ROAD ASSET MANAGEMENT SYSTEM (RAMS)

SOP for Data Collection through NSV

1. Background

National Highways are developed and managed by Ministry of Road Transport and Highways (MORT&H), through its implementing agencies, i.e., State PWDs and its associated organisations, National Highways Authority of India (NHAI), National Highways Infrastructure Development Corporation Ltd (NHIDCL), and Border Roads Organisation (BRO).

MoRTH and NHAI have developed Road Asset Management System (RAMS) for managing and maintaining the entire National Highways in India through a systematic, scientific and life cycle analysis. It combines the engineering principles with sound business practices and economic rationale. It provides tools to facilitate a more organized, logical and flexible approach to decisions for handling both short- and Long-term planning, programming and budgeting. In addition, RAMS also provides a platform for seamless experience in accessing up to date information on road assets. RAMS has GIS capability to provide information to road users on various attributes of road networks such as traffic, road site amenities and facilities.

RAMS for the entire National Highways along with the collection of requisite data is underway as part of the Digital India initiative.

2. RAMS Objectives and Benefits

The broad objective of the RAMS is to store road asset information in digital format, analyse these information using different software modules and then provide tangible outputs which can be utilized for planning, maintenance, upgradation, renewal and taking scientific based decisions into consideration for optimal utilisation of available budgets.

The system will provide input on continuous basis for maintenance and up-gradation of completed roads with economic analysis to determine priorities. RAMS is an integrated Web based system coupled with GIS features. The information captured in RAMS is collectively used as input to Highway Development & Management (HDM-4) software which would be used as tool for strategic, tactical analysis and planning of

National Highways. RAMS consists of core modules and support modules, catering to collection and management of highway information i.e. highway planning and maintenance management.

Various benefits can be derived from RAMS, particularly on:

- maintaining reliable, historical and up to date asset inventory and other data;
- road assets condition status and maintenance strategies;
- scientific analysis of maintenance options and selection of optimal maintenance regime;
- providing vital information on road network planning;
- providing relevant information on other aspects such as development of road safety measures, etc.

4. Modules of RAMS

RAMS consists of

- **Location Reference Management System (LRMS):** Maintains road network information, such as spatial coordinates of road alignment (road centre lines) and linear chainage etc;
- **Road Information System (RIS):** A data repository system including inventory, condition, Roughness, wayside amenities, road furniture, multimedia data like videos and photos etc;
- **Pavement Management System (PMS):** An important module aimed at performing maintenance needs analysis, prioritisation of maintenance activities, selection of optimal maintenance treatments/strategies under unconstrained and constrained budgets;
- **Bridge Information System (BIS):** A data repository for bridge and culvert inventory and condition including brief details on maintenance and priorities (interfaced with Indian Bridge management System – IBMS);
- **Traffic Information System (TIS):** A data repository for traffic volume and loading details (interfaced with IHMCL Traffic Database);
- **Accident Information System (AIS):** A data repository for accidents data including fatal, major and minor accidents and its attributes including location details;
- **Toll Information System (TOIS):** A data repository for Toll Plazas locations and user fee details levied on National Highways;

- **Environmental Information System (EIS):** A data repository of all relevant assets, features and structures within the Right of Way (ROW), such as religious structures, heritage structures, trees, ponds, lakes, encroachments etc.
- **Geographical Information System (GIS):** A geo-referenced representation of all attribute information inbuilt into each module.

5. Centralised RAMS Cell

A dedicated and centralised RAMS Cell has been established at NHAI to take over the implementation and continual operation of the RAMS. The RAMS Cell would bring all initiatives related to data collection, data management, and information sharing on National Highways under one umbrella including periodical data collection by NH Divisions of State PWDs, NHAI, NHIDCL, BRO and their Concessionaires, Contractors and Consultants. The main objective of the proposed RAMS Cell would be to operate, maintain, update and upgrade RAMS system developed for all National Highways in India notwithstanding to the owning agency of development and maintenance.

