Don'ts
<ul style="list-style-type: none"> ✓ Ensure correct rate and uniform spread of binder based on field trials. ✓ Add approved anti-stripping agent to binder where aggregate fails to pass the stripping test. Alternatively, use pre-coated chips. ✓ Correct any excessive deposit of bitumen by blotting before spreading the chips. 	<ul style="list-style-type: none"> ✗ Do not carry out work when atmospheric temperature is less than 10°C or when weather is foggy, rainy or windy. ✗ Do not carry out the work on wet surface. ✗ Do not resort to excessive rolling as that may crush the stone chips. ✗ Do not allow traffic to ply on any newly laid surface dressing until the following day except with restricted speed.

4.3 Open graded Premix Surfacing using Bitumen

Methodology

- Prepare the base on which premix carpet is to be laid to the specified lines, grade and cross-section.
- Apply a prime coat followed by tack coat over a granular base preparatory before laying of the carpet.
- The quantities of material required for 20mm thick premix carpet should be as specified.
- Mixing should be thorough to ensure a homogenous mixture. The temperature of bitumen at the time of mixing should be in the range of 150~163°C and that of aggregates 155~163°C, provided that the difference between the temperature of aggregate and the binder should not exceed 14°C. The temperature at the time of discharge of the mixture should be between 130°C and 160°C.

- Locate hot mix plant near the work site. The mixed material shall be transported quickly to the site ok work and laid uniformly by suitable means. The premixed material shall be spread on the road surface with rakes.
- Commence rolling as shown under Sub-section 4.2.
- Correct any high spots or depressions noticed after the roller has passed over the whole area once by removing or adding premixed material and re-compacting.
- Provide a seal coat to the surface immediately after laying the carpet as per details in Sub-section 4.6.
- Generally, the road may be opened to traffic after laying the seal coat with restrictions given in Sub-section 4.6.

Do's	Don'ts
<ul style="list-style-type: none"> ✓ Ensure that aggregates for premix carpet and seal coat conform to the prescribed physical and grading requirements and are clean and dry. ✓ Exercise strict control over mixing and lay in temperatures as per specifications using appropriate thermometers. ✓ Rolling operations should be completed before the temperature of the mix falls below 100°C. 	<ul style="list-style-type: none"> ✗ Do not allow manual mixing. ✗ Do not undertake the work in foggy, rainy, windy weather or when the atmospheric temperature in the shade is less than 10°C or when surface is wet. ✗ Do not allow the premix material to adhere to the roller wheels. Do not use excess water for the purpose. Light sprinkling should do. ✗ Do not allow the roller to stand on newly laid material. ✗ Do not allow any traffic without laying seal coat over the premix carpet.

4.4 Premix Carpet using Bitumen Emulsion

Methodology

- Prepare the base on which premix carpet is to be laid to the specified lines, grade and cross section.
- Apply tack coat over an existing prepared black top surface. The quantities of material required for 20mm thick premix carpet should be as per specification.
- Premix the bitumen emulsion and aggregates in a suitable mixture such as cold mixing plant as per IS: 5435 (Revised) or concrete mixture.
- Spread the premix to the desired thickness, grade, cross fall within 10 minutes of applying the tack coat and ensure that all levelling, raking completed within 20 minutes of the mixing.
- Roll the surface as per methodology described in Sub-section 4.2.
- Provide a seal coat as specified within 4 to 6 hours after laying the premix carpet. Follow Sub-section 4.6 for the work on seal coat.

- Preferably, the road is opened to traffic after 24 hours of laying the seal coat. In single lane roads generally allow traffic after 6 to 8 hours with speed restriction to not more than 16km/h.

Do's	Don'ts
<ul style="list-style-type: none"> ✓ Ensure that the aggregates and binder satisfy the specified requirements. ✓ Before opening the bitumen emulsion drum, roll the drum at slow speed, back and forth at least five times for a distance of about 10m to ensure proper distribution of storage sedimentation. ✓ As far as possible use suitable cold mixing plant. 	<ul style="list-style-type: none"> ✗ Do not allow manual mixing. ✗ Do not undertake work in foggy, rainy, windy weather or when the minimum air temperature is less than 10°C. ✗ Do not allow any traffic unless the emulsion is properly set and the surface has acquired adequate stability.

4.5 Mix Seal Surfacing

Methodology

- Follow the methodology described for open graded premix surfacing using bitumen, except that the quantities of materials shall be as per specification.

Do's and Don'ts

Follow do's and don'ts given for open graded premix surfacing using bitumen. Generally, Mix Seal Surfacing should not be placed directly over WBM base.

4.6 Seal Coat

The seal coat shall be any of the three types mentioned below:

Type A: Liquid seal coat comprising of an application of layer of bituminous binder followed by a cover of stone chips.

Type B: Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

Type C: Premixed seal coat comprising of an application of 6.7mm size stone chips premixed with bituminous binder.

Methodology

- Clean the surface until free of dust and extraneous material before applying seal coat.
- Apply seal coat immediately after laying the bituminous course.

(a) **Type A Seal coat with bitumen:**

- Apply heated bitumen with a temperature between 150°C and 163°C uniformly with the help of a bitumen sprayer.
- Immediately thereafter, spread stone chips over the bitumen layer at a uniform rate, preferably, with the help of a mechanical grit spreader to cover the surface completely.
- Commence rolling as shown under Sub-section 4.2. If required, spread additional chips by hand to make up irregularities. Continue rolling operations until all aggregate particles are firmly embedded and present a uniform closed surface.

(b) **Type A seal coat with emulsion**

- Apply emulsion uniformly over the prepared surface by mechanical sprayers.

- Immediately after application of emulsion, spread aggregate uniformly and evenly by mechanical means.
- Roll the surface following the procedure given above.

(c) Type B seal coat with bitumen

- Follow the methodology described in open graded premix carpet.
- Roll the surface as per procedure given in Sub-section 4.1. Continue rolling of the mix until the voids in the bituminous surface are completely sealed and a smooth and uniform surface is obtained.

(d) Type B seal coat with emulsion

- Follow the methodology described in open graded premix carpet using bitumen emulsion except that for small jobs manual mixing may be required.

(e) Type C seal coat

- Methodology for open graded premix carpet may be referred to for preparation of the mix, spreading and rolling the same.

Traffic on Type A seal coat may be allowed only on the following day. In exceptional circumstances the road with Type A seal coat may be opened to traffic immediately after rolling but the traffic speed should be restricted to 16 km/h until the following day. Traffic on Type B and Type C seal coat may be allowed after completion of rolling operations and the surface is at ambient temperature.

Do's	Don'ts
<ul style="list-style-type: none"> ✓ Use angular fragments of clean, hard, tough and durable rock of uniform quality throughout as an aggregate for seal coat. ✓ Ensure that Stone chippings conform to the specified size and are dry and clean at the time of mixing. ✓ Ensure that the seal coat results in a smooth, uniform and closed surface. ✓ Maintain requisite temperature control at the time of mixing and rolling if bitumen is used as a binder. 	<ul style="list-style-type: none"> ✗ Do not use soft or disintegrated stone, organic or other deleterious material as an aggregate for seal coat. ✗ Do not undertake the work in foggy, rainy, windy weather or when the atmospheric temperature in the shade is less than 10°C. ✗ Do not allow the premix material to adhere to the roller wheels. Use light sprinkling of water for this purpose. ✗ Do not use lubricating oil on the wheels of the roller to prevent mix from adhering. ✗ Do not allow traffic on Type A seal coat till the following day unless speed restriction is 16km/h.

5. MAINTENANCE OF GRAVEL ROAD

It is an essential requirement prior to undertaking any maintenance measures that the gravel road is inspected at least once a year and that the past record of performance, maintenance and traffic is available with the Maintenance Engineer.

5.1 Methodology

Periodic Surface Renewal

- Prior to regravelling, scarify the old surface and provide additional gravel 50mm to 75mm in loose thickness meeting specified requirements over the scarified surface.
- After bringing the moisture content of the additional gravel to optimum $\pm 2\%$, compact the loose gravel layer to the maximum dry density as per IS:2720 (Part 7).

Surface Finish

Surface Levels: The tolerance in surface level for gravel/soil-aggregate base and surface will be restricted to $\pm 10\text{mm}$. Form a grid of 10m by 2.5m to check the surface level.

Surface Regularity: The maximum permitted difference between the gravel/soil-aggregate layer and 3m straight edge shall be 12mm for longitudinal profile and 10mm for cross profile. The cross profile should conform to the prescribed camber.

Camber/Cross-fall

Check that the final surface conforms to the specified camber/cross fall.

Do's	Don'ts
<ul style="list-style-type: none">✓ Do ensure that any gravel used for repairs, whether as salvaged material or as fresh material meets the specified requirements for use in the layer in question.✓ The grader should start from the edges of the road and work towards the center.✓ Improve the surface of a gravel road by dragging with the use of an approved drag.✓ Do make sure that prior to filling up local depressions, ruts, potholes and erosion gullies, the affected area is first cleaned of all loose material, brought to a regular shape and the bottom surface hand-rammed.	<ul style="list-style-type: none">✗ Do not allow heavy grading, without the provision of additional surface material if the remaining thickness of gravel is less than 75mm.✗ Do not use any scrapped gravel for repairs, if it does not meet the specified requirements.✗ Do not spread additional gravel for re-gravelling on the old surface without scarifying the old surface.✗ Do not start roller compaction unless the material to be compacted is of optimum moisture content. Do not use manual methods for making up the loss of profile without the approval of the Engineer.

6. MAINTENANCE OF WATER BOUND MACADAM ROAD

It is a requirement prior to undertaking any maintenance measures that the WBM road is inspected once a year and that the past record of performance, maintenance and traffic data are available with the Maintenance Engineer.

Methodology

Where the condition survey data reveals the need for surface renewal, provide a 75mm thick layer of WBM grading 3 as per Sub-section 4.5.

- Prior to laying a surface renewal, clean the existing surface of all dust and caked mud by wire brushes and brooms.
- After light sprinkling of water, scarify the surface and screen the salvaged materials to be used later, if found suitable.
- The salvaged material together with fresh additional material should be spread and dry rolled followed by application of screenings and binding material and wet rolling.

Surface Finish

Surface Level: The tolerance in surface levels of the WBM would be as under:

Sub-base course (+) 10 mm, (-) 20 mm

Base course (\pm) 15 mm

Surfacing Course (\pm) 10 mm

(A grid of 10m by 2.5m may be formed to check the surface levels).

Surface Regularity: The maximum allowable difference between the road surface and 3m straight edge shall be as given below: -

	Maximum permissible difference	
	Longitudinal Profile	Cross Profile
WBM Grade 1	5mm	12mm
WBM Grade 2 and Grade 3	12mm	8mm

Camber/Crossfall: should be checked for ensuring conformance with the specified requirements.

Do's	Don'ts
<ul style="list-style-type: none"> ✓ Make sure that all materials used in maintenance repairs i.e., coarse aggregates screenings and binding material meet the quality requirements laid down in Sub-section 4.5. ✓ When filling potholes, keep the surface slightly proud of the surrounding area. ✓ When repairing damaged portions of edges, rolling of the edge and shoulder should be carried out simultaneously and the cross profile of the shoulder remedied by grading. ✓ After providing surface renewal, a 6mm layer of course sand should be provided and lightly sprinkled with water. 	<ul style="list-style-type: none"> ✗ Do not use the salvaged material for repairs, if it does not meet all the quality requirements. ✗ Do not ignore the presence of fine hairline cracks on WBM surface, as these are indicative of serious ravelling to occur later. ✗ Do not provide resurfacing unless the old surface is scarified. ✗ Do not allow traffic immediately after laying the WBM surface renewal.

7. SPECIAL REPAIRS AND FLOOD DAMAGE REPAIRS / EMERGENT REPAIRS

Special repairs are urgent works required to prevent further deterioration of roads and structures and to ensure safety. Examples include minor improvement of culverts, improvement of visibility for traffic, repairs to bridges, filling of large potholes and pavement rectification. Flood damage repairs / emergent repairs involve works to restore traffic on roads affected by severe weather and other natural events, e.g. heavy rains, floods, cyclones, landslides and sand dunes.

8. CONCLUSION

All rural roads require periodical maintenance which needs meticulous planning, efficient execution and strict quality management. Timely periodical maintenance will protect the pavement structure from major damages and also gives a better riding quality resulting in reduced vehicle operational costs. Regular routine maintenance increases the interval between the periodical maintenances which would result in considerable savings in terms of money and effort.



Delayed Periodic Maintenance will result in higher repair cost



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