ASIAN DEVELOPMENT BANK

TA-8063 IND: Advanced Project Preparedness for Poverty Reduction – Capacity Building for North Eastern State Road Sector (Subproject 24)

Data Collection for ROAD ASSET MANAGEMENT SYSTEM (RAMS)

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Chapter 1. Introduction

1.1 BACKGROUND

The goal of this Technical Assistance Project is to strengthen the State PWDs' road management capability through the introduction of modern road management practices, and to transform them into road managers by the introduction of more effective and efficient road management processes and systems, and through institutional measures such as the establishment of road maintenance funds.

1.2 SCOPE

The specific tasks assigned to this TA are:

Task 1: Assistance in Equipment Procurement Required for Effective Road Management

Assist the PWDs to identify their IT needs beginning with computers and software for planning, engineering and management information systems.

Assist the PWDs to identify equipment and facilities required for road monitoring, field investigations, monitoring and management of quality for construction, operations and maintenance.

Assist the PWDs to prepare specifications, procure and install the equipment. The procurement should include training of PWD staff by the suppliers.

Task 2: Implementing Road Asset Management System

Examine the appropriateness of the Road Asset Management System (RAMS) developed under ADB TA 4697-IND: Development of Road Agencies in the North Eastern States, for applications to each state in the six states under NESRIP. If modifications are necessary, recommend and implement the modifications in consultation with each state PWD.

Implement RAMS by populating the database with traffic, road, bridge and condition data for the state highway and district road networks.

Use the RAMS to evaluate maintenance requirements and assist the PWDs to prepare a three-year program of road rehabilitation and periodic maintenance for state highways and major district roads.

Prepare a procedures manual and train PWD staff in use of RAMS. Organize and implement overseas training on the use of RAMS.

Task 3: Development and Implementation of Road Safety Initiative (Dealt in a separate report)

1.3 APPRECIATION

Software for RAMS, "North-Eastern Road Asset Management System (NERAMS)" was developed and implemented by SMEC International Pty Ltd. during 2006-07 as a part of ADB TA No. 4697 IND. Further development and improvements were undertaken during 2008-09. NERAMS was introduced through pilot studies in the State of Meghalaya. Some 1,000 km of road network was identified and data collected by the PWD division officials on a pilot basis.

However when an initial visit was made to Meghalaya State by the TA Consultants in January 2013 it appeared that the system was no longer in use.

Initial interactions with the PWD officers revealed that the PWDs have some basic IT equipment and facilities at headquarters level and at the PIUs, but they are limited to the extent of meeting

the present day work requirements. The internet backbone in the North East Region is lagging behind the rest of the country and is still under development. The limited connectivity available in the PWD units is a problem.

1.4 STRUCTURE OF THE REPORT

The purpose of this report is to provide suggested data collection formats to meet the objectives of the current TA.

The Report therefore includes following sections:

- **Chapter 2** North-Eastern Road Asset Management System (NERAMS) – Summarises the application and its various features.
- **Chapter 3** Suggested Data Collection – Improvements based on the gaps of the data collection is provided to address the requirement of the current TA.
- **Chapter 4** Guidelines on Survey Methodology

Chapter 2. NE Road Asset Management System

2.1 BACKGROUND

The PWDs of the North Eastern Region are responsible for policy development, design, procurement, construction, maintenance, and management of their road network. The road management and maintenance approach and philosophy followed by many of the PWDs are not designed to get maximum value from the available funds. Road network preservation and maintenance has a low profile. A road management information system for scientific decision making is lacking. Recognizing the shortcomings mentioned above, along with the need to increase asset value and productivity, earlier studies recommended introducing and implementing computer aided tools and best practices in road asset management. Such processes and procedures would enable the use of computer based technology to ascertain problem areas and set feasible and economically viable goals for the preservation of the road network.

2.2 NORTH-EASTERN ROAD ASSET MANAGEMENT SYSTEM (NERAMS)

The major development of the Asset Management System was part of the North Eastern States Road Improvement Program (NESRIP). This work was undertaken as a Technical Assistance Project (TA 4378-IND, during August 2005 to April 2007). Its objective was to assist the North Eastern Region to develop their state-level highways road network and provide reliable access and connectivity to the national and sub-regional-level road networks. An additional aim was to encourage the effective and efficient management of construction, maintenance, and operation of the road assets at the state level. A Consultancy project initiated under the TA had aims to increase the capacity of the Public Works Departments (PWDs) in the North Eastern States by enabling them to use computerised road asset management tools, and project management techniques.

During November 2006 to December 2008 another study under the same TA-4697-IND, facilitated all the NER states (except Arunachal Pradesh) in the use of computerised road asset management system (RAMS). This came to be known as the North Eastern Road Asset Management System (NERAMS) with the following objectives;

- To increase access and use of new technologies for data collection and management so as to provide a major benefit to the management and administration of the road assets.
- To obtain consistent data of a higher quality and more convenient analysis and reporting tools resulting in better management decisions.
- To provide opportunities to upgrade existing technologies thus improving the efficiency of data collection, storage, management, analysis and reporting.
- To provide opportunities to upgrade staff skills and ensure staff acceptance of a new business framework.
- To enable the improved use of inventory and condition data in planning, maintenance and budgeting.
- To provide up-to-date, accurate information on the condition of the individual road assets.
- To enable the determination of design standards and levels of service together with the required budget to maintain these levels.

- Prioritisation of maintenance needs on the basis of future costs rather than current condition.

Efforts to continue development in this project were made subsequently from different funding sources till 2011.

2.3 COMPONENTS OF NERAMS

NERAMS comprises of the following functional components as shown in Diagram 2-1.

1) Road Information (Roads, Sections, Inventory, Pavement Structure and Surface Condition)
2) Structure Information (Bridge & Culvert Inventory and Condition)
3) Habitation (Village and Population, Educational Institutions, Market Places, Hospitals, administration centres, Forests, Tourist spots)

In addition to the above, a separate module to store information on Mechanical wing is available.

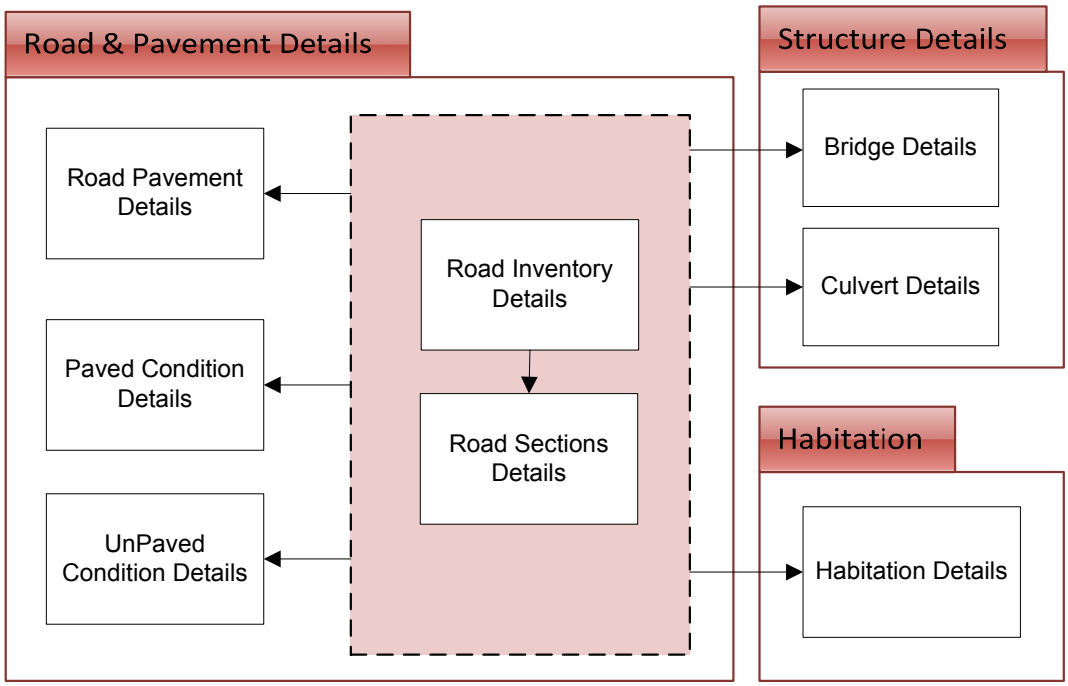

Diagram 2-1: Components of NERAMS

Each of the above components has a data input facility through data entry screens, data view, data querying capability, data reporting, and data export facilities. Besides the above, NERAMS has the following tools to administer and provide help on various components, functions, users and security.