The stretch-wise data may be collected by field offices, PIUs, Contractors, Consultants etc of MoRTH, NHAI, NHIDCL, State PWDs, BRO, etc., and such data may be fed into RAMS system through the RAMS Cell established in NHAI. Data flow Diagram and intuitional framework is enclosed at Annex IV. The Centralized RAMS Cell shall do quality assurance checks of data collected and upload the same on the portal/ RAMS system. The RAMS Cell then performs maintenance needs analysis and of the data available in the RAMS system and prioritises the available maintenance budget. Therefore, the data expected to be collected by the above mentioned stakeholders play a vital role and data accuracy is very critical to generate reliable maintenance strategies and interventions.

5.1 Objective of Centralized RAMS Cell

The main objective of the RAMS Cell is to operate, maintain, update and upgrade RAMS system developed for all National Highways in India, irrespective of the agencies with whom such stretches of NHs are entrusted.

5.2 Key Functions of Centralized RAMS Cell

The primary function of RAMS Cell is to act as a cohesive office for facilitating

planning, programming and budgeting of National Highways in the country and facilitate timely decision making through analysis of data and presenting the same to the MORTH and other agencies on regular basis.

The other key functions of the RAMS Cell are:

- To plan, monitor and manage annual data collection of National Highways;
- To process, manage and perform quality assurance of the data collected;
- To load processed data into RAMS;
- To operate RAMS on daily basis;
- To provide or answer daily or ad hoc enquiries;
- To identify potential improvement and up-gradation of projects on PPP/EPC basis or otherwise;
- To prepare annual maintenance needs and related budget for public funded roads;
- To impart training and technology transfer on RAMS operation;
- To provide helpdesk support on RAMS users;
- To Manage and monitor external consultants working on RAMS.

5.3 Stakeholders

National Highways are currently entrusted to different agencies, MORTH (through NH divisions of State PWDs, PIUs of MORTH), NHAI, NHIDCL and BRO for development and/or maintenance. These agencies thus become major stakeholders of RAMS.

