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Development of Highway Information System in Gis Environment Himachal Pradesh

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ABSTRACT

Managing information to assist more efficient decision making is currently in high demand for transportation organizations, from engineering at the micro level to statewide planning and management at the macro level. Furthermore, data sharing and cooperation among several government agencies at all levels are required to address the complex environmental and economic development issues that face society today. In the past, the majority of transportation agencies and government sectors frequently used information systems and database development for particular applications. The use of geographic information systems (GIS) outside of the transportation sector has been quite effective. Since GIS in transportation (GIS-T) has been used in numerous transportation projects to detect transportation-related problems, it (GIS-T) offers thorough and timely information for sound decision-making. Using geographic information systems for storage is effective. Geographic data from the real world is retrieved, modified, and displayed for transportation systems. In many nations throughout the world, GIS has been utilized as an effective development platform for information systems for the management of pavement maintenance. Road widening or upgrading, maintenance management, evaluation, geometric design and improvement, and other operations related to road transport can all be managed with the help of a GIS-based Highway Information System (HIS). In the current dissertation, GIS was used to create a highway information system. Many road factors including topography characteristics, distresses, traffic data, highway amenities, and pavement data were gathered.

Keyword: Scope of Study**,** Proposed His System, Software And Tech.

1. INTRODUCTION & BACKGROUND

Over 38,500 km of roads make up Himachal Pradesh road network, which includes major district roads, state highways, and rural roads. The National Highway System, State Highway System, Major District Roads, and Rural Roads are all under the construction and maintenance control of the Himachal Pradesh Public Works Department (HPPWD).MORTH is in charge of creating and maintaining National Highways throughout the state. As mandated by the MORTH, the HPPWD operates as an agent to carry out building and maintenance tasks on this national network. However, the HPPWD is in charge of building and maintaining State Highways, Major District Roads, and Rural Roads. The majority of traffic is carried by NHs, SHs, and MDRs, which are also the main conduits for economic activity.

For the World Bank-funded HPSRP-I (2007-2017), data on the inventory of pavement, pavement condition (international roughness index using any NSV equipment and by visual inspection for Black Top Roads), road surface condition of Non-BT Roads, pavement strength using FWD, CD & Bridge Condition, and traffic data for all roads are collected on standard forms, updated annually, and entered

into the Road Management System (RMS).The HPPWD creates an annual report on the state roadways' core road network condition using the RMS. Annual maintenance plans (AMPs), which prioritize periodic and rehabilitative tasks, are created based on an indicated budget. The program is created in accordance with the government's budgeting cycle and is updated iteratively when more precise projections for the upcoming fiscal year's budget are made.

It has been noted that the HPPWD has not been using the RMS that was implemented under HPSRP-I to its full potential up to this point, primarily because the HPPWD has not deployed any dedicated RMS units and the software has become out-of-date. Due to the RMS's poor performance, the intended rationalization of decision-making in the road sector's planning, programming, funding, procurement, and resource allocation to make the best use of public funds and maintain the road networks at an acceptable level of serviceability is not being met.

Every year, a Maintenance Plan (AMP) is created with the indicated needs taken into account. All of the available resources will be combined to carry out these plans. The State Roads Network (SRM), which consists of State Highways, MDRs, and potential MDRs, is to be planned and managed by the RAMS, a system that will ultimately support all levels of HPPWD. The RAMS must be user-friendly and flexible enough to deliver trustworthy results with the right amount of data inputs and the ability to increase output accuracy with superior data. The Road Asset Management System (RAMS) will serve as the system's foundation, around which a number of applications will be created or set up to meet the diverse needs of road planning, management, and monitoring. To improve efficiency and prevent duplicate data repositories, the proposed RAMS should be able to interact with other HPPWD systems already in place.