- System Configuration
- Data Management
- System Security
- System Tools and Utility
- Help and other information

Chapter 3. Suggested Data Collection

3.1 SUGGESTED DATA COLLECTION REQUIREMENT

1. **Road Referencing:** This data is core to any asset management system. It is a primary activity that defines the location and extent of the assets.

   1.1. Road Identification: define the road number, classification, length, start and end points, and jurisdiction

   1.2. Road Sections: The methodology suggested earlier was to collect all the data for each 0.5 km. accordingly, 0.5 km sections are to be defined for the entire road. Description on each section start / end can also be provided such as location of km stones or any major identification points located.

2. **Road Inventory:** Road inventory data is to be defined for every 0.5 km sections created earlier. It consists of physical characteristics such as pavement type, width, shoulder type / width, Terrain, Submergence, Landslide Protection Wall, Drain, Right of Way etc.

3. **Pavement Composition:** Pavement composition and engineering properties of the road such as wearing course, base, sub-base, subgrade and related features.

4. **Pavement Condition Details:**

   4.1. **Paved Roads:** Paved road condition data describe the current state of paved roads using seven condition criteria: cracking, potholes, transverse deformation (Rutting), ravelling, failed sections, general drainage and roughness.

   4.2. Unpaved Roads: Unpaved road condition data describe the current state of unpaved roads using four condition criteria: loss of gravel thickness, surface drainage and crossfall, roadside and longitudinal drainage, and roughness.

5. **Pavement Structural Strength:** Pavement deflection will be collected using Benkelman Beam Deflection technique at 0.5 km interval as per IRC 81-1997. Deflection values are obtained at 0m, 2.7m and 9.0m along with pavement temperature, subgrade soil and moisture content.

6. **Traffic Volume Count:** Classified Traffic Volume Count surveys record the number of vehicles (in different categories of passenger, goods and non-motorised vehicles) in a day (averaged from a 3-day 24 hour continuous volume count)

7. **Bridge Details:** Bridge details data describe the identification and location of bridge structures and their engineering components, and a subjective judgment on bridge condition for requirement of a detailed inspection.

8. **Culvert Details:** Culvert details data describe the identification and location of culvert structures and their engineering components, and a subjective judgment on condition. Culvert details data should be collected simultaneously with road inventory data.

9. **Habitation Details:** Habitation details data describe habitations and social facilities adjacent to road sections.

3.1.1 Road Referencing

3.1.1.1 Road Identification

The road identification data components to be collected are summarised in Table 3-1.

Table 3-1: Road Identification Data

Data Component	Description	
Road Category	Road Category issued by PWD /other authority, using one of the following prefixes:	
	NH	National Highway
	SH	State Highway
	MDR	Major District Road
	ODR	Other District Road
	RR	Rural Road
Road No.	No. assigned to each road	
Road Name	The name (if any) commonly used by the PWD	
Chainage From (km)	The Start Chainage of the road	
Chainage To (km)	The End Chainage of the road	
Official Length(km)	The official road length issued by PWD in km.	
Reference From	Places at the start of the road	
Reference To	Places at the end of the road	
Division	The division responsible for the road. (Where responsibility is shared, data should be collected for each division using appropriate references and chainages)	

3.1.1.2 Road Sections

The roads are to be divided into sections at 500 m (0.5 km) intervals, with the sections numbered sequentially throughout the road as described in Table 3-2. They are used in road and data referencing. All the data needs to be collected for every 0.5 km, and related referencing must be mention against each data type.

Table 3-2: Sectioning

Data Component	Description
Unique Section No.	Unique Section Identifier (Road Category – Road Number : Chainage From : Chainage To)
Chainage From km	The start chainage of the section in km.
Chainage To km	The end chainage of the section in km.
Reference From	Local / village/ landmark name of start / end of the section
Reference To	
Division	The division responsible for the road.
Sub-Division	Code of the Sub-Division
District	Code of the District

3.1.2 Road Inventory Data

Road inventory data is to be defined for every 0.5 km sections created earlier. Changes within each 0.5 km needs to be rounded up to the nearest multiple of 0.5 km.

Table 3-3: Pavement Inventory

Data Component	Description		
Terrain	Select from the following alternatives:		
	Flat	Rolling	Mountain
Carriageway Type	Pavement type selected from the following alternatives:		
	BT	Bituminous Top	
	CC	Cement Concrete	
	WBM	Water Bound Macadam	
	GRAVEL	Gravel	
	KUTCHA	Kutcha	
Carriageway Width	Width of the Pavement (m)		
Lane	Carriageway width selected from the following alternatives:		
	SL	Single Lane	
	IL	Intermediate Lane	
	DL	Double Lane	
	DLPS	Double Lane with paved shoulder	
Shoulder Type(Left/Right)	Shoulder type selected from the following alternatives:		
	BT	Bituminous Shoulder	
	CC	Cement Concrete Shoulder	
	BS	Brick Shoulder	
	GS	Gravel Shoulder	
	HS	Hard Shoulder	
	ES	Earth Shoulder	
Shoulder Width(Left/Right)	Left Side Shoulder width (measured to the nearest 0.1 m)		
Submergence	Selected from the following alternatives:		
	Yes	Road regularly submerged during monsoon	
	No	Road not regularly submerged during monsoon	
Landslides Protection Wall	Selected from the following alternatives:		
	Yes	Features identified within the section	
	No	No features identified within the section	
Drain	Selected from the following alternatives:		
	Lined	Drains with permanent linings / surfacing	
	Unlined	Drains without permanent linings / surfacing	
	None	No drain	
ROW	Right of way (Reserved width of land for roads) in m.		
Survey Date	The date when the road was inspected.(dd.mm.yyyy)		
Remarks	Used to record any other issues of the road, and should be supported with continuation sheets where the space provided in insufficient.		

3.1.3 Pavement Composition

Base course, sub-base and shoulder data components are summarised in Table 3-4.