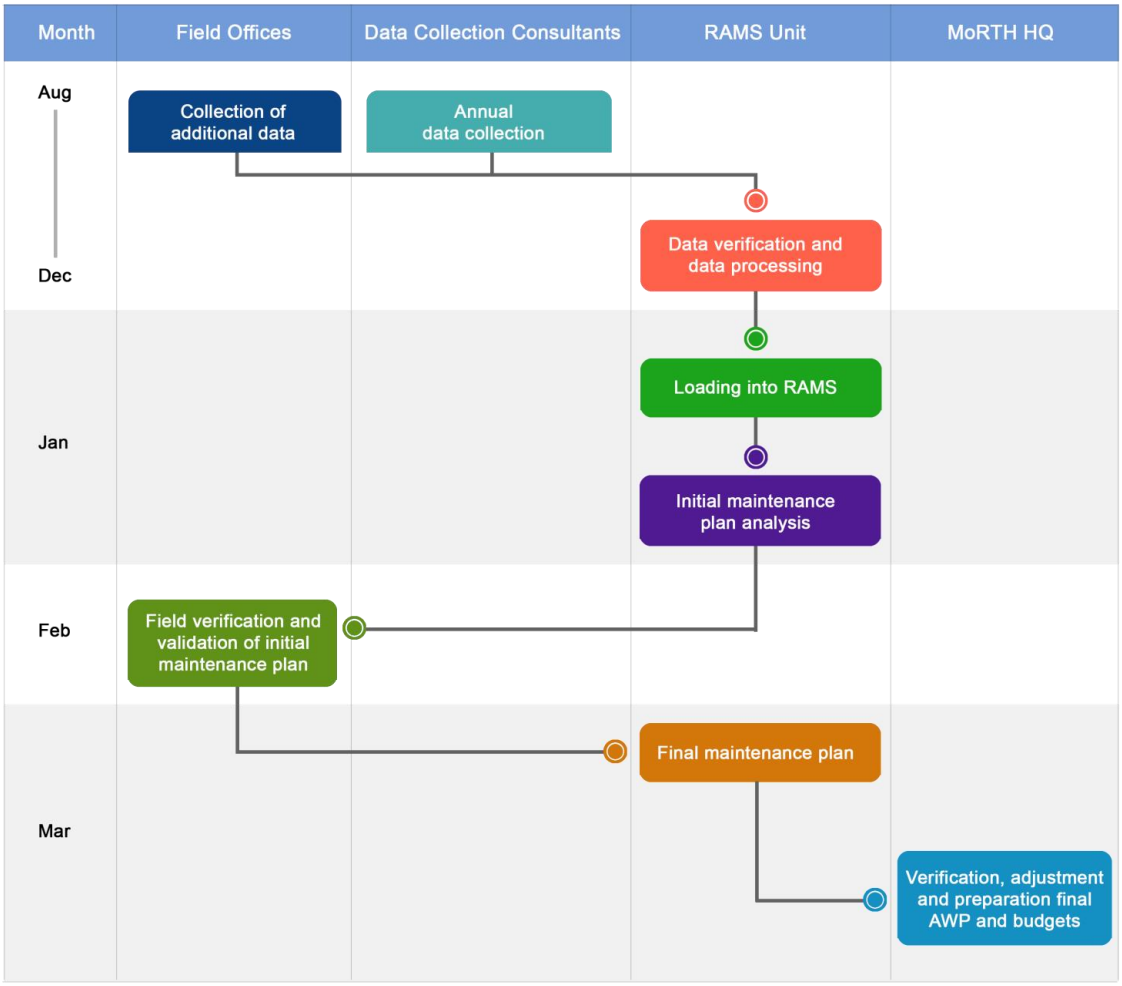
As mentioned above, the centralized RAMS Cell will support all stakeholders. Each agency may have one or two liaison officers within the organization to coordinate with the centralized RAMS Cell. The main function of the liaison cells shall be to ascertain regular data flow from the PIU/ field level cells to the centralized RAMS Cell. 8

6. Process of Maintenance Needs Analysis

The collection of data shall be through NSV runs as per extant policies. The field cells of various agencies shall submit the same to the centralized RAMS Cell at NHAI, who will validate and further process data into required format. The processed data will be loaded into RAMS. The maintenance analysis will then be performed by RAMS Cell considering the overall development and maintenance strategy for National Highways. The preliminary maintenance plan and needs will be sent to the Planning Zone of the Ministry, NHAI and respective field offices; the respective field cells of agencies shall verify and validate the program within seven days. Field offices will submit their

observations and comments along with their recommended maintenance program for the National Highways in their jurisdiction. RAMS Cell will collate the feedback from all field offices and rerun or reconsider the preliminary program. The final maintenance plan and needs will be prepared by RAMS Cell for sending to Planning Zone of the MORTH HQ and all agencies (viz. MORTH, NHAI, NHIDCL, BRO and NH Divisions of State PWDs). The MORTH Planning Zone will then validate, adjust and finalise the annual maintenance plan for the subsequent financial year.