2. NEED OF STUDY

The field of transportation planning greatly benefits from the use of the highway information (HIS). Route type, route number, domain, governmental control, toll system consideration length, and number of through lanes are the essential components of HIS. Surface type, section type of the pavement, shoulder type, median type, and median width. Right of way width, information on horizontal curves, speed cap, capacity, and traffic control. For a well-planned HIS, all of these factors should be taken into account, including device information, parking information, drainage information, terrain, interchange and intersection information, bridge inventory, accident investigation, and other data gathering and maintenance activities. The database takes into account each of these criteria. The database is maintained using a wide variety of transportation applications.

Population of H.P. (2011 Census)	Population (2001 Census)	% Growth (2001-2011)	Rural Pop.	Urban Pop.	Area km²	Density (per km²)
68,64,602	6,077,900 Lac	12.95%	61,77,050 Lac	6,88,552 Lac	55,673	123

Table 1

The region considered for the development of database encompasses districts spread around Himachal Pradesh. The main objective of developing this database was to assist the Public Work Department in planning and monitoring of three primary level of road i.e. National Highway (NH), State Highway

(SH), and Major District Road (MDR) PWD is mainly responsible for maintaining road network in the country[1].

3. OBJECTIVES AND GOAL

The assignment has the following broad objectives:

- Complete your conduct To create the strategic Asset Management Strategy roadmap and expand the scope for an updated RAMS for Himachal Pradesh, the present RMS and maintenance management practices will be assessed as-is and their gaps will be analyzed.
- A COTS (Custom of the Shelf) Road Asset Management System (RAMS) should be provided and put into place. Customize the offered RAMS to the demands of HPRIDC and HPPWD based on the preceding As-is evaluation and Gap analysis.
- Work closely with HPRIDC/HPPWD to ensure that all RAMS and data collecting process goals are met.
- Adoption of Data Formats and Road Information Systems has improved Conduct an exhaustive road network survey of the whole 30,000 km (approximately) State Road Network (SRN) required under the new HPRIDCL/HPPWD authority.

DETAILED SCOPE OF WORK

1. A broad assessment of the state of e-governance in Himachal Pradesh, including a review of asset management-related regulations, organizational structure, human resource sufficiency, training requirements, and IT policies and initiatives.
2. Evaluation of the IT infrastructure important to the efficient operation of RAMS.
3. Review technical, managerial, and institutional best practices for RAMS in India and around the world. Conduct gap analyses to connect the RAMS environment's requirements in Himachal Pradesh with international best practices.
4. Conduct a thorough examination of the previously created RMS, taking into account all modules, institutional sustainability indicators, and technical robustness. Create a thorough scope for the new RAMS, including previous functionality and data as appropriate.

4. DEVELOP THE PROPOSED HIS SYSTEM

i. SYSTEM ADMINISTRATION AND SECURITY

System administration and security module should work as command and control unit of all other modules of HIS application. This module may include: (a) User Management; (b) Password Management; (c) Role Management; (d) System Access rules and rights.

ii. ROAD INFORMATION SYSTEM (RIS)

RIS module shall have facility to manage the road network like road creation on GIS platform, edit attribute and add and modify GIS alignment of road. In addition to road management the RIS module shall have functionalities to add, edit, delete road assets data like carriageway, pavement composition, pavement condition, road roughness etc.

iii. BRIDGE INFORMATION SYSTEM (BIS)

Bridge Information System (BIS) module shall comprise of functions such as bridge registration and recording inventory of structures such as bridges, culverts, flyovers, RoBs, RuBs, etc. and their condition. Further BIS shall also allow storage of multi- media content and retrieval. This module will

also comprise of parameters required for overall condition rating of bridge assets.

iv. TRAFFIC INFORMATION SYSTEM (TIS)

Traffic Information System (TIS) module shall comprise of functions such as traffic station creation, traffic volume count data validation, calculation of annual average daily traffic (AADT) and Million Standard Axle (MSA). Further TIS shall also allow assigning traffic data into road network.

v. RIGHT OF WAY FEATURE INFORMATION SYSTEM (ROWFIS)

The Ro WIS supports the following core right-of-way business areas of appraisal (land valuation), acquisition, relocation, and property management for the Ministry or Road Authority. An integrated Right-of-Way Management System (RoWIS) primary functions must include the following capabilities:

