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

ROAD CONDITION SURVEY MANUAL

NOVEMBER 2001

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1. ROADS

1.1 INTRODUCTION

A road network is a valuable Government asset and failure to maintain the roads that form the network will lead to their rapid deterioration which in turn will lead to increases in road user costs and accidents and the need for expensive re-construction works. Well-maintained roads make a valuable contribution towards the country's economy.

This guide is accessible on the RHD Intranet.

1.2 ROADS UNDER ROADS & HIGHWAYS DEPARTMENT

The main road network of the country is under Roads and Highways Department (RHD). Maintenance of the roads including bridges is carried out by RHD. There is approximately 20,850 km of roads under this department.

The road network capable to carry vehicles has increased significantly and is increasing every year.

Bangladesh government realises the importance of road maintenance and the RHD has given more emphasis on this subject. Only a few years back there was no proper planning and system for road maintenance. Therefore International agencies assisted the Government of Bangladesh to address and solve the problem.

RHD has created an HDM Circle within the department. The HDM Circle will assist with road maintenance planning and implementation by using modern technology. "The Road Condition Survey" is a step forward for the government in order to achieve proper road maintenance.

1.3 ROAD CLASSIFICATION

The Roads and Highways Department (RHD) within the Ministry of Communications, is responsible for the management of approximately 20,850 km comprising three categories of road classes; National, Regional and Feeder type 'A' roads.

1.3.1 National Highways

National Highways are defined as Highways connecting national capital with different divisional and old district headquarters port cities and international highways.

These roads have been categorised as National Highways considering the national importance and geographical positions. Each National Highway has been provided

with a name and a number, such as Dhaka-Chittagong Highway has been numbered **N-1** whereas N stands for National. This number can only be changed by RHD head quarter.

1.3.2 Regional Highways

Regional Highways are defined as Highways connecting different regions and new district headquarters not connected by National Highways Feeder Road.

Regional Highways are named after National Highways of national importance. Names and numbers of these highways are decided such as Comilla-Lalmai, **R-140**, whereas R stands for Regional meaning the Region. This number can only be changed by RHD head quarter.

1.3.3 Feeder Road

Feeder Roads are defined as Roads connecting Upazila head quarters and other important rural centres (growth centres) with the existing Road network.

These connecting roads are defined as Feeder Roads. There are two types of Feeder roads. Feeder road - Type A and Feeder road - Type B. Name and numbers of these roads are decided such as Akhaura-Agartala, **F-1203** whereas F stands for feeder.

1.4 ROAD LINK

1.4.1 Definition

Every road has been divided into one or more links. Every link has got a link name and a number, such as Moulavibazar-Fenchuganj-Sylhet road, **N-28** , which has got three links; (1) Moulavibazar-Rajnagar **link no. 322**, (2) Rajnagar- **Fenchuganj link no. 323**, (3) Fenchuganj-Sylhet **link no. 324**.

1.4.2 Same Road and Link number

Some roads have not been divided in to more than one link. Road number and link number is same, such as Brahmanbaria-Lalpur, which has got road number **F- 1210** and also link number **1210**.

1.4.3 Link conditions

Links are not dependent on distance. Links depend on important places, traffic volume, road intersections and other factors. A link will be named and start with 0

kilometres where it begins and proceed towards the next link and measure its length in kilometres. Thereafter the next link will also start with 0 kilometres and measure the link length as previously described. The RHD head quarter has prepared these links and provided them with a number. Therefore only the RHD head quarter is allowed to change these.