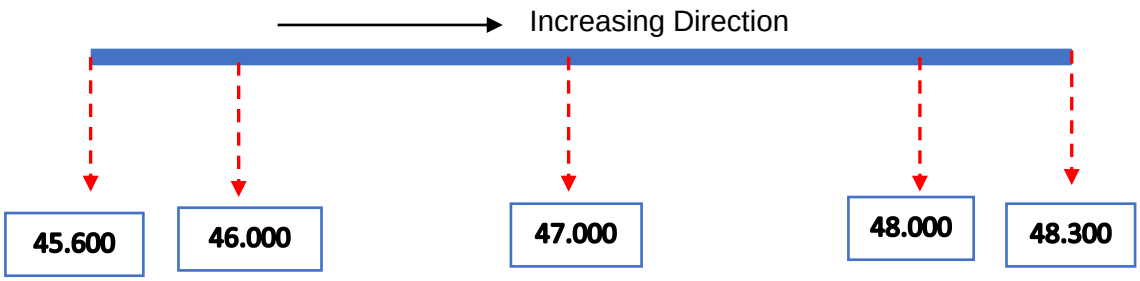
A tentative process for maintenance needs analysis is depicted below. The below picture depicted engaging Consultants by Field Offices for collecting data. Alternatively, Field Offices may collect data by themselves, however the responsibility of supplying the required data lies with Field Offices.



6.1 Guidelines for Data Collection using NSV

To bring the uniformity in data collection through NSV, a standard operating procedure has been developed and it is requested to follow these standards procedures to collect data:

1. The road inventory data shall be collected for each carriageway while the condition data shall be collected for each lane. Starting from initial chainage to final chainage in increasing direction and final to initial in decreasing direction. if the chainage is not starting from zero, start from initial point and end at km stone then record km wise e.g. starting for 45.600 to 46.000, then 46.000 to 47.000, 47.000 to 48.000, 48.000 to 48.300 not like that 45.600 to 46.600 etc. The same procedure shall be followed in the reverse direction.



2. While recoding data, it is recommended to record some permanent location points, such as km stone and starting point of bridge etc as these points would help when there is a change in alignment or for resetting the changings to avoid cumulative chainage errors.
3. The minimum inventory items to be recorded are, Centre Line GPS, Right of Way (ROW), Road Type, Pavement Surface Type, Pavement Width, Shoulder Type, Shoulder Width, Median Type, Median Width, Side Drain Type, Type of Cross-Section, Topography, Adjoining Land Use, Road Furniture, Wayside Amenities and Emergency Contact etc. The details of data to be recoded are given in **Annex-I**.
4. The minimum condition items to be recorded are, Cracking, Ravelling, Potholes, Depression, Bleeding, Patching, Edge Damage, Shoulder Condition, Drain Condition, Roughness and Rutting etc. The details of data to be recoded are given in **Annex-II.**
5. Once the inventory is recorded, the same shall be verified in the subsequent cycles and update data, if and as appropriate.

6. GPS coordinates of the notional centreline shall be collected on the pre-designated route. The survey vehicle records the coordinates and distance measurements while travelling closest to the centreline (i.e. on the fast or innermost lane, next to the road median). The coordinates shall be recorded continuously at no more than every 10 meters (or 5 meters) interval in one direction for single carriageway while in both bounds for divided or dual carriageways.

7. All continuous items, such as pavement width, pavement type, crash barrier, bridge start and end points etc, shall be recorded with start point and end point (both location and chainage).

8. Point inventory items, such as sign board, road furniture, wayside amenities etc, shall be recorded with location and chainage.

9. The full motion video shall be captured by the video camera mounted on Network Survey Vehicle. The camera mounted on the vehicle shall be used to capture features on the carriageway as well as roadside features. The video shall be captured on a real-time basis with full correlation with chainage measurements and GPS coordinates.

10. The standard NSV at least shall have the following components:

- **Laser Profilometer (LP):** For measuring dual wheelpath Roughness. Must possess manufacture's calibration certificate.
- **Transverse Profile Logger (TPL):** For measuring Rut Depth in both wheelpaths. Must possess manufacture's calibration certificate.
- **Running Distance Measurement Instrument (RDMI**): For measuring linear chainage. Must possess manufacture's calibration certificate.
- **DGPS:** For recording spatial coordinates notional road centrelines**.** Must have capability of real time correction for more accurate spatial data using BHUVAN or similar technology.
- **HD Video Cameras:** At least two HD cameras recording continuous footage of the visible ROW (say at every 5m or 10m). Attributes shall be embedded on video such as chainage, name of road, date of data collection, latitude, longitude, altitude, distance travelled etc.

- **Road Inventory and Condition Recoding Keyboards:** For recording other inventory and condition data as mentioned in Annex I and Annex II.

11. In addition, Falling Weight Deflectometer (FWD) shall engaged to measure pavement deflection and thus pavement strength.
12. The collected data shall be supplied in the formats enclosed in **Annex III** along with raw data generated from machine.
13. The data collected shall be supplied to HQ within 15 days after completion of survey.
14. Other required data, such as pavement composition and maintenance history shall be compiled from the available records or knowledge in the required format mentioned in **Annex III**.
15. Data flow Diagram and intuitional framework is enclosed at **Annex IV**.
16. In case of any query / help, please contact

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Road Inventory Data

Inventory Feature	Details of Measurement
GIS	Centre line coordinates at an interval of 5 m not more than 10m
Right of way	Through secondary sources such as design standards. Through visual observations in the field, wherever the boundary was visible.
Road type	Visual observations in the following categories: • Two-lane; • Four-lane without divided carriageway; • Four-lane with divided carriageway; • Six-lane without divided carriage way; • Six-lane with divided carriage way.
Pavement surface type	Visual observations in the following categories: • Asphalt; • Cement Concrete; • Others.
Pavement width	Visual observations in the following categories: • With accuracy to 10cm
Shoulder type	Visual observations in the following categories: • None; • Paved; • Gravel; • Earth. • Other
Shoulder width	Visual observations in the following categories: • With accuracy to ±10cm
Median Type	Visual observations in the following categories: • Depressed • Barrier • Flushed • None
Median width	Visual observations in the following categories: • With accuracy to ±10cm

Inventory Feature	Details of Measurement
Side Drain Type	Visual observations in the following categories: • Open unlined; • Open lined; • Covered lined; • No drain; • Drain not needed.
Cross section	Visual observations in the following categories: • Cut; • Fill; • Embankment.
Topography	Visual observations in the following categories: • Flat; • Rolling; • Hilly.
Road furniture	Visual observations in the following categories: • Road Sign • Bus Shelter • Km stone • Toll Plaza • Crash Barrier (Start, End) • Street Light (Start, End) • Culvert • Bridge
Land use	Visual observations in the following categories: • Residential; • Commercial; • Industrial; • Agricultural; • Water bodies; • Public/commcelly use; • Forest reserve.

Inventory Feature	Details of Measurement
Wayside Amenities	Visual observations in the following categories: • Restaurant / Motel • Toilet / Public Convenience • Rest Rooms • First Aid / Medical Centre • Telephone Booth • HT Line Crossing • Petrol Pump • Police Station • Temple / Mosque
Emergency Contact	• Ambulance • Hospital • Police • Toll Plaza

Annex-II

Road Condition Data

Num	Surface Distress	Rating Criteria
1.	Crack Area (% Surface Area)	• Very Good (<5%) • Good (5 - 10%) • Fair (11 - 20%) • Poor (21 - 30%) • Very Poor (>30%)
2.	Ravelling (% Surface Area)	• Very Good (0%) • Good (1 – 5%) • Fair (6 - 10%) • Poor (11 - 30%) • Very Poor (>30%)
3.	Potholes (Numbers)	• Very Good (0) • Good (1) • Fair (2) • Poor (2 – 5) • Very Poor (> 5)
4.	Depression (% Surface Area)	• Very Good (0%) • Good (0-1%) • Fair (1-2%) • Poor (3 - 5%) • Very Poor (>5%)
5.	Bleeding (% Surface Area)	• Very Good (<1%) • Good (1-10%) • Fair (10-20%) • Poor (20 - 50%) • Very Poor (>50%)
6.	Patching (% Surface Area)	• Very Good (<2%) • Good (2-5%) • Fair (6-15%) • Poor (16 - 30%) • Very Poor (>30%)
7.	Edge Damage (Area m2)	• Very Good (0 m^2) • Good (0-0.5 m^2) • Fair (0.5-1.0 m^2) • Poor (1.0 – 5.0 m^2) • Very Poor (>5.0 m^2)