- Manage transportation project information relevant to the right-of-way (land) acquisition process;
- Manage information on individual parcels that are candidates for acquisition
- Support all aspects of the right-of-way acquisition lifecycle, including appraisal (land valuation), negotiation, and relocation (RAP);
- Support land ownership management activities, including tracking of land parcels cataloguing, gazetting of land parcels, lease/rental for advertising or utilities, etc.
- Capture the appraisal (land valuation), the review appraisal, and the finding of just compensation within the system
- Support residential and business relocation services, including either calculations of relocation eligibility within the system or linkages to external tools/calculators;
- Manage and track utility/facilities relocations, including managing the details of required agreements with utilities. This includes managing resettlement action plans (RAPs), community (affected persons) consultations, social impacts management, etc.

vi. ACCIDENT AND ROAD SAFETY INFORMATION SYSTEM (ARSIS)

Accident and Road Safety Information System (ARSIS) module shall have facility to fetch the key road accident data from HP Road Accident Data Management System (RADMS) and IRAD being implemented through MoRTH. This module should be ableto analyze accident data and generate black spot location. It should allow to input more detailed data on safety collected from inspection regarding accident prone locations, road safety hazards such as sharp curves, narrow bridges, deficient road geometry, lack of sight distance, poor designed junctions etc. and suggest standard engineering safety countermeasures for a defect already stored as a reference. It should also help in monitoring and reporting Road safety outcomes against the various Road Safety engineering and enforcement interventions undertaken on corridor level.

vii. PAVEMENT MANAGEMENT SYSTEM (PMS)

The Pavement Management System (PMS) to have tools to process the data for use in HDM-4. The consultant will design operating procedure to perform strategic and programme analysis for maintenance, preservation and upgradation of the road network and for prioritization and optimization of works for different funding levels, using tools in HDM-4. The consultant will identify procedure to indicate the necessary funding required to maintain the network at a given service level and the consequences of various funding levels on the health of the network. Further, the procedure to predict the future asset condition and value, agency/user costs for maintenance/improvement/upgrading treatment alternatives for various funding scenarios and evaluate them using measurable economic and engineering parameters is to be decided in discussion with PWD during the project. Using these parameters, RAMS will have the facility to prioritize a list of candidate sections for PWD to further

undertake detail project evaluation and allocation of resources from the budget. The system will be able to prepare a short term (1-2 year) program and a long term (5 year) plan - detailed and summarized based on road, division and state.

viii. SIMPLIFIED MAINTENANCE PROGRAMMING TOOL (SMPT)

The tools in SMPT module shall comprise/ of simple user-friendly web-based form for performing analyses for short-term/routine maintenance work. The software tool will assign the treatment, quantity and cost based on road condition. Further the application will have facility to generate detailed and summarized report based on road, division and state.

ix. WEB-GEOGRAPHIC INFORMATION SYSTEM

Web-GIS module shall have functionalities to overlay all the assets on comprehensive GIS platform. This module shall have simple user-friendly web-based interface that should help user to monitor their asset by generating various geo referenced map-based and tabular reports.

❖ **COOPERATE WITH HPRIDC/HPPWD TO VERIFY THAT ALL DATA GATHERING PROCESS GOALS ARE MET.**

Create a first report outlining the process for providing the services. The following key elements must be covered in the report:

1. Data collection: The Consultant/Sub Consultant will conduct data collection using the survey equipment and trained staff of HPPWD, and will only contract out a small portion of the required manpower to supervise and support data collection through key departmental personnel and to provide equipment not already in the possession of the department.
2. Plans to integrate/import current data as well as data from NSV vehicles, including photos and videos.
3. Detailed methodology to fulfill the requirements of this TOR finalized in consultation with the HPRIDC/ HPPWD officers, including scheduling of various sub-activities to be completed for completion of various stages of the work; clearly stating their approach & methodology to integrate data collected from NSV, data interpretation & analysis tools development in conjunction with the nominated technical consultant by HPRIDC/ HPPWD.
4. Task delegation and the Manning Schedule;

5. GRAPHICAL DATA

The four categories below are used to classify the geographic information in PMS.