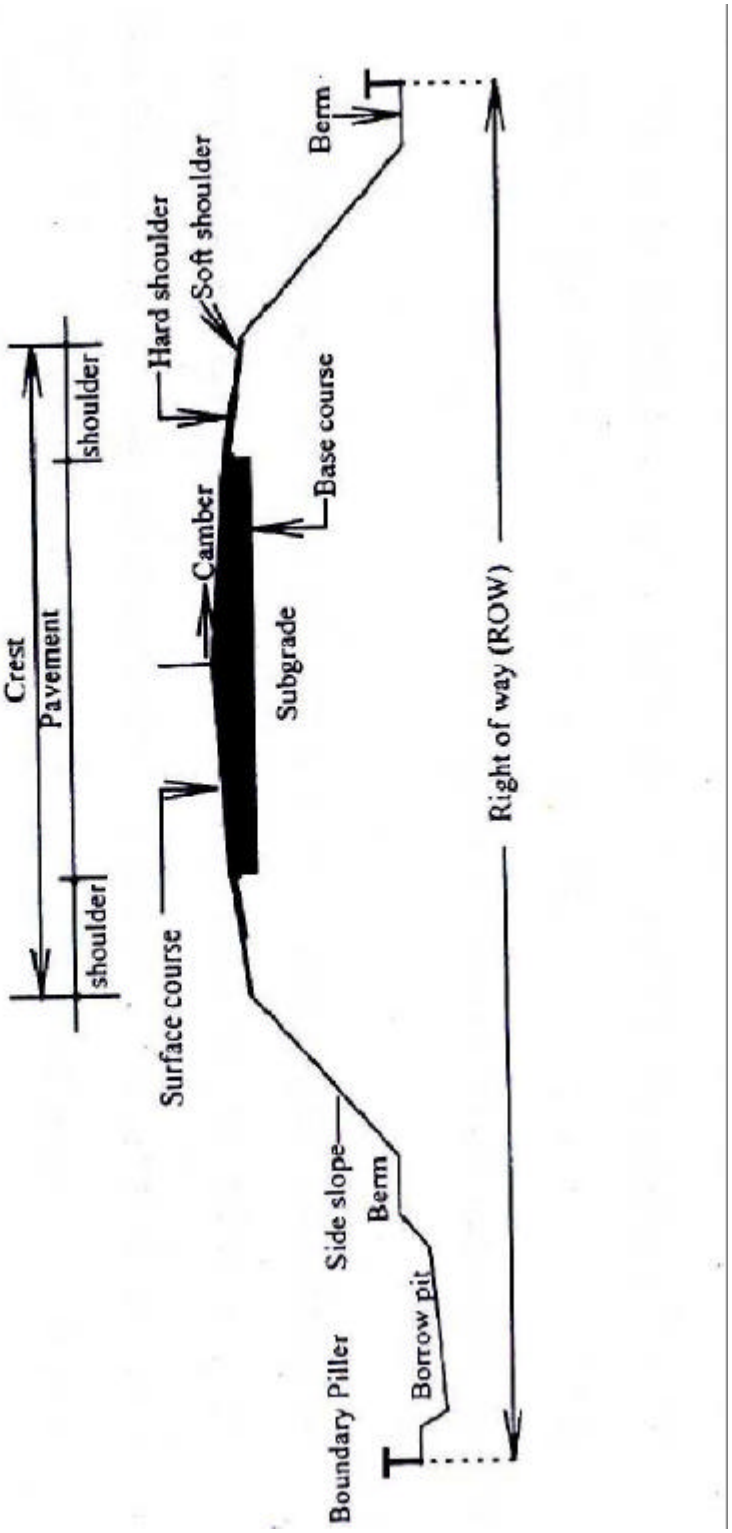
1.4.4 Survey order

The Road condition survey should start from the beginning of the link name and proceed towards the end of the link name. If the survey is started from the opposite side, it will not be useful. If any place or any bridge is mentioned by K.M. it means the distance of the place or the bridge from beginning of that particular link.

1.5 ROAD COMPONENT

Different Road Components are shown in the figure on next page.

১.১.৫.১ নীচের চিত্রে সড়কের বিভিন্ন অংশের নাম দেওয়া হল ।



1.5.1 Road components

The road **Embankment** is build with earth. Earth is filled and **Compacted** up to the required height. The **Pavement** is constructed on the top for traffic movement. Earth at the bottom of the pavement is called the **Sub-grade**. The **Base Course** is placed on top of it in two or more than two layers. Finally the **Surface Course** is placed on top of it. The **Shoulder** on both sides of the pavement is for the pedestrian, light vehicle movement and car park.