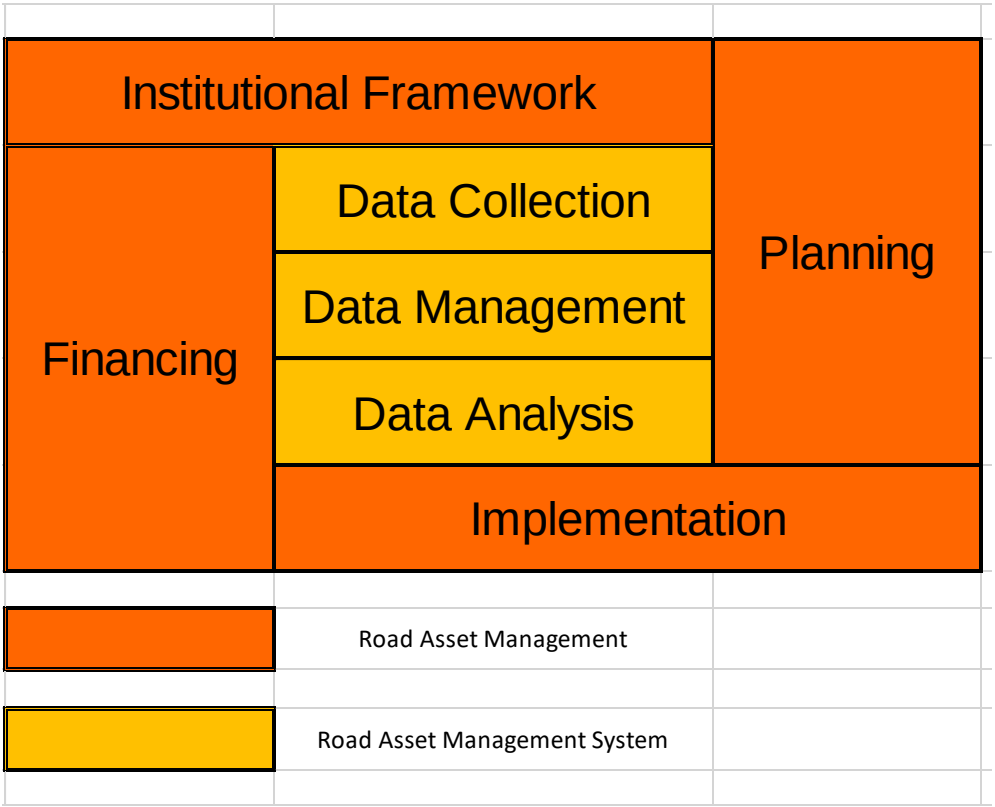
Num	Surface Distress	Rating Criteria
8.	Shoulder Condition	• Good • Fair • Poor
9.	Drain Condition	• Good • Fair • Poor
10.	Shoulder Elevation with respect to Edge	• Level • Above • Below
11.	Rutting	• Rut Depth (mm)
12.	Roughness	• Roughness is to be recorded at an interval of 100m

Annex III: Data Formats (Excel Sheet Enclosed)

1. **Location Reference Management System (LRMS)**
2. **Road Information System (RIS)**
3. **Pavement Management System (PMS)**
4. **Bridge Information System (BIS)**
5. **Traffic Information System (TIS)**
6. **Accident Information System (AIS)**
7. **Toll Information System (TOIS)**
8. **Environmental Information System (EIS)**

Annex IV : Data Flow Diagram and Institutional Framework

Institutional Framework :



Data Flow Diagram :