- Street layouts, different landmarks, and land mark names are included in the base map data.
- Main street centerlines, main street sections, secondary streets, street names, and intersections are all included in the data for the streets network. District boundaries, city boundaries, etc. Are included in administrator boundaries.
- Output from segmentation graphics.

GIS's primary goal is to collect, manage, store, analyze, and visualize geographic data. A geographic database can be saved in a variety of formats, including:

1. Vector graphic information
2. Data using raster graphics
3. Geospatial data in alphanumeric form [2]

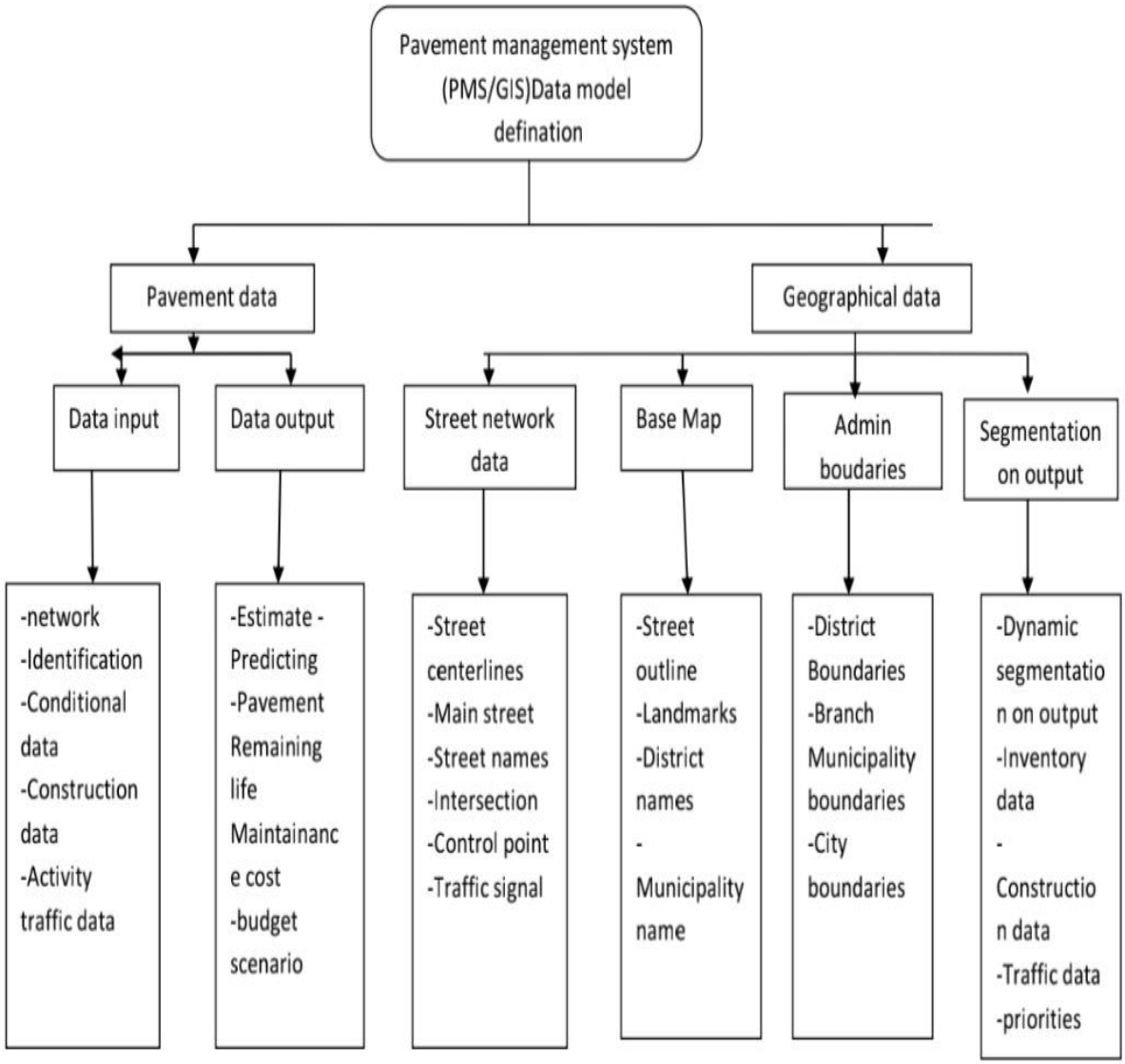

Fig. 1

6. ADOPTION OF DATA FORMATS AND ROAD INFORMATION SYSTEMS HAS IMPROVED

The case study suggests a straightforward structure for roads and suggests ways to improve the formats for SHs, MDRs, and NHs over the entire network. They might suggest modifying the data compatibility techniques and their calibrations for various categories of roads.

the Road Management System (RAMS) installation through customization and the addition of necessary new fields for data on the core network. To suit the needs of other systems and the management requirements of the HPRIDC/HPPWD, this RAMS must be connected to data management programs.

1. Use software and computer hardware that are interoperable with other systems.
2. Recognized global standards (such as "single-source of truth" data standards, common user interfaces, and data import/export standards).
3. Have a built-in alarm system to make sure that data on the state of the roads and pavements is updated annually, and to highlight the year of data collection when performing parameter analyses.
4. Be web-based to ensure operability and data updating via the internet;

5. Be able to check data accuracy, inconsistencies, and the data falling outside of acceptable ranges;
6. Have access to all road network data stored on RAMS, including the ability to export to Excel and/or PDF all average road attributes for each kilometer of the network and all average road attributes for each homogeneous road section.
7. o Be created in such a way that it requires a query engine to process millions of data with a minimum amount of processing time for database queries and information extraction;
8. Linear referencing and compatibility with multimedia (photos and movies) data;
9. A centralized database for all the various forms of data should be included.