The **Pavement** has slopes on both sides from the centre of the road. This slope is called the **Camber** and has its own **Camber Design**. Sometimes this camber is also called **Crossfall**. Each **Embankment** has **Slopes** on both sides according to the design. At the end of the toe of the **Slope**, the earth is prepared such so that the **Embankment** remains stable. This part is called **Berm**.

2. ROAD MAINTENANCE

2.1 WHY MAINTENANCE

Of all the possible types of spending on the road network **Preventive Maintenance** is the most beneficial. This is because a small amount of money on timely maintenance can preserve the huge initial expenditure that was made at the time of construction.

Maintenance expenditure saves money in two ways. Firstly it reduces the overall costs to the roads agency (in this case the RHD). Secondly it reduces the costs to the road users.

Maintenance is done to keep the vehicle operating cost lower. There will be less accident and the road will reach its design life when properly maintained. It will have satisfactory level of economic rate of return.

2.2 TYPE OF MAINTENANCE

Preventive maintenance is usually classed as either **Routine** or **Periodic**. Routine maintenance consists of minor works that must be carried out at frequent intervals, usually several times a year. Periodic maintenance consists of actions that must be carried out every few years

2.2.1 Routine Maintenance

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2.2.1 Routine Maintenance

Pavement distresses occur due to vehicular traffic. Distresses are found in shoulder and slope due to rain, flood and other reasons. These essential maintenance works should be repaired on regular basis otherwise these in course of time becomes large in shape and size thereby difficult to repair. Repairing these types of distresses every day on regular basis is known as **routine maintenance**.

2.2.2 Periodic Maintenance

The road requires surfacing work (Seal coat, Surface treatment) on top of the pavement surface within a gap of few years after doing typical routine maintenance work. There are different designs for this type of works. Sometimes a thick layer of overlay is done on the pavement. These types of works are called **periodic maintenance**.

2.2.3 Emergency Maintenance

Emergency Maintenance can be defined as works to respond to natural calamities such as flood, cyclone and earth slides etc. and prevent it from further damage.

3. ROAD CONDITION SURVEY

3.1 A ROADS DESIGN LIFE

A road is designed for a specific period of time and constructed accordingly. For example, the design period could be 20 years and it would be constructed up to an International standard, such as, Dhaka-Chittagong Highway. If the Engineer thinks that there will be no need for any maintenance work during this 20 years period, he will be mistaken. Each and every road requires maintenance. Routine maintenance should be initiated directly after construction and continue on regular basis. Thereafter periodic maintenance will come. By maintaining the road in this way it will reach its required design life, and thereby beneficial from economic point of view.

3.2 ROAD CONDITION SURVEY

It is necessary to know the condition of the road every year for doing proper maintenance works. Accordingly road condition surveys is done to find out the condition, and should be done every year at a particular time. The next paragraphs will direct ways and procedure of the survey.

3.3 WHY ROAD CONDITION SURVEY

I. It is possible to find out the condition of the road by doing the survey, whether the road is Good, Fair, Poor or Bad.

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3.3 WHY ROAD CONDITION SURVEY

I. It is possible to find out the condition of the road by doing the survey, whether the road is Good, Fair, Poor or Bad.

II. Effective road maintenance requires proper planning and budgeting. By knowing the exact condition of the road this could easily be prepared and the Government can provide and distribute money accordingly.

III. HDM Circle receives the road condition survey reports, analyses it and considering an economic analysis by using HDM 4. This provides proper planning and feasible time period for periodic maintenance, rehabilitation and reconstruction work.

IV. HDM Circle provides correct information for higher level of planning.

V. Donor agencies are also interested in the HDM results, which enables them to finance projects on proper basis.

VI. RHD can prepare a Road Data Book on the basis of these field data, which will be very useful for planning maintenance and development works.

3.4 DATA COLLECTION

All road links of the whole country need to be surveyed by using the RCS 4 form.

See Appendix 1.

The field level staff needs to collect the required data on this RCS 4 form.

3.5 SURFACE TYPE

Respective type of road surface is to be indicated by putting tick mark in the RCS form. Abbreviations and explanations for surface types are given below.

AC: Asphaltic Concrete – It is usually premixed material prepared in a plant and laid by paving machine. For example Dhaka-Chittagong Highway or others.

ST: Surface Treatment – SBST (single seal surface treatment) or DBST (double seal surface treatment) is done on Highways as well as others bituminous or AC roads.

SC: Seal Coat – Seal coat is applied over the bituminous surface of the road. Put a tick mark in the box if it is seal coat road.

CC: Cement Concrete – Though CC roads are not constructed at present but it was done previously.

WB: Water Bound Macadam – Roads made with stone or brick aggregates rolled by spraying water.

HB: Herringbone Brick Bond – Roads made with HBB bricks over a layer of flat soling.

ER: Earth Road – Roads constructed with earth.

UK: Unknown – There is an alignment for the road but no work has been done

Last Surfacing Year: Last Surfacing Year is to be provided in the form.

3.6 HOW TO COLLECT FIELD DATA

The following information is to be examined or collected from the field.

- Fill in the required basic data on the RCS 4 form.
- Different types of distresses are shown and explained with pictures in this manual. Use this information as a guide to collect correct data from field.
- This survey is generally for the top surface condition of the road. Cracks and other distresses can not be taken together at the same place at the same time. Potholes, edge breaks and patches can not be taken together and other distresses should be deducted from those areas.
- The Cross Section of pavement at left bottom of the form should be checked and the dimensions ought to be taken at the start of each km.
- Each distress for 200 meters of the road should be noted and compared with the next 800 meters travelled by vehicle. The difference compared to the first 200 meters is to be noted in percentage or how much more/less in the figure.
- The distresses of each km should be recorded in the Kilometer Sheet. The survey and its results will have an impact of the planning of the next year maintenance budget.
- Fill in Name, Signature and Date

3.7 RESPONSIBILITIES OF PERSONNEL INVOLVED

3.7.1 Role & Responsibilities

The Executive Engineer (EE) and the Sub-divisional Engineer (SDE) engaged as supervisor should take the responsibility for the following:

- The Supervisors should verify if there are any changes in this year survey form. If changes, these ought to be discussed and explained to their fellow workers.
- The Executive Engineer and Sub-divisional Engineer will check whether the survey team has any past experience or not. If found no, then it is required to organise proper training. Thereafter the quality and understanding of the survey should be checked within one week after commencement.
- The Executive Engineer should check and verify all data before sending.
- The Executive Engineers are entirely responsible for the quality of the collected data in his respective division.
- The respective Sub-divisional Engineers are also responsible for their sub-divisional data.
- The Sub-Assistant Engineer (SAE) and the Work Assistant (WA) should be properly trained before sending them to the survey.

3.7.2 To be checked in the Office

- Last surfacing year
- The respective Executive Engineer and Sub-divisional Engineers should check and verify all information in the boxes.

Each Sub-division should survey approximately 150 kms of road on average. It will require about 20 kms per day, in total ~ 8 days to complete the respective sub-division's survey.

It is necessary to complete and return the survey forms as early as possible. It should be noted that these data will be used for next year maintenance plan and budget.

ROAD DISTRESSES

1.1 INTRODUCTION

Even when roads are constructed to the highest quality, over a period of time the road will show distress due to the effects of traffic wear, vehicle loads, climatic effects and other reasons. Road maintenance of this is required on a regular basis to keep these effects to a minimum, extend the life of the road and provide a high service to road users. Maintenance of all elements of the road is important but the condition of the pavement is the most important in predicting the performance of the road.

The major types of pavement distress to be recorded on RCS are described below. These are the principal condition indices that provide important information in predicting the pavement, and hence the road, life which enables long term strategies for maintenance to be determined.

For the condition survey a form has been designed which will enable the major distresses to be recorded when the form is correctly completed.

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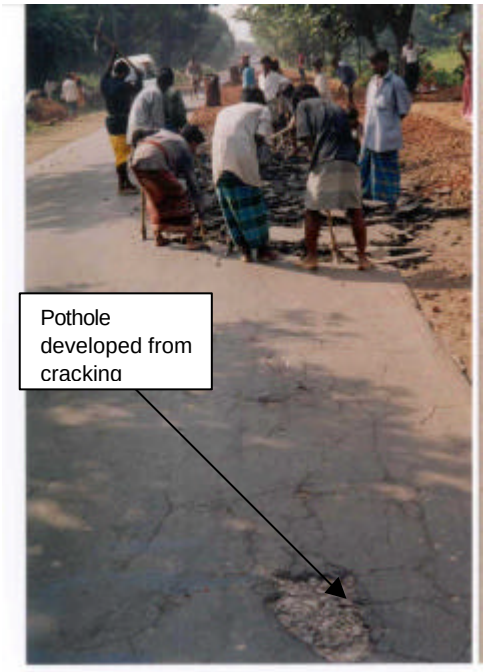
4.2 POTHOLES (RCS: COLUMN 2)



Potholes usually develop in a surface that is either cracked, raveled or both.

The presence of water accelerates the formation of potholes both through a general weakening of the pavement structure and through lowering of the resistance of the surface and base materials to disintegration.

Potholes result from the loss of surface and base material in cracked, raveled or undamaged areas. Potholes can ONLY appear from Undamaged, Cracked or Raveled areas. An area that has Broken Edge cannot be included as being Potholed.

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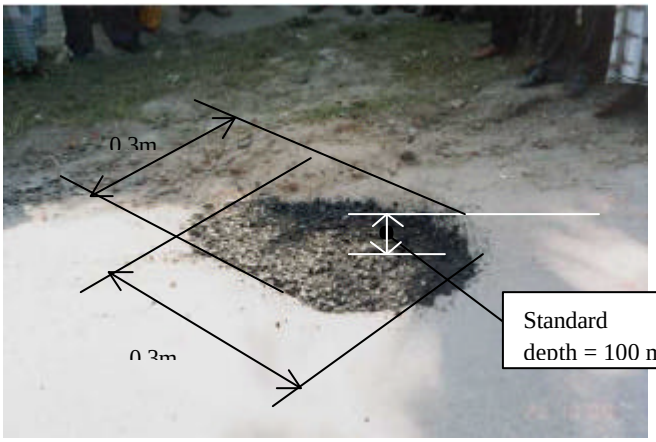
Potholes are recorded as the Equivalent Number of 0.3 m x 0.3 m, 10 cm deep potholes (i.e. 10 litres each). The majority of potholes in Bangladesh are less than 10 cm in depth and hence some adjustment should be made for this when calculating the number.



4.3 BROKEN EDGE (RCS: COLUMN 3)

Broken Edge can be defined as the loss of surface and base material at the pavement edge, caused by shear failure and attrition. This commonly arises on narrow roads with unsealed shoulders, where vehicles pass on or close to a pavement edge.

Broken Edge can appear from Undamaged, Cracked or Raveled areas.

Broken edge is recorded as the Equivalent Length of edge, average 30 cm wide, that is missing over the section being surveyed.

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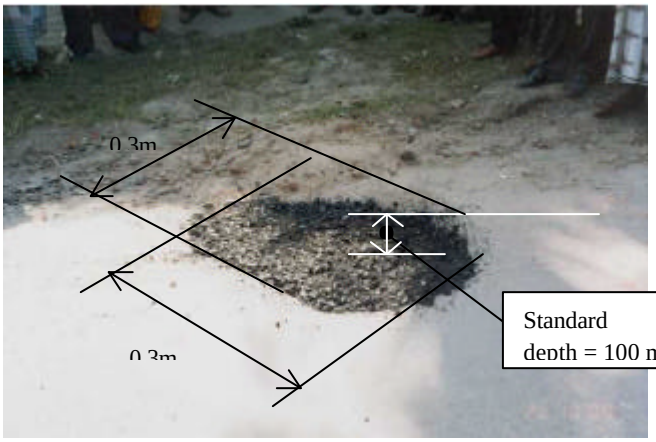

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4.4 CRACKING (RCS: COLUMN 4)

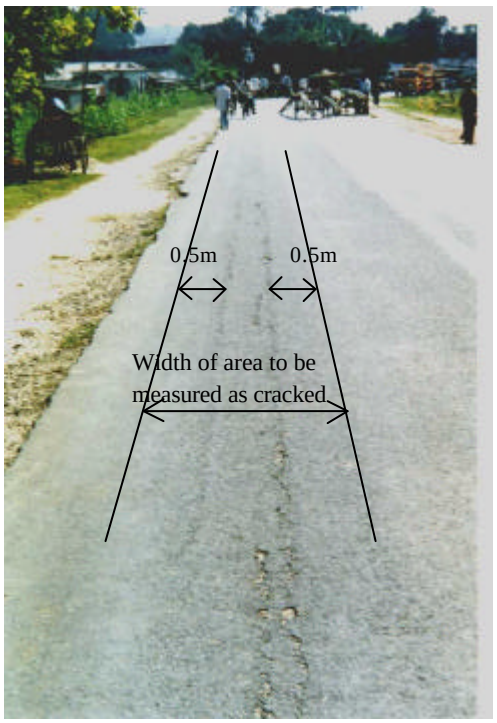
Cracking is one of the most important distresses in bituminous pavements. Fatigue, due to passage of traffic and ageing of the pavement binder are the principal factors contributing to the cracking of a bituminous layer. The propagation of cracking is accelerated through the embattlement of the binder material (bitumen) resulting from ageing and ingress of water, which can significantly weaken the underlying pavement layers.

There are two types of cracking considered in the HDM:

Narrow cracks in surface due to the effect of climatic or traffic damage: these are < 3mm in width

Wide cracks in surface and base due to weakness in pavement structure: these are > 3mm in width.

With a 3 mm wide crack, it would be possible to easily insert a 3.5 inch floppy disk on edge into the crack. When in doubt about the width, record the cracking as Narrow cracks rather than wide.



Cracks can ONLY appear from Undamaged or Raveled areas.

An area that is Potholes or Patch cannot be measured as cracked, raveled or Broken Edge. Areas of Narrow and Wide cracks are independently measured as the predominant area. Widely spaced cracks are measured as length x 0.5 m. Dense cracking is measured as area only.

In any location only one type of crack can be considered. Hence where two type of crack exist, Narrow or Wide, it is the most prevalent crack that is recorded.

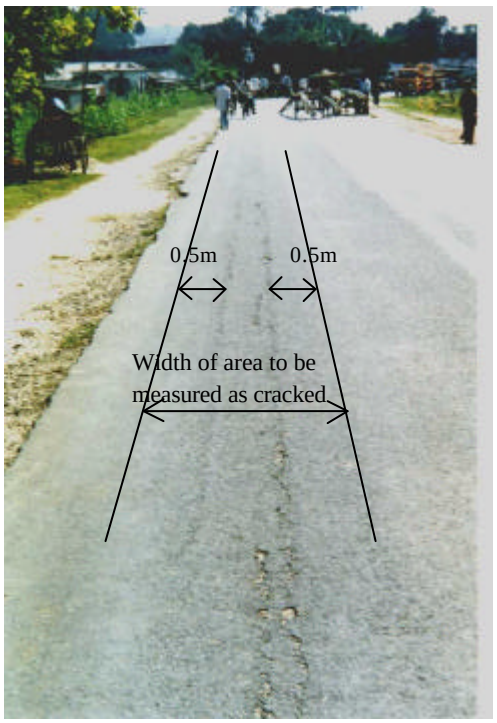
The area of cracks is recorded as Square metres.

4.5 RUTTING (RCS: COLUMN 5)

Rutting is defined as the permanent or unrecoverable traffic-associated deformation within pavement layers which, if channelled into wheelpaths, accumulates over time and becomes manifested as a rut.

Rutting can exist with all other surface damage except Depressions.

Rutting is recorded as the total length of Rut occurrence in each wheelpath and in each direction.



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4.6 DEPRESSION AREA (RCS: COLUMN 6)

Depression is the deformation of larger areas of pavement resulting from poor compaction in sub-grade, sub-base or other pavement layers.

All other surface defects can coincide with Depressions except Rutting that cannot occur in a Depression Area.

Depression is recorded as the total area in square metres that is depressed.

4.7 RAVELING (RCS: COLUMN 7)

Raveling is the progressive loss of surface material through weathering and/or traffic abrasion.

Raveling can ONLY appear in an Undamaged road or in a Patched area. An area of road that is Cracked, Potholes or Broken Edge cannot be included as a raveled area.

Recorded as the total area suffering surface damage not covered by Cracking, Potholes, Broken Edge or Patch in Square Metres.

4.8 HBB ROAD – REPLACE BRICKS (RCS: COLUMN 8)

This applies only to Herringbone Brick Roads. It is defined as the brick loss resulting from removal due to traffic damage or other causes. Is used to identify the area of bricks to be replaced under the next year programme.

The Area requiring replacement of bricks in Square metres is recorded.

4.9 EARTH ROAD – REGRADE (RCS: COLUMN 9)

This is the need for a road to be reshaped resulting from deformation due to poor compaction or due to traffic attrition and/or climatic damage.

The area requiring to be reshaped in square metres is recorded.

4.10 SHOULDER REPAIR – LOW AND HIGH (RCS: COLUMN 10)

The need for Shoulder Repairs result from climatic attrition or vehicle damage. The condition is reported as either High or Low:

This is reported as the total length of shoulder repair on both sides of the road.

High: where the level of the shoulder is raised above the edge of the road pavement. In this category the locations where surface water run-off is unable to escape from the shoulder should be recorded.

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High: where the level of the shoulder is raised above the edge of the road pavement. In this category the locations where surface water run-off is unable to escape from the shoulder should be recorded.

Low: where the level of the shoulder, or edging, adjacent to the pavement is more than 5 cm below the edge of the road pavement. In addition localised areas which are low and will cause ponding of surface water should be considered as “Low” for the purposes of this definition.

4.11 EMBANKMENT – LEFT REPAIR & RIGHT REPAIR (RCS 11 & 12)

This may be defined as Erosion due to uncontrolled surface run-off or flood related damage. It can occur on any section of road on embankment.

The total length of embankment requiring repair is recorded for the left and Right side in linear metres.

4.12 SIDE DRAIN – REPAIR (RCS COLUMN 13)

This may be defined as the length of side drain suffering from climatic damage due to climatic effects and/or lack of maintenance where side drains are already in existence.

The total length of drain in bad condition is recorded in linear metres.

5. PLANNING ROAD CONDITION SURVEY

5.1 ORGANISING ROAD CONDITION SURVEY (RCS) TEAM

One or more than one team conducts the road condition survey. The Team leader will either be the Sub-divisional Engineer (SDE) or the Sub-Assistant Engineer (SAE). The SAE together with few work assistants (WA) will form each survey team. More survey teams will be required if there are more roads. SDE will be responsible for all survey-related information. The Executive Engineer (EE) will co-ordinate all survey works under his each sub-division. He should ensure that all the roads are surveyed and each column of the survey sheet are filled in properly.

5.2 DUTIES OF TEAM MEMBERS

The Team leader is responsible for organising the survey work. He will explain and clarify the survey work to his staff members and how to conduct the work, which types of instruments and equipment to use and how to fill in required forms. He also has the responsibility for the quality of the survey, examine whether the form has been properly filled or not. Each team member is responsible to fill in the form after taking the correct measurement. The safety aspect has to be considered. The driver shall note the odometer's reading and drive the vehicle at the defined speed.

5.3 TRANSPORT FOR THE SURVEY

The EE or the SDE will arrange a vehicle for the survey. A proper vehicle equipped with the odometer should be used for the survey. A signboard with "Road Condition Survey" should be mounted in front and back of the vehicle for safety reasons.

5.4 EQUIPMENT FOR THE SURVEY

Each Sub-division have previously been provided with tools and equipment for the survey. The SDE is responsible for the tools and equipment. If any tool or equipment is lost or found defective it should be replaced. The list of required tools and equipment are as follows:

- Hammer
- Chisel
- Brush
- Nylon string
- 15 meter tape
- 3 meter tape
- 1 meter long straight edge Wage
- Spirit level
- 1 meter square template
- Chalk
- Clip board
- File folder
- Torch with batteries
- Signboard
- Red flag
- Umbrella

5.5 DOCUMENTS, FORMS & STATIONERIES

The survey team should carry the following:

- Road Condition Survey Booklet
- One notebook and a few sheets of paper
- Pencil, eraser and clipboard
- Road map, list of roads with link name and number
- Pre-printed computer RCS forms for the road condition survey

5.6 ADJUSTMENT OF ODOMETER

The vehicles odometer should before the survey be checked and adjusted. Either a vehicle or a motor cycle with a functional odometer can be used for the survey. The length will be measured with the odometer. There might be an error in the odometer

readings therefore it should be adjusted before beginning the survey. RCS Form should be used for this adjustment.

Select a straight portion of a road with a km post. Put a mark “A” at the km post. Measure one km manually with a tape from this mark. After measuring one km again measure one km and put mark ”B” here. Bring the vehicle at “A”. Record the odometer reading in the RCS form at “A”. Start the vehicle at an uniform speed and stop it at “B”. Record the odometer reading at “B” and note it in the form. Deduct the first odometer reading from the second odometer reading and note it down. It will be probable be seen that the odometer reading is more or less than two kms. The exact length should be two kms. Suppose that the odometer reading is 2.03 kms. The figure was the result after dividing the readings by 2, namely the “Correction Factor Adjustment”. (If time allows even better adjustment will be achieved if the readings are taken of a length of ten kms.) The distance found in the odometer reading should then be multiplied with this Correction factor to get the correct distance.

5.7 SAFETY

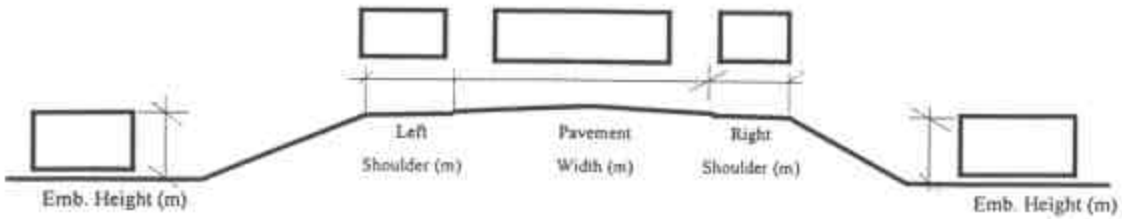
In many roads the speed as well as the traffic volume is high. Special care should be taken for the safety of each member of the survey team on each road condition survey. The use of red flags, signboard, survey caps, jersey, etc. should be promoted for the survey. The Team Leader will have the overall responsibility for the safety aspects.

RHD ROAD CONDITION SURVEY **KILOMETRE SHEET**

Zone	Circle	Division	Sub-Division	Code no.	Road No	Link No.	Length

Surface Type AC / ST / SC / CC / HB / ER	Shoulder Type BIT / WB / HB / ER	Last Surfacing Year	Link name	from Km	to Km

1	Bituminous Pavement										HBB Rd	Earth Rd	Shoulder		Side slope	SideDrain	Culvert
Bridge Location	2 Chainage	3 Potholes	4 Broken Edge	5 Delamination	6 Cracking		7 Rutting		8 Depression Area	9 Ravelling Area	10 Replace Bricks	11 Regrade	12 Repair		13 Repair	14 Repair	15 Repair
					< 3 mm	> 3mm	Depth	Length					Low	High			
	.0 km	No	L.m	No	Sq.m	Sq.m	mm	L.m	Sq.m	Sq.m	Sq.m	Sq.m	L.m	L.m	L.m	L.m.	No
	.8 km																
	.6 km																
	.4 km																
	.2 km																
	.0 km																
	Total 0-0.2 Km																
	Total/Km																



Comment :-

SDE
Name , Signature and Date

RCS TL
Name, Signature and Date