Table 3-4: Pavement Composition

Data Component	Description	
Last / Present Wearing Course Type	Last / Present Wearing course type selected from the following alternatives:	
	AC	Asphalt Concrete
	SDBC	Semi-Dense Bituminous Concrete
	MSS	Mix Seal Surfacing
	PC	Premix Carpet
	SD	Surface Dressing
	CC	Cement Concrete
Old Wearing Course Type	Old Wearing course type selected from the following alternatives:	
	AC	Asphalt Concrete
	SDBC	Semi-Dense Bituminous Concrete
	MSS	Mix Seal Surfacing
	PC	Premix Carpet
	SC	Seal Coat
	SD	Surface Dressing
	CC	Cement Concrete
Present Wearing Course Thickness	Layer thickness (in mm)	
Old Wearing Course Thickness	Layer thickness (in mm)	
Binder Course Type	Base course – I type selected from the following alternatives:	
	DBM	Dense Bituminous Macadam
	BM	Bituminous Macadam
	BPM	Bituminous Penetration Macadam
	BS	Built-up Spray Grout
	DLC	Dry Lean Concrete
Binder Course Thickness	Layer thickness (in mm)	
Base Course Type	Base course – II type selected from the following alternatives:	
	WMM	Wet Mix Macadam
	WBM	Water Bound Macadam
	DLC	Dry Lean Concrete
Base Course Thickness	Layer thickness (in mm)	
Sub-base Type	Sub-base type selected from the following alternatives:	
	GSB	Granular Sub-base
	BSL	Brick Soling
	SNL	Stone Soling
	LSS	Lime Stabilised Sub-base
	CSS	Cement Stabilised Sub-base
	WBM	Water Bound Macadam Sub-base
	CCC	Crushed Cement Concrete Sub-base
	WMX	Wet Mix Macadam Sub-base
	LGS	Low Grade Aggregate Sub-base
	SAS	Soft Aggregate Stabilised Soil Sub-base
	DBM	Dry Bound Macadam Sub-base
Sub-base Thickness	Layer thickness (in mm)	
Subgrade Type	Subgrade type selected from the following alternatives:	
	HS	Hard Soil

Data Component	Description	
	SS	Soft Soil
	LSS	Lime Stabilised Soil
	C	Clay
Subgrade Soil Classification	As per Indian Soil Classification System	
	ML	Clayey Silt
	SM	Silty Sand
	CL	Silty / Sandy Clay
	SC	Clayey Sand
	GC	Clayey Gravel
	CI	Medium Silty Clay
	MH	Highly Plastic Silt
	CH	Highly Plastic Clay
Subgrade Thickness	Layer thickness (in mm)	
California Bearing Ratio CBR	Soaked CBR at 95 % of OPM. Data obtained by testing in accordance with IS: 2720 Parts 16 and/or 31	
Plasticity Index PI	Data obtained by testing in accordance with IS: 2720 Part 5 (%)	
Year of Last Wearing Course	The year when Last Wearing Course was provided	
Year of Last Rehabilitation	The year when base rehabilitation was provided	
Year of Last Reconstruction	The year when reconstruction was provided	
Survey Date	The date when the road was inspected. (dd.mm.yyyy)	
Remarks	Used to record any other issues of the pavement, and should be supported with continuation sheets where the space provided in insufficient.	

3.1.4 Pavement Condition Data

3.1.4.1 Paved Road Condition Data

A visual assessment is considered for evaluation of the six condition criteria using a four-point distress scale. The criteria and scale are summarised in Table 3-5.

Table 3-5: Paved Road Condition Data

Data Component	Description	
Cracking	The following distress levels and ratings are common to all four of the condition criteria:	
Potholes	Nil	0
Rutting	Minor	1
Ravelling	Moderate	2
Failed Sections	Extensive	3
Roughness	IRI (Select from appropriate class)	
	Low	< 4.0 IRI
	Fair	4.0 – 6.0 IRI
	Poor	6.0 – 9.0 IRI
	Very Poor	9.0 – 12.0 IRI
	Failed	> 12.0 IRI
Surface Type	Surface type selected from the following alternatives:	

Data Component	Description			
	BT	Bituminous Top		
	CC	Cement Concrete		
Roadside and Longitudinal Drainage	Selection from the following alternatives:			
	Excellent	Good	Fair	Poor
Survey date	The date when the road was inspected. (dd.mm.yyyy)			
Remarks	Used to record any other issues of the pavement, and should be supported with continuation sheets where the space provided in insufficient.			

3.1.4.2 Un-Paved Road Condition Data

A visual assessment is considered for evaluation of the condition criteria using a four-point distress scale. The criteria and scale are summarised in Table 3-6 and described in detail in the following sub-chapters.

Table 3-6: Un-Paved Road Condition Data

Data Component	Description	
Loss of gravel thickness	The following distress levels and ratings are common to all three of the condition criteria:	
	Nil	0
	Minor	1
	Moderate	2
	Extensive	3
Roughness	IRI (Select from appropriate class)	
	Low	< 6.0 IRI
	Fair	6.0 – 12.0 IRI
	Poor	12.0 – 18.0 IRI
	Very Poor	> 18.0 IRI
Surface Type	Surface type selected from the following alternatives:	
	WBM	Water Bound Macadam
	Gravel	Gravel
	Kutcha	Kutcha
Surface drainage and cross fall	Selection from the following alternatives:	
	Functional	Non-Functional
Roadside and longitudinal drainage	Selection from the following alternatives:	
	Functional	Non-Functional
Survey date	The date when the road was inspected.(dd.mm.yyyy)	
Remarks	Used to record any other issues of the pavement, and should be supported with continuation sheets where the space provided in insufficient.	

3.1.5 Pavement Structural Strength

Table 3-7: Pavement Structural Strength

Data Component	Description	
Location	Chainage of the location where test was conducted (km)	
Overall Pavement Condition	Base of Visual observation	
	Good	No Cracking, Rutting < 10mm
	Fair	No / single Cracking, Rutting between 10-20mm
	Poor	Extensive Cracking, Rutting > 20mm
Dial Gauge Reading (Initial)	at 0.0 m	
Dial Gauge Reading (Intermediate)	at 2.7 m from start point	
Dial Gauge Reading (Final)	at 9.0 m from start point	
Pavement Temperature	Degree Celsius	
Subgrade Moisture (%)	Moisture content of subgrade soil determined from laboratory test	
Subgrade Soil	As recorded in Pavement Structure	
Plasticity	As recorded in Pavement Structure	
Survey date	The date when the road was inspected.(dd.mm.yyyy)	
Remarks	Tyre pressure, Air Temperature, Rear Axle Weight etc.	

3.1.6 Traffic Details

Table 3-8: Traffic Details

Data Component		Description
Count Post No.		Unique No. of the Count Post
Count Post Location		Chainage in km
Count Post Name		Name of Place / Village
Vehicle Type	Scooter / Motor Cycle (2-wheeler)	Average Vehicle Count per day
	Auto Rickshaw (3-wheeler)	
	Car/Jeep (4-wheeler)	
	Mini Bus	
	Standard Bus	
	Tempo / Pick-up / Small Goods Vehicle	
	Light Commercial Vehicle (LCV)	
	2-Axle Truck	
	3-Axle Truck	
	Multi-Axle Truck	
	Agricultural Tractor With Trailer	
	Agricultural Tractor without Trailer	
	Cycle	
	Cycle Rickshaw	
	Animal Drawn	
	Others (Construction Vehicle etc.)	
Survey Date From		Date of Survey Initiation.(dd.mm.yyyy)
Survey Date To		Date of Survey Completion.(dd.mm.yyyy)
Remarks		Any other important observations.

3.1.7 Bridge Inventory and Condition

Bridge inventory and Condition data are summarised in Table 3-9.