10. Has a GIS component, which displays work schedules, condition data, and hotspots such high roughness areas.

A. SURVEY THE ROAD NETWORK

- For this project, data on the chosen network will be gathered over a two-year period in order to facilitate system testing, to codify the data gathering processes, and to develop treatment approaches based on analysis of numerous time series data. All of the state's roadways (the State Road Network), which total roughly 30,000 km, as well as any existing bridges, drainage systems, landslide protection structures, and bioengineering solutions should be included in the RAMS inventory. The road network inventory must be geo referenced, and the HDM4 location referencing and distance/road segment length code-sets must be migrated to. The client and the list of State Road Network for RAMS inventory will be finalized. The state core roads network (5,000 km) paved district roads in the pilot/demonstration horticultural supply chain districts/division/zones identified for the logistics system and strategy study could be the only area where pavement condition data is collected, with the remaining paved roads condition data being collected externally. In this way, the RAMS upgrade consultant will get TOR ready for outsourcing. Once a year, on sites to be determined with the customer on the chosen network, the Consultant is needed to undertake a 24/7 traffic volume count, including a direction, day, time, and hourly count of vehicle kinds. During the three (3) years of the consultation services period, the client will decide on the traffic count locations with the consultant/sub consultant who will send out a team to gather traffic data in accordance with the pertinent codal regulations once a year. The consultant must specify that data collecting must be finished in two years.
- Data gathering must be done realistically in order for a big network's data to swiftly be fed into the database and enable the RAMS. It should have the capacity to interface with GPS/DGPS, laser-based pavement surface profiler, FWD, and R-o-W video pictures, among other data sources, if necessary.
- The Consultant must create a "Data Collection Procedural Manual" before beginning the job and submit it for HPPWD's approval. Data collection, preparation, correction, and validation must wait until HPPWD has approved the manual before beginning. Formats for data collection and compilation must be included in the procedure manual and approved by HPPWD. To meet the demands of the work's scope, other forms may be used.

B. THE CREATