Government of the People’s Republic of Bangladesh
Ministry of Communications
Roads and Highways Department

Annual Road Maintenance Plan
2000-2001

November 2000
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OVERVIEW

Introduction

This is the second Road Maintenance Plan produced based on the HDM output. This current plan is based on the new HDM-4 system that provides some important features that have improved the capabilities to predict the future network performance.

A total of 20,799 km of road was included in the analysis of which about 8,320 km was identified as requiring immediate treatment.

What does the HDM-4 Analysis provide?

The HDM-4 analysis examines all the roads under RHD to determine their current condition and establishes the most appropriate treatment for each road section. The model then adjusts the data and projects the condition in the subsequent years including the application of treatments at the appropriate time during the analysis period. Each time a treatment is applied the condition of the road is reset to a condition determined for that treatment.

Based on this lifetime selection of treatment strategy, an economic analysis is undertaken to determine the priority of the selected strategy in comparison with that for other roads in Bangladesh under RHD.

Summary of the Plan

If unrestricted funds were available the first year budget should be:

Preventative Maintenance  Routine Maintenance:  Tk 37 crore
                         Periodic Maintenance:  Tk 316 crore

Backlog of Periodic Maintenance  Partial Reconstruction:  Tk 1,241 crore
                                 Total Reconstruction:  Tk 277 crore

Total Requirement  Tk 1,871 crore
Investment Profile

Over the next ten years the expenditure required on Periodic and Reconstruction will be of the form shown below:

![Projected 10-year Investment](chart)

Current Plans which impact the Programme

The programme for the current year includes certain foreign funded and Bangladesh financed projects that may be summarised as follows:

Value of Works on Roads in this Maintenance Programme already included in other programmes in 2000-2001:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of committed projects</td>
<td>Tk 380 crore</td>
</tr>
<tr>
<td>Foreign Aided Periodic Maintenance</td>
<td>Tk 70 crore</td>
</tr>
<tr>
<td>Revenue Periodic Maintenance</td>
<td>Tk 80 crore</td>
</tr>
</tbody>
</table>

Hence the uncommitted part of the plan will amount to Taka 1,304 crore.

Long-term Periodic Maintenance Plan

Bangladesh have invested considerable sums of money into the Road network. If these major assets are not to be lost, it is essential that the backlog indicated above should be removed as soon as possible. If adequate funds are not provided, the rate at which the backlog increases will accelerate with each succeeding year and hence the massive cost of rehabilitation will become increasingly difficult to address as time goes by.
Impacts of Delayed Implementation

It is easy to assess the impacts of delayed implementation. In the 1999 – 2000 Maintenance Plan a backlog of Tk 2,000 crore was noted. This has risen to a backlog of over Tk 2,400 crore in this years plan. Some of this could be explained by the change to using HDM-4 but the indications are that HDM-4 is identifying less rather than more projects when compared to HDM-3.

The long term annual demand will continue to be about Tk 500 crore on the current network and while this is not addressed the value of the backlog will continue to rise at an accelerating rate.

It is clear that action must be taken to mobilise additional funds to address this major problem.
1 INTRODUCTION

In 1999, the first Road Maintenance Plan was produced for the period 1999-2000 based on the output from HDM-3 applied to the entire RHD road network. That report provided important information on the investment required to restore and maintain the RHD road network.

Over the last 12 months the new HDM-4 system has been introduced to Bangladesh. This has introduced some new concepts and new challenges to the HDM Circle and hence the production of this plan has been delayed while the initial difficulties have been overcome.

This report presents the findings of the HDM-4 analysis and provides the basis for the selection of the 2000-2001 Periodic Maintenance Program. It also provides some information on the level of deferred periodic maintenance that requires attention in the immediate future.

2 SUMMARY OF THE PLAN

The major components of the programme from the HDM-4 analysis of the bitumen surfaced network are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Requirement:</td>
<td>Tk 1,851 crore</td>
</tr>
<tr>
<td>Routine Maintenance Requirement:</td>
<td>Tk 17 crore</td>
</tr>
<tr>
<td>Partial Reconstruction:</td>
<td>Tk 1,241 crore</td>
</tr>
<tr>
<td>Total Reconstruction:</td>
<td>Tk 277 crore</td>
</tr>
<tr>
<td>Hence, Periodic Maintenance Program Requirement:</td>
<td>Tk 316 crore</td>
</tr>
</tbody>
</table>

Of the above the Partial and Total Reconstruction works are considered as Backlog Periodic Maintenance: Tk 1,518 crore

Because there is such a large backlog, some works that would be expected in the periodic maintenance will have been moved into the deferred total. Until such time as regular periodic maintenance is undertaken in the field such phenomenon will continue to occur.

In addition to the above there will be an additional Routine Maintenance Requirement on the remainder of the network not considered in the analysis. This is approximately Tk 20 crore.

Hence the immediate needs are:

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine Maintenance:</td>
<td>Tk 37 crore</td>
</tr>
<tr>
<td>Periodic Maintenance:</td>
<td>Tk 316 crore</td>
</tr>
<tr>
<td>Deferred Periodic Maintenance:</td>
<td>Tk 1,518 crore</td>
</tr>
<tr>
<td><strong>Total Requirement:</strong></td>
<td><strong>Tk 1,871 crore</strong></td>
</tr>
</tbody>
</table>
3 DESCRIPTION OF TREATMENTS

The HDM analysis has been based on a number of treatments that represent the most commonly used types of maintenance work items in Bangladesh. Costs for these are based on recent tender prices and RHD estimates with allowance for work undertaken by Contract.

**Routine Activities**

Routine Maintenance: This includes all the regular works along a road: shoulder leveling, drain cleaning, vegetation control and so on;

Patching: This includes for the repair of potholes based on a standard pothole unit of 0.01 m³ per pothole;

Crack Seal: This is minor sealing to cracks using Seal Coat. It assumes a maximum in any one kilometre of 15% area affected;

**Periodic Activities**

Preparatory Patching: As Patching but before other treatments are undertaken;

Preparatory Edge Repair: Allows for restoring pavement edges that have been damaged by vehicles leaving the road to drive onto the shoulder;

Manual Seal: This is a traditional Seal Coat treatment used on the more lightly trafficked roads: this has a 2 – 3 year life;

Single Surface Dressing: This is Single Bitumen Surface Treatment (SBST). It consists of a layer of bitumen sprayed at controlled rates onto the existing prepared surface and a layer of crushed, single size, aggregates spread at a predetermined rate onto the bitumen surface. Life expectancy can range from 3 to 7 years depending on conditions;

Double Surface Dressing: This is Double Bitumen Surface Treatment (DBST). It is similar to SBST except a second layer of bitumen followed by a second layer of aggregates is included. Life can vary from 5 to 10 years depending on conditions;
Bituminous Carpeting: This is Bituminous Carpeting using traditional techniques. It consists of a normal carpet with seal coat finish on roads with lower traffic volume. Expected to have a life of at least 4 years;

Overlay: Premixed bitumen overlay of 5 cm thickness, prepared under carefully controlled conditions with good quality control. Life expectancy would be at least 5 years. This would normally be applied where there is higher levels of traffic or higher roughness levels;

Partial Reconstruction: 4 cm premixed bituminous overlay on a 20 cm crushed aggregate base. This is a treatment to overcome higher roughness or higher levels of surface cracking resulting from delayed maintenance. Life expectancy should be 5 to 10 years prior to major preventive maintenance. Design of the pavement would normally be undertaken prior to treatment. Shoulder improvement would also be provided where necessary;

Complete Reconstruction: A major reconstruction on the existing alignment and within the same overall dimension limits. The road is not widened. The surface will be redesigned prior to construction and upgraded shoulders provided as necessary. Life could be 10 to 15 years before major preventive maintenance. Applied where there are extremely high levels of roughness and extensive cracking.

The options are applied using criteria that are defined in Section 4 of this report.

4 THE HDM-4 ANALYSIS

4.1 PRINCIPLES OF THE LIFE CYCLE ANALYSIS USED FOR DEVELOPMENT OF THIS PLAN

The life cycle analysis in HDM-4 predicts the life cycle pavement conditions and costs over a specified analysis period (in this case 20 years) under a user-specified scenario of circumstances (Intervention Criteria described below). The cost set for this analysis includes cost of capital investment, maintenance and vehicle operating costs.
The cost of two scenarios were compared:

- the “do minimum maintenance only” scenario;
- the “with intervention and routine maintenance” scenario.

These scenario were used to obtain the benefit: costs of the with and without intervention case over the 20 year period from which the Net Present Value and Costs of the two scenario were compared.

The priority list of projects based on this is shown in the Annex A to this Plan.

4.2 **INTERVENTION CRITERIA USED IN THE ANALYSIS**

The Intervention Criteria define what treatment should be applied to a section of a link when it reaches a specific condition.

The change from HDM-3 to HDM-4 has required new Intervention criteria to be determined for the analysis of maintenance requirements. The intervention criteria were refined in September from those selected in August 2000 to ensure appropriate treatments were applied to roads needing attention without exception. The Intervention Criteria used in the preparation of this plan are shown on the following page.
## Intervention Criteria used in 2000-2001 HDM-4 Analysis

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Purpose/Description</th>
<th>Unit</th>
<th>Financial Unit Cost (Tk)</th>
<th>(IRI)</th>
<th>Surface damage</th>
<th>Potholes</th>
<th>Interval</th>
<th>Traffic limits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Routine Activities</strong></td>
<td>Maintenance of drainage, routine shoulder repairs, side slope repairs etc</td>
<td>Per km/yr</td>
<td>15,000</td>
<td>N/A</td>
<td></td>
<td></td>
<td>Scheduled annually</td>
<td></td>
</tr>
<tr>
<td>Patching Potholes</td>
<td>Patching of potholes.</td>
<td>M²</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td>Max 15 m² per km/yr</td>
<td>All potholes up to limit</td>
</tr>
<tr>
<td>Crack Sealing</td>
<td>Seal coat on roads not scheduled for maintenance.</td>
<td>M²</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td>Annual as needed</td>
<td>Max 150 m² year</td>
</tr>
<tr>
<td><strong>Seal Coat</strong></td>
<td>Non-structural 15 mm thick manual seal coat</td>
<td>M²</td>
<td>110</td>
<td>&lt;= 11.5</td>
<td>Total damage &lt;= 10%, &gt;=40 %</td>
<td></td>
<td>Min 2 years</td>
<td>MT &lt; 1499</td>
</tr>
<tr>
<td>Single Seal</td>
<td>SBST</td>
<td>M²</td>
<td>180</td>
<td>&lt;= 11.5</td>
<td>Total damage &gt;=10% &lt;= 25%</td>
<td></td>
<td>Min 3 years</td>
<td>MT &gt; 1500</td>
</tr>
<tr>
<td>Double Seal</td>
<td>Machine Laid DBST</td>
<td>M²</td>
<td>260</td>
<td>&lt;= 11.5</td>
<td>Total damage &gt;=25% &lt;=40%</td>
<td></td>
<td>Min 4 years, max 7 years</td>
<td>MT &gt; 1500</td>
</tr>
<tr>
<td>Overlay 1</td>
<td>50mm thick Machine Laid Asphalitic Concrete</td>
<td>M²</td>
<td>550</td>
<td>&gt; 5, &lt;= 9</td>
<td>Total damage &lt;= 55%</td>
<td></td>
<td>Min 5 years</td>
<td>MT &gt; 1500</td>
</tr>
<tr>
<td>Overlay 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total damage &gt;=40% &lt;=55%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carpeting 1</td>
<td>38mm Bituminous Carpeting with Seal Coat</td>
<td>M²</td>
<td>300</td>
<td>&gt;5, &lt;=9</td>
<td>Total damage &gt; 25% &lt;=55%</td>
<td></td>
<td>Min 4 years</td>
<td>MT &lt; 1499</td>
</tr>
<tr>
<td>Carpeting 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total damage &gt;40% &lt;=55%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Partial Recon 1</strong></td>
<td>Strengthening with 200 mm of granular base + 40 mm machine laid AC including shoulder filling/leveling</td>
<td>M²</td>
<td>1,300</td>
<td>&gt;9 , &lt;=11.5</td>
<td>Total damage &lt;= 55%</td>
<td></td>
<td>Min 4 years</td>
<td></td>
</tr>
<tr>
<td>Partial Recon 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total damage &gt;=55%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete Reconstruction</td>
<td>Total reconstruction within right-of-way plus hard shoulder works, road signs, road marking etc.</td>
<td>M²</td>
<td>2,500</td>
<td>&gt;= 11.5</td>
<td>Total damage &gt;=55%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5 PLAN DEVELOPMENT

To translate the unconstrained HDM-4 output into a works program requires some additional steps in order that proposed projects are considered in prior to determining the final priorities.

The steps in the development of the first year program from the unconstrained HDM-4 output was as follows:

(a) A summary of works by descending NPV/Cost for all treatments was prepared. This indicated the total annual Periodic and major works requirement. This is included as Annex A to this Plan.

(b) A summary by Division and Zone was prepared showing:

- “Seal Coat”, “SBST”, “DBST”, “Carpeting” and “Overlay”: (Periodic Maintenance)
- “Partial Reconstruction” and “Total Reconstruction”: (Deferred Periodic Maintenance).

On the above summary the links that are currently in ongoing programs was indicated including:

- JBARP (Jamuna Bridge Access Roads Project),
- RRMP-3 (Third Road Rehabilitation and Maintenance Project),
- RRMP-3 PM (Third Road Rehabilitation and Maintenance Project – Periodic Maintenance Component),
- RMIP (Road Maintenance and Improvement Project),
- ADP (Annual Development Program including Thana Roads and Roads of Public Importance 1 & 2).

This is included as Annex B to this Plan.

(c) All projects identified above were then removed to provide a new list that only showed projects on links without major “Committed” works. The exception to this are ADP works since they are not clearly defined and often of a limited impact on a section of road.

This is included as Annex C.

(d) Separate lists by descending NPV/Cost (for the unconstrained programme) was then prepared from Annex C for:

- roads needing treatment considered as Periodic Maintenance. This is shown as Annex D.
- roads needing treatment described as Deferred Periodic Maintenance. This is included as Annex E.
(e) Finally the proposed 2000-2001 Program by Division was determined (including committed projects) and this is summarised in Annex F.

In all the above the listings are unconstrained and indicate the total requirement assuming there are no budget constraints.

From the lists in Annex D and E it is possible to identify programs what will provide the best economic returns. If the ADP program roads are not to be considered, they can be omitted. If only National or Regional roads are to be considered these can be extracted. Any specific requirement can then applied to meet the objectives of the RHD and Ministry of Communications.

The potential needs for the subsequent 20 years have been determined. These are available for use as the basis for selecting the RRMP-3 and RMIP Periodic Maintenance programmes. They can be printed as needed by the HDM circle.

6 INVESTMENT PROFILE

The funding requirements for the first year of the program are shown in Table 1 below. This indicates the investment needed by main type of works in each Zone at this time.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Network Analysed (km)</th>
<th>Funding needs (Taka crore)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maintenance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Routine</td>
<td>Periodic</td>
</tr>
<tr>
<td>Barisal</td>
<td>3,590</td>
<td>6.1</td>
<td>28.9</td>
</tr>
<tr>
<td>Chittagong</td>
<td>2,848</td>
<td>4.7</td>
<td>34.4</td>
</tr>
<tr>
<td>Comilla</td>
<td>3,908</td>
<td>7.0</td>
<td>59.1</td>
</tr>
<tr>
<td>Dhaka</td>
<td>3,567</td>
<td>6.6</td>
<td>46.7</td>
</tr>
<tr>
<td>Khulna</td>
<td>2,443</td>
<td>4.2</td>
<td>66.8</td>
</tr>
<tr>
<td>Rajshahi</td>
<td>1,895</td>
<td>3.4</td>
<td>35.3</td>
</tr>
<tr>
<td>Rangpur</td>
<td>2,548</td>
<td>4.5</td>
<td>45.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20,799</strong></td>
<td><strong>36.5</strong></td>
<td><strong>316.3</strong></td>
</tr>
</tbody>
</table>

From the overall analysis the 10-year expenditure profile has been determined and this is shown in the following figure:
This indicates that:

- Periodic maintenance expenditure will continue at about Tk 500 crore per annum over the period;
- The backlog of periodic maintenance (represented by “Partial Reconstruction” and “Reconstruction”) should decrease over the initial two years provided the funds required are provided;
- There will be a slight increase in “Total Reconstruction” in the sixth year due to the demands of traffic growth.

This clearly indicates the pressing need for this program to be fully implemented immediately.

7 LONG TERM PERIODIC MAINTENANCE PLAN

It has been estimated that the current works under the Revenue PMP-2000, the ADP and Foreign Aided projects will account for an equivalent value of Periodic Works of about Taka 380 crore. In addition it is understood that RHD plan to expend Taka 80 crore on major Periodic Maintenance in 2000-2001 from the Revenue Budget. This on its own will not be sufficient to address the immediate and long term needs.

The net effect of this in the short term is that the estimated shortfall will be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Current Periodic</th>
<th>Backlog Periodic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Needs from HDM-4</td>
<td>316</td>
<td>1,520</td>
</tr>
<tr>
<td>Estimated equivalent value of committed projects</td>
<td>60</td>
<td>320</td>
</tr>
<tr>
<td>Proposed value of PMP-2001</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td><strong>Balance of work requiring attention</strong></td>
<td>176</td>
<td>1,200</td>
</tr>
</tbody>
</table>
A Project Concept Paper has been prepared for a long-term ADP Periodic Maintenance project valued at Tk 2,000 crore over 10 years which is currently being taken through the planning process. This could have a major impact by addressing the immediate needs and hence reduce the rate at which the backlog of works is increasing.

The projected investment needs over the next 10 years have been indicated above. This presumes that an immediate major investment can be made which is clearly not the case. However, the World Bank and ADB will be supporting Periodic Maintenance over the next 5 years that will amount to Tk 550 crore.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Expected Finance for Periodic Maintenance (Tk crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000</td>
</tr>
<tr>
<td>World Bank</td>
<td>70</td>
</tr>
<tr>
<td>ADB</td>
<td>70</td>
</tr>
</tbody>
</table>

The impacts of the proposed ADP fund and the commitment already made by IDA and ADB will go some way towards controlling the rate of deterioration. However the major backlog of periodic maintenance must also be addressed in order to bring the extent of annual periodic maintenance under control.

8 IMPACTS OF DELAYED IMPLEMENTATION

The scenario described in Section 6 above assumes that over Tk 2,400 is spent over two years to reduce the backlog (Tk 1,500 crore in the first year and Tk 900 crore in the second). In the 1999-2000 plan it was highlighted that there was a backlog of Tk 2,000 crore. Hence, the backlog would appear to have increased by almost Tk 400 crore in one year. As very little investment was made in the period 1999-2000 this would seem to be a logical conclusion.

The backlog appears to have increased by Tk 400 crore in one year as a result of insufficient and timely investment in Periodic Maintenance in 1999-2000.

It is essential that sufficient funds be mobilised to enable this to be addressed to avoid the steadily declining condition of the road network and continuously increasing cost of remedial works.

In the next plan, it will be possible to evaluate the impact of the under-funding on the value of the maintenance backlog.