Table 3-9: Bridge Inventory and Condition

Data Component	Description			
Bridge ID	Unique Identification Code for Bridge (Road Category – Road Number : Location)			
Bridge Type	Minor / Major			
Bridge Name	Formal or informal name (if any) assigned to the bridge			
Bridge No	Bridge number assigned by PWD / other authority			
Location (km)	Physical location of bridge (in km) from start of the road			
River Name	Formal or informal name (if any) assigned to the river / stream			
Year of Construction	The year the bridge was originally constructed			
Number of Spans	The total number of spans between abutments			
Length of the Bridge	The horizontal distance (m) between abutments			
H.L / S	High level or Submersible			
Carriageway Width	Typical carriageway width (measured to the nearest 0.1 m)			
Outer to outer width of bridge	Width measured from outer to outer face of railing / crash barrier / parapet			
Hand Rails Guard Stones Signs Footpath	Selected from the following alternatives:			
	Yes	Features are present		
	No	Features are not present		
To be specified for each Span separately (A1-P1, P1-P2, … , Pn-An)	Span Length	Distance between the centre to centre of expansion joints in m		
	Clear Span	Length between the inside faces of piers at pier cap level		
	Superstructure Type	Selected from the following alternatives:		
		Bailey Bridge with Timber	Concrete Beam	
		T-Girder	Box Cell	
		Concrete Deck	Pre stressed	
		Steel Beam	Arch	
	Construction Type / Superstructure Material	Selected from the following alternatives:		
		RCC	Reinforced Concrete Construction	
		Steel	Self-explanatory	
		Timber	Self-explanatory	
		Masonry	Self-explanatory(Brick / Stone)	
		Other	Any construction other than RCC, Steel or Timber	
	Bearings	Selected from the following alternatives		
		Roller-Rocker	Elastomeric	
		Pot cum PTFE	Rocker cum Roller-Rocker	
		Metal Plate	Any other	
	Deck Type	Selected from the following alternatives:		
		Reinforced Concrete	Steel	
	Deck Slab Thickness	Thickness of deck slab at the central line of the bridge in m.		
Wearing Coat Type	Flexible	Cement Concrete		

Data Component	Description				
Wearing Coat Thickness (mm)	Thickness from top surface of the deck slab to Finished Road Level				
To be specified for each Member (W1,A1,P1,P2,..,An,W2)	Substructure Abutment Type	Selected from the following alternatives:			
		Solid Wall	Spill through		
	Substructure Pier Type	Selected from the following alternatives:			
		Solid Wall	Column	Column with web	Frame
	Substructure Wing wall Type	Selected from the following alternatives			
		Return	Splayed	Butterfly	
	Pier Thickness	The typical dimensions (m) of the individual piers at top & bottom			
	Pier & Abutment Height	The height of the Pier & Abutment in m			
	Substructure Abutment Material	Selected from the following alternatives			
		PCC	RCC	Masonry	
	Substructure Pier Material	Selected from the following alternatives			
		PCC	RCC	Masonry	
	Substructure Wing wall Material	Selected from the following alternatives			
		PCC	RCC	Masonry	
	Foundation Pier Type	Selected from the following alternatives:			
		Well	Open	Pilled	Raft
	Foundation Pier Material	Selected from the following alternatives:			
		PCC	RCC	Masonry	
	Foundation Abutment Type	Selected from the following alternatives:			
		Well	Open	Pilled	Raft
	Foundation Abutment Material	Selected from the following alternatives:			
		PCC	RCC	Masonry	
Expansion Joints	Selected from the following alternatives:				
	Yes	Features are present			
	No	Features are not present			
Bed Protection Work	Selected from the following alternatives:				
	Stone Rip Rap	Gabions			
	Concrete block	Mat			
Abutment and Approach Pitching	Selected from the following alternatives:				
	Stone Rip Rap	Gabions			
	Concrete block	Mat			
Skew Angle	Angle between the perpendicular to the flow of traffic direction and the flow direction of the river.				
Vertical Clearance	Height from the design highest flood level with afflux of the channel to the lowest point of the bridge superstructure at the position along the bridge.				

Data Component	Description			
Direction of Flow	Direction of River Flow			
Clear Waterway	Total width of the waterway at HFL minus the effective width of the obstruction			
Kerb Distance	The total length of kerbing (m) adjacent to the carriageway on the bridge			
Kerb Width	The typical width of the kerbing (m) adjacent to the carriageway			
Scour Depth	The typical depth of scour (m) at the piers			
Load Capacity	Load capacity (in t) as originally designed or subsequently regulated			
Water Discharge	The estimated maximum flow discharge (m3/sec)			
Design Velocity	The Maximum Velocity for which the bridge has been designed			
Flood and Water Levels (All relative to state-defined datum)	HFL	Highest flood recorded at / calculated for the bridge location (m)		
	LWL	Level of water surface generally observed in dry season (m)		
	LBL	Lowest river bed level (m)		
General Condition	Selected from the following alternatives:			
	Poor	Fair	Good	
Inspection Required?	Selected from the following alternatives:	Yes	No	
Survey Date	The date when the bridge was inspected.(dd.mm.yyyy)			
Remarks	Used to record any other issues on the bridge, and should be supported with continuation sheets where the space provided is insufficient.			

3.1.8 Culvert Data

Culvert inventory and Condition data are summarised in Table 3-10.

Table 3-10: Culvert Inventory and Condition

Data Component	Description	
Culvert ID	Unique Identification Code (Road Category - Road Number : Location)	
Culvert No.	Culvert number assigned by PWD / other authority	
Location (km)	Physical location of culvert (in km from start of section)	
Type	Selected from the following alternatives:	
	BOC	Concrete box culvert
	CP	Concrete pipe culvert
	SLB	Slab Culvert
	CW	Causeway
	Other	Other type specified by the state
No. of rows	The number of rows in a pipe culvert	
No. of Spans	The number of spans of Slab or Box Culvert	
Pipe Diameter	Diameter of the pipe in m	
Slab width	Width of the slab along the carriageway in m	
Length	The total length (m) of the culvert parallel to the direction of flow	
Outlet Type	Selected from the following alternatives:	

Data Component	Description		
	Opening Drain	Stepping Drain	
Facewall Type	Selected from the following alternatives:		
	PCC	Precast Concrete	
	RCC	Reinforced Concrete	
	Stone Masonry		
	Brick		
Toewall Type	Selected from the following alternatives:		
	PCC	Precast Concrete	
	RCC	Reinforced Concrete	
	Stone Masonry		
	Brick		
Carriageway Width	Outer to outer width between kerbs (m)		
Overall Condition	Selected from the following alternatives:		
	Good	Fair	Poor
Survey Date	The date when the culvert was inspected. (dd.mm.yyyy)		
Remarks	Used to record any other issues on the culvert, and should be supported with continuation sheets where the space provided in insufficient.		

3.1.9 Habitation Details Data

Habitation details are summarised in Table 3-11.

Table 3-11: Habitation Details

Data Component	Description	
Administrative Centre Market Facility Intersections	Selected from the following alternatives:	
	Yes	Features are present
	No	Features are not present
Reserve Forest Sanctuary Lakes Tourist Spots	Selected from the following alternatives:	
	Yes	Features are present
	No	Features are not present
Health Centre	Selected from the following alternatives:	
	HOSPITAL	Hospital
	HC	Health Centre
	CLINIC	Clinic
Land Use (L / R)	Selected from the following alternatives:	
	Bu	Built-up
	A	Agriculture
	F	Forest
	I	Industrial
	R	River
	Ba	Barren

Data Component	Description	
	W	Water
Abutting Village	Name of Village (if present)	
Population	The population of village	
List of Monuments	Important monuments	
Education	Institutions offering education selected from the following alternatives:	
	Degree	Secondary
	Primary	
Remarks	Existing data on facilities and remarks thereon	

3.2 SUGGESTED DATA COLLECTION METHODOLOGY

The methodology and equipment proposed for each data type is listed in the Table 3-12.

Table 3-12: Suggested Data Collection Methodology

Data Collection Type	Methodology & Equipment Proposed
Road Inventory	Precision odometer (and DGPS mounted vehicle-optional for GPS data) for road length, measuring tape for other roadway features.
Pavement Composition	Pavement composition, PI & CBR data - Historical data from PWD / Test Pit & testing of soil samples in Laboratory
Paved Road Condition Details	Rating of Distress through visual inspection.
Unpaved Road Condition Details	
Bridge Details	30m Measuring tape, Binocular (Min. 10/32), Visual Assessment of condition, camera, Design data from PWD
Culvert Details	30m Measuring tape, Binocular (Min. 10/32), Visual Assessment of condition, camera, Design data from PWD
Habitation Details	30m Measuring tape, GPS, Visual Assessment, camera. This survey is proposed along with Road Inventory survey.
Traffic volume Count Survey	Manual Classified Volume Count (24 hours – 3 days). One Volume count station with in each major intersection is suggested. Traffic count location is to be identified away from local traffic interference.
Pavement deflection Study	Benkelman Beam Deflection Survey based on IRC-81: 1997 is proposed in every 0.5km

Chapter 4. Guidelines on Survey Methodology

4.1 PAVEMENT INSPECTION

For Bituminous Topped (BT) roads carry out a visual condition survey at least once a year, after the monsoon the condition survey to be based per 0.5 km on road distress types and extent defined in Table 4-1.

Each Segment of the State Highway (SH) and Major District Roads (MDR) network is to be rated for every 0.5 km segments (0 – 0.5, 0.5 – 1.0 etc.). The start or end should necessarily be a Km Stone. Generally the segment length will be 0.5 km; however it can be less than 0.5 km in the following cases.

- for the first Segment (between the beginning point of the Road and the first 0.5 km location) where small portion is merged in city road
- the last Segment (between the last km Stone and the road ending point)
- intermediate Segments in case of portions merged in National Highway or other roads.

Table 4-1: Typical Bituminous Pavement Distresses to be Rated

Typical Bituminous Pavement Distresses Types/Definition	Severity	
	Code	Description
Failed Sections (evidence of base course failure): Distressed (crack width > 20 mm) or deformed road surface where depth is greater than 75 mm and exceeding 1 m^2	Nil (0)	None or few isolated spots (< 5 m2/km)
	Minor (1)	Failed over less than 10% of road length
	Moderate (2)	Failed over 10-50% of road length
	Extensive (3)	Failed over more than 50% of road length
Cracking (sealed & unsealed longitudinal Cracks and alligator cracks)(1)	Nil (0)	No cracking or few isolated spots (< 5 m2/km)
	Minor (1)	Cracking over less than 10% of road length
	Moderate (2)	Cracking over 10-50% of road length
	Extensive (3)	Cracking over more than 50% of road length
Potholes (bowl shaped holes > 100 cm^2 in area and >25 mm in depth) (2) Shallow: Depth less than 50 mm Deep: Depth more than 50 mm	Nil (0)	None or few isolated shallow potholes (< 5 m2/km)
	Minor (1)	Occasional deep potholes and/or frequent shallow potholes
	Moderate (2)	Frequent deep potholes affecting vehicle speed
	Extensive (3)	Potholes spread across carriageway (comfortable speed: <30 km/h)
Ravelling (wearing away of aggregates)	Nil (0)	None or few isolated spots (< 5 m2/km)
	Minor (1)	Ravelled over less than 10% of road length
	Moderate (2)	Ravelled over 10-50% of road length
	Extensive (3)	Ravelled over more than 50% of road length

Typical Bituminous Pavement Distresses Types/Definition	Severity	
	Code	**Description**
Rutting (Transverse Deformation)	Nil (0)	No visible sign of Rutting.
	Minor (1)	Depth less than 15 mm with or without longitudinal crack
	Moderate (2)	Depth between above 15 mm – 30 mm with or without longitudinal crack
	Extensive (3)	More than 30 mm in depth less with or without longitudinal crack or multiple longitudinal cracks
General Cond. of Drainage (for HDM use)	Exc (0)	No problem of drainage
	Good (1)	Excellent over more than 90% of road length
	Fair (2)	Excellent over 50-90% of road length
	Poor (3)	Excellent over less than 50% of road length

(1) Severe cracks rated under "Failed Sections" are not rated again under "Cracking"; potholes within the Failed Sections are excluded when rating “Potholes”

(2) Irregularities less than 100 cm2 in area or less than 25 mm in depth are considered under “Ravelling”

Failed Sections

Evidence of base course failure: Distressed (crack width > 20 mm) or deformed road surface where depth is greater than 75 mm and exceeding 1 m^2

Nil (0):

None or few isolated spots (< 5 m^2/km)

The picture shows two failed spots, including very wide cracks, deep depressions and total failure of pavement. The 0.5-km segment under rating showing only such few failed spots (< 5 m^2/km) is rated **Nil** regarding Failed Sections.

Minor (1):

Failed over less than 10% of road length

The picture shows several failed sections. The 0.5-km segment under rating showing similar failed sections significantly more than 5 m2/km but over less than 10 percent of the **length** (visual assessment) is rated **Minor** regarding Failed Sections.

Failed Sections

Evidence of base course failure: Distressed (crack width > 12 mm) or deformed road surface where depth is greater than 75 mm and exceeding 1 m^2

Moderate (2):

Failed over 10-50% of road length

The picture shows several failed sections. The 0.5-km segment under rating showing similar failed sections over 10-50 percent of the **length** (visual assessment) is rated **Medium** regarding Failed Sections.

Extensive (3):

Failed over more than 50% of road length

The picture shows several failed sections. The 0.5-km segment under rating showing similar failed sections over more than 50 percent of the **length** (visual assessment) is rated **Extensive** regarding Failed Sections.

Cracking

A crack is a fissure or discontinuity in the pavement surface which may or may not extend through the entire thickness of the pavement.

Cracking may be identified by its cause, such as transverse or environmental, fatigue and miscellaneous cracking.

It could be identified by its location and/or visual appearance, such as longitudinal, transverse, wheel path, edge, map and alligator cracking

Severe cracks (>20mm) rated under "Failed Sections" are not rated again under "Cracking".

Nil (0):

None or few isolated spots (< 5 m^2/km)

The picture shows a cracked spot. The 0.5-km segment under rating showing only such few cracked spots (< 5 m^2/km) is rated **Nil** regarding Cracking.

Minor (1):

Cracked over less than 10% of road length

The picture shows several cracked areas. The 0.5-km segment under rating showing similar cracked sections significantly more than 5 m2/km but over less than 10 percent of the **length** (visual assessment) is rated **Minor** regarding Cracking.

Cracking

Sealed & unsealed longitudinal cracks and alligator cracks

Severe cracks rated under "Failed Sections" are not rated again under "Cracking".

Moderate (2):

Cracked over 10-50% of road length

The picture shows more extended cracked areas. The 0.5-km segment under rating showing similar cracked sections over 10-50 percent of the **length** (visual assessment) is rated **Moderate** regarding Cracking.

Extensive (3):

Cracked over more than 50% of road length

The picture shows extensive Cracked sections. The 0.5-km segment under rating showing similar cracked sections over more than 50 percent of the **length** (visual assessment) is rated **Extensive** regarding Cracking.

Potholes

Bowl, round or irregular shaped holes (depressions) in pavement. It can be unrelated to or a direct result of other defects such as ravelling, alligator cracking etc. Bowl shaped holes > 100 cm2 in area and >25 mm in depth) (1) (2)

Shallow: Depth less than 50 mm

Deep: Depth more than 50 mm

(1) Potholes within the Failed Sections are excluded when rating “Potholes”

(2) Irregularities less than 100 cm2 in area or less than 25 mm in depth are considered under “Ravelling”

Nil (0):

None or few isolated shallow potholes (< 5 m2/km)

The picture shows an isolated shallow pothole. The 0.5-km segment under rating showing only such few potholes (< 5 m2/km) is rated **Nil** regarding Potholes.

Minor (1):

Occasional deep potholes and/or frequent shallow potholes

The picture shows several shallow potholes. The 0.5-km segment under rating showing similar potholes (or occasional deep potholes) significantly more than 5 m2/km is rated **Minor**.

Potholes

Bowl shaped holes > 100 cm2 in area and >25 mm in depth) (1) (2)

Shallow: Depth less than 50 mm

Deep: Depth more than 50 mm

(1) Potholes within the Failed Sections are excluded when rating "Potholes"

(2) Irregularities less than 100 cm2 in area or less than 25 mm in depth are considered under "Ravelling"

Moderate (2):

Frequent deep potholes affecting vehicle speed

The picture shows frequent deep potholes, resulting in significant speed reduction for the users.

Extensive (3):

Potholes spread across carriageway (comfortable speed: <30 km/h)

The picture shows numerous deep potholes resulting in severe consequences for the users.

Ravelling

Progressive loss of pavement materials (coarse / fine aggregates or both) from the surface is raveling.

Pavement surface looks as if it is breaking up into small pieces due to dislodging of aggregate particles and degradation of the bituminous binder.

Raveling can occur over the entire surface but the wheel paths are generally the worst areas because of the traffic action.

Nil (0):

None or few isolated spots (< 5 m2/km)

The 0.5-km segment under rating showing only few ravelled spots (< 5 m2/km) is rated **Nil** regarding Ravelling.

Minor (1):

Ravelled over less than 10% of road length

The picture shows several ravelled areas. The 0.5-km segment under rating showing similar ravelled sections significantly more than 5 m2/km but over less than 10 percent of the **length** (visual assessment) is rated **Low** regarding Ravelling.

Ravelling

Wearing away of aggregates

Moderate (2):

Ravelled over 10-50% of road length

The 1-km segment under rating showing similar ravelled sections over 10-50 percent of the **length** (visual assessment) is rated **Moderate** regarding Ravelling.

Extensive (3):

Ravelled over more than 50% of road length

The picture shows extensive Ravelled sections. The 1-km segment under rating showing similar ravelled sections over more than 50 percent of the **length** (visual assessment) is rated **Extensive** regarding Ravelling.

Note: Potholes are also visible as a result of extensive ravelling.

Rutting

Longitudinal depression left in the wheel path after repeated load application. It results from densification and pavement deformation under load combined with displacement of pavement materials. Deep ruts are often accompanied by longitudinal cracking in the wheel path.

Nil (0):

None or less than 5 mm average Rut depth

This is generally not noticeable. The 0.5-km segment under rating showing only few rutting spots (< 5 mm) is rated **Nil** regarding Rutting.

Minor (1):

Average Rut depth 5 – 15 mm

The picture shows visible rutting of depth 5 – 15 mm . The 0.5-km segment under rating showing similar average rut depth 5 – 15 mm is rated **Minor** regarding Rutting.

Rutting

Moderate (2):

Average Rut depth 15 – 30 mm

The picture shows visible rutting of depth 15 – 30 mm . The 0.5-km segment under rating showing similar average rut depth 15 – 30 mm is rated **Moderate** regarding Rutting.

Extensive (3):

Average Rut depth > 30 mm

The picture shows visible rutting of depth > 30 mm. The 0.5-km segment under rating showing similar average rut depth > 30 mm is rated **Extensive** regarding Rutting.

General Condition of Drainage

HDM requires an assessment of the general condition of drainage of each road section. The relevant data are collected per km.

The main cases of deficient drainage are listed below:

1. Low embankment in flat area
2. Drainage system blocked resulting in flooded sections
3. Cross drainage under designed resulting in flooded sections

Example of case 1 in rural area: Low embankment in flat area

The pond in the background is approximately at the same level as the wearing course. The drainage condition is deficient.

Example of case 2/3 in rural area: Deficient cross drainage

This pipe culvert (2 rows) is severely blocked and seems to require some form of structural adjustment.

Accordingly, each Segment is rated as shown below:

General Cond. of Drainage	Rating	Definition
	Exc (0)	No problem of drainage
	Good (1)	Excellent over more than 90% of Segment length
	Fair (2)	Excellent over 50-90% of Segment length
	Poor (3)	Excellent over less than 50% of Segment length

4.2 ROUGHNESS

Assessment of roughness has to be carried out at least once a year prior to programming the maintenance works for next year along the complete network. This yearly survey is performed **per 0.5 km** of BT roads based on:

- Range of safe/comfortable speed for road user
- Severity of pavement distresses

It results in the rating of the SH/MDR network into four classes of roughness ("1" to "4") according to the criteria shown in below.

Criteria

Derived from the OECD Document "Road Monitoring for Maintenance Management" Annex B, the criteria for assessing the roughness range per km are listed for BT and Gravel roads. In the case of BT roads, direct measurement through equipment (profiler, bump integrator etc.) can also be used for record in the database.

Table 4-2: Definition of Roughness Classes for BT Roads

Criteria		PMS Roughness Class	For information IRI Range (m/km)
"Comfortable"(1) Speed* (km/hour)	Distress Type/Severity"(2)		
Seems to be comfortable at any speed…	No distresses	**1 Low**	<=4
> 60	No Failed Sections, no significant potholes; other distresses are Low/Med	**2 Fair**	4-6
40 - 60	Failed Sections and/or Potholes are Low/Med and/or other distresses are High	**3 Poor**	6-9
25 - 40	Potholes are Med/High and/or other distresses are High Special case: Failed Sections/Potholes have been fixed resulting in frequent "bumpy" patching	**4 Very Poor**	9-12
< 25	Failed Sections and/or Potholes are High ***The Segment requires reconstruction due to base failure***	**5 Failed** (3)	> 12

(1) along straight alignments excluding interferences with other users

(2) as defined in Table 4.1

(3) **The PMS module considers this roughness class (5) as criteria for selecting the corresponding sections for the reconstruction programme**

4.3 PAVEMENT DEFLECTION

The most commonly used equipment to measure pavement surface deflections under static or slow moving loads is the Benkelman Beam. This device was developed at the Western Association of State Highway Organizations Road Test in 1952 in Malad, Idaho. Until recently it was the most widely used pavement deflection measuring device, and is still the equipment of choice in developing countries. The Benkelman Beam test procedure involves the measurement of a surface rebound with a cantilevered beam as a truck loaded to 8200 kg (80kN) on its rear axle moves from rest. Measurements are made between dual tires on the rear axle at specified intervals in the outer wheel path.

The main advantages of Benkelman Beam are:

(i) Its simplicity and ease of use

(ii) Low equipment cost

(iii) The existence of a large database from its use over many years.

The disadvantages and the problems include:

(i) The cumbersome nature of the device

(ii) The slow and labour intensive test procedure

(iii) The need to ensure that the front supports are not in the deflection basin

(iv) The difficulty or inability to provide a 'true' shape and size of the deflection basin

(v) Poor repeatability of measurements

(vi) Poor precision and bias.

In addition, the static or quasi-static loading employed does not accurately represent the effects of a moving wheel load. The equipment and test method for normal Benkelman Beam deflection measurements are given in "Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique", IRC-81:1997. In brief, the test procedure is as follows:

1. A truck loaded so that the weight on the rear axle is 8.20 $\pm$ 0.20 tonne equally distributed on dual tired wheels operating at the inflation pressure of 550 $\pm$ 10kPa is brought over the test point and the probe is inserted between the wheels.
2. The dial gauge reading (D_0) is noted.
3. The truck is driven forward at a slow speed and readings (D_1 and D_2) recorded while stopped at 2.7m and 9.0m from the starting point.
4. If $D_1 - D_2 \leq 0.25$m, then, rebound deflection = $2 (D_0 - D_2)$.

   If $D_1 - D_2 > 0.25$m then, rebound deflection = $2 (D_0 - D_2) + 5.82 (D_1 - D_2)$

4.4 TRAFFIC SURVEY

One of the fundamental measures of traffic on a road is the volume of traffic using the road in a given interval of time. It is also termed as flow and it is expressed in vehicles per hour or vehicles per day. It can also be expressed in PCU per hour or PCU per day. When the traffic is composed of a number of vehicles, it is the normal practice to convert the flow into equivalent Passenger-Car Unit (PCU), by using equivalency factors. The flow is then expressed as PCUs per hour or PCUs per day.

4.4.1 Locating Traffic Survey Count Post/Census Station

Judicious location of traffic survey count post/census stations is crucial to the success of a traffic survey programme. Hence, locating a traffic survey station on a pre-identified road section should be undertaken as follows:

- Step 1: Indentify the end points along the section of any such developed areas, which could include local traffic. Also identify junctions and intersections that could have high volumes of local traffic.
- Step 2: Identify tentative locations for survey count posts/census stations which can avoid such local traffic. The location shall be well away from all urbanized development, major villages, and major junctions/intersection on the road section.
- Step 3: Check that the necessary logistics for conducting traffic volume surveys such as permanent shelter for 3 days, light, table/chairs etc., can be provided at the identified location.
- Step 4: Finalize the location and name the traffic survey count posts/census station.
- Step 5: Locate and mark all the traffic survey stations on an index at district level.

4.4.2 Frequency and Duration of Survey

Traffic shall be counted at each station for three continuous days

4.4.3 Definition of Vehicle Type

All sixteen vehicle types have been arranged into “passenger motorized”, “goods motorized”, and “non-motorized” categories. A brief description of each vehicle type is given in the following table:

Table 4-3: Vehicle Types

Sl. No.	Vehicle Type	Vehicle Category	Brief Description
1.	Sc/Mc (2-wheeler)	Passenger Motorized	All **motorized two wheelers** e.g. Scooters/motor cycles/mopeds with or without side car.
2.	Auto Rickshaw (3-wheeler)	Passenger Motorized	All **motorized three-wheelers** e.g. Auto Rickshaw/Tempo/ Ace Auto.
3.	Car/Jeep (4-wheeler)	Passenger Motorized	**Passenger carrying four-wheelers** (up to 8/10 seaters) equipped with old / new technology ignition and fuel injection system. Examples: All Maruti/Hyundai/Ford/Toyota/TATA/Daewoo products, Palio, Scorpio, Ambassador, Fiat, Mahindra Jeeps etc.

Sl. No.	Vehicle Type	Vehicle Category	Brief Description
4.	Mini Bus	Passenger Motorized	**Passenger carrying four/six-wheelers** (up to 25 seaters) mini buses built on TATA-407/607chassis or other products such as Swaraj Mazda, Eicher, RTV, Starline etc.
5.	Std. Bus	Passenger Motorized	**Passenger carrying six-wheelers** (from 26 to 60 seaters or more) big buses built on TATA or Ashok Leyland chassis or other products such as Volvo etc.
6.	Tempo/ Pick-up/ Small Goods Vehicle	Goods Motorized	**Tempo/ Pick-up/ Small Goods Vehicle** (< 3 Tonne Capacity)
7.	Light Commercial Vehicle (LCV)	Goods Motorized	**Goods carrying four/six-wheelers** (up to 5 tonne capacity) small/mini trucks built on TATA-407/607chassis or other products such as Swaraj Mazda, Eicher etc including pick-up vans (light delivery vehicles).
8.	2-Axle Truck	Goods Motorized	**Goods carrying six-wheelers** (up to 9 tonne capacity) big trucks built on TATA or Ashok Leyland chassis. Rear axle normally has four wheels, two on each side.
9.	3-Axle Truck	Goods Motorized	**Goods carrying ten-wheelers** (up to 13 tonne capacity) big trucks with tandem axle or semi articulated typically built on TATA make chassis or other products such as Volvo. These trucks shall have three axles in total. The rear two axles normally have four wheels on each axle, two on each side.
10.	Multi-Axle Truck	Goods Motorized	**Goods carrying truck trailers** with more than three axles or more than ten-wheel (up to 60 tonne capacity) articulated typically built on TATA make chassis or other products such as Volvo.
11.	Tractor With Trailer	Goods Motorized	**Tractors** used for agricultural purposes from any manufacturing companies such as Mahindra, Ford, Eicher, Massy etc **with trailer(s)** for transportation of agricultural products or any other goods.
12.	Tractor without Trailer	Goods Motorized	**Tractors** used for agricultural purposes **without trailer** from any manufacturing companies such as Mahindra, Ford, Eicher, Massy etc.
13.	Cycle	Passenger Non Motorized	Non-motorized two wheelers operated with **pedals** used for self transport.
14.	Cycle Rickshaw	Passenger Non Motorized	Non-motorized three wheeler operated with **pedals** used for passenger transport. With a bit change in body are also used for goods transport.
15.	Animal Drawn	Non Motorized	Non-motorized vehicles **driven by animal(s)** such as bullock(s) and Buffalo(s) etc.
16.	Others (pl. specify)	Motorized/ Non-Motorized	**Any other** vehicle type not covered above. Typically construction vehicles or country-made customized vehicle for specific purpose. Mention local name of these vehicle type.

Note: Ambulances/police van/School Bus etc. made/customized on any motorized passenger vehicle type shall be counted under the respective vehicle type. Example: "Maruti Van/OMNI" Ambulance shall be captured in Car/Jeep category. Ambulance of mini bus definition shall be captured in Mini Bus category. Same applies in case of police vans/school buses etc.

ANNEXURE 1: (data collection formats)

Public Works Department

Road Identification Data								
Division Code:								
Division Name:	Jirania							
Sl. No.	**Road Name**	**Road Category** NH SH MDR ODR	**Road Number**	**Chainage From** km	**Chainage To** km	**Length** km	**Reference From** name of Place	**Reference To** name of Place

Public Works Department

Road Sections							
Division: Jirania							
Unique Section No. (Road ID.+ Chainage From+ Chainage To)	**Road ID** (Road Category+Number eg. SH01)	**Chainage From** km	**Chainage To** km	**Reference From** Name of Village	**Reference To** Name of Village	**Subdivision**	**District**

 # Data is to be defined for every 0.5km sections for a road

Public Works Department

Road Inventory Data

Division: Jiarania

Unique Section No.	Terrain	Carriageway Type	Carriageway Width	Lanes	Shoulder Type (L)	Shoulder Width (L) (m)	Shoulder Type (R)	Shoulder Width (R) (m)	Submergence (Y/N)	Landslides Protection Wall (Y/N)	Drain	ROW (m)	Survey Date	Remarks

Options

Flat	BT	SL	BT	BT		Lined
Rolling	CC	IL	CC	CC		Unlined
Mountain	WBM	DL	Brick	Brick		None
	Brick Soled	DLPS	Gravel	Gravel		
	Earthen	3L	Hard	Hard		
		4L	Earthen	Earthen		

 # Data is to be defined for every 0.5km sections created earlier

Public Works Department

Pavement Composition

Division: Jiarania

Unique Section No.	Last / Present Wearing Course Type	Wearing Course Thickness (mm)	Old Wearing Course Type	Old Wearing Course Thickness (mm)	Binder Course Type	Binder Course Thickness (mm)	Base Course Type	Base Course Thickness (mm)	Sub-base Type	Sub-base Thickness (mm)	Subgrade Type	Subgrade Thickness (mm)	Subgrade Soil Classification	California Bearing Ratio (CBR)	Plasiticity Index (PI) (%)	Construction Year	Year of Last Wearing Course	Year of Last Rehabilitation	Remarks

 # Data is to be defined for every 0.5km sections for a road

Options

SDBC	SDBC	DBM	WMM	**GSB**:Gravel Sub-base
MSS	MSS	BM	WBM	**BSL**:Brick Soling
PC	PC	BSG	DLC	**SNL**:Stone Soling
SD	SD			**LSS**:Lime Stabilised Sub-base
CC	CC			**CSS**:Cement Stabilised Sub-base
AC	AC			**WBM**:Water Bound Macadam
				CCC:Crushed Cement Concrete
				WMM:Wet Mix Macadam
				LGS:Low Grade Aggregate
				SAS:Soft Aggregate Stabilised Soil
				DM:Dense Bound Macadam

HS:Hard Soil	**ML**:Clayey Silt	
SS:Soft Soil	**SM**:Silty Sand	
LSS:Lime Stabilised Soil	**CL**:Silty / Sandy Clay	
CL:Clay	**SC**:Clayey Sand	
	GC:Clayey Gravel	
	CI:Medium Silty Clay	
	MH:Highly Plastic Silt	
	CH:Highly Plastic Clay	

Public Works Department

Paved Road Condition Data

Division:

Unique Section No.	Cracking	Potholes	Rutting	Ravelling	Failed Section	Roughness	Surface Type	Drainage	Survey Date dd.mm.yyyy	Remarks
SH03:0-0.5										
SH03:0.5-1										
SH03:1-1.5										
SH03:1.5-2										
SH03:2-2.5										

 # Data is to be defined for every 0.5km sections for a road

Options

Nil	0	0	0	0	0	Low:<4.0 IRI	BT	0:Excellent
Minor	1	1	1	1	1	Fair:4.0-6.0 IRI	WBM	1:Good
Moderate	2	2	2	2	2	Poor:6.0-9.0 IRI	GRAVEL	2:Fair
Extensive	3	3	3	3	3	Very Poor:9.0- 12.0 IRI	KUTCHA	3:Poor
						Failed:> 12.0 IRI		

Public Works Department

Pavement Structural Strength											
Division:											
Unique Section No.	**Location (km)**	**Overall Pavement Condition**	**Dial Gauge Reading (Initial) (mm)**	**Dial Gauge Reading (Intermediate) (mm)**	**Dial Gauge Reading (Final) (mm)**	**Pavement Temparature (^{0} C)**	**Subgrade Moisture (%)**	**Subgrade Soil***	**Plasiticity Index (PI)* (%)**	**Survey Date**	**Remarks**
SH03:0-0.5											
SH03:0.5-1											
SH03:1-1.5											
SH03:1.5-2											
SH03:2-2.5											
SH03:2.5-3											
SH03:3-3.5											
SH03:3.5-4											

 # Data is to be defined for every 0.5km sections for a road

* To be used from Pavement Composition

Good
Fair
Poor

Public Works Department

Unpaved Road Condition Data						
Division:						
Unique Section No.	**Loss of Gravel Thickness**	**Surface Drainage and Crossfall**	**Roadside and Longitudinal Drainahge**	**Roughness**	**Survey Date**	**Remarks**

 # Data is to be defined for every 0.5km sections for a road

Options

Nil	0	Functional	Functional	Low:<6.0 IRI
Minor	1	Non-Functional	Non-Functional	Fair:6.0-12.0 IRI
Moderate	2			Poor:12.0-18.0 IRI
Extensive	3			Very Poor:> 18.0 IRI

Public Works Department

Bridge Inventory

Division:

Bridge ID (BR:RoadID+Chainage)	Bridge Type	Bridge Name	Bridge Number	Location (km)	River Name	Year of construction	No. of Spans	Length of bridge (m) (between inner faces of dirt walls)	High level or submersible	Carriageway width (m)	Outer to outer width of bridge (m)	Hand Rails Guard Stones Signs Footpath (Y/N)	Super structure (Span Wise)							Wearing coat		Sub-structure (Member Wise)									Foundation (Member Wise)				Protection works		Skew angle (degree)	Vertical clearance (m)	Direction of flow	Clear waterway (m)	Kerb Distance(m)	Kerb Width(m)	Scour Depth(m)	Load Capacity(Tonnes)	Design discharge (cumecs)	Design Velocity(m/s)	High flood level (HFL) (m)	Lowest water level (m)	Lowest River Bed Level(m)	General Condition(Poor / Fair / Good)	Inspection required(Yes / No)	Survey Date	Remarks
																						Type			Thickness/ Diameter of pier (m)		Height of pier & abutment (m)	Material			Pier		Abutment																					
													Span Length (m)	Clear Span (m)	Type (Slab/Girder & Slab/ Balanced Cantilever/ Arch / Steel Girder)	Material (RCC/PSC & RCC/Masonry/Steel)	Type of bearings (elastomeric/pot-cum-PTFE/roller-rocker)	Deck Type (RCC / Steel)	Thickness (m) (Deck Slab)	Type (CC / Flexible)	Thickness (mm)	Abutment (Wall / Spill through)	Pier (Columns / Wall / Frame)	Wing wall (Return/Splay/Butter fly)	Top	Bottom		Abutment (Masonry/PCC/RCC)	Pier (Masonry/PCC/RCC)	Wing wall (Masonry/PCC/RCC)	Type (Well/Piles/Raft/Open)	Material	Type (Well/Piles/Raft/Open)	Material	Bed	Abutment & Approach Pitching																		
1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
R04																																																		
A1																																																		
p1																																																		
p2																																																		
A2																																																		
A1p1																																																		
p1p2																																																		
p2A2																																																		
W1																																																		
W2																																																		

Public Works Department

Culvert Data															
Division:															
Culvert ID (CL:RoadID+Chainage)	**Culvert No.**	**Location (km)**	**Type of Culvert**	**No. of Rows**	**Pipe Diameter (m)**	**No. Of Spans**	**Slab Width (m)**	**Length of the Culvert (m)**	**Outlet Type**	**Facewall Type**	**Toewall Type**	**Carriageway Width (m)**	**Overall Condition**	**Survey Date**	**Remarks**
CL:SH03+10.1															

Options

Box	Open	PCC	PCC	Good
Pipe	Stepping	RCC	RCC	Fair
Slab		Stone Mas	Stone Masonry	Poor
Causeway		Brick	Brick	
Other				

Public Works Department

Habitation Details															
Division:															
Unique Section No.	**Administrative Centre** (Y/N)	**Market Facility** (Y/N)	**Intersections** (Y/N)	**Reserve Forest** (Y/N)	**Sanctuary** (Y/N)	**Lakes** (Y/N)	**Tourist Spots** (Y/N)	**Health Facility**	**Education Centre**	**Landuse** (Left)	**Landuse** (Right)	**Abutting Village**	**Population**	**List of Monuments**	**Remarks**

 # Data is to be defined for every 0.5km sections for a road

Options

Hospital	Degree	Built-up	Built-up
Health Centre	Secondary	Agriculture	Agriculture
Clinic	Primary	Forest	Forest
		Industrial	Industrial
		River	River
		Barren	Barren
		Water	Water

Public Works Department

Traffic Volume Count Survey

Division: :

Addl. Information:

Circle:

Name of Road: :

Weather:

Day:

Location Name and Chainage

Direction:

From

To:

Date :

Time Period	PASSENGER TRAFFIC					GOODS TRAFFIC							NON-MOTORISED TRAFFIC			Others (Pl. Specify)
	Sector / Motor Cycle	3-Wheeler/ Auto	Car/Jeep/Van/ Taxi	Buses		Tempo	LCV	2-Axle Trucks	3-Axle Trucks	Multi-Axle	Agri.Tractor		Cycle	Cycle Rickshaw	Animal Drawn	
				Mini Bus	Stand. Bus						With Trailer	Without Trailer				
: 00 To : 15																
: 15 To : 30																
: 30 To : 45																
: 45 To : 00																
Total																

Name & Signature of Enumerator :

Name & Signature of Supervisors :

Public Works Department

Traffic Details

Division:

Unique Section No.	Count Post No.	Count Post Location (km)	Count Post Name	Scooter/ Motor Cycle (2-wheeler)	Auto Rickshaw (3-Wheeler)	Car/Jeep (4-Wheeler)	Mini Bus	Standard Bus	Tempo/ Pick-up/ Small Goods Vehicle	Light Commercial Vehicle (LCV)	2-Axle Truck	3-Axle Truck	Multi-Axle Truck	Agricultural Tractor With Trailer	Agricultural Tractor Without Trailer	Cycle	Cycle Rickshaw	Animal Drawn	Others (Construction Vehicle etc.)	Survey Date From	Survey Date To	Remarks

 # Data is to be defined for every 0.5km sections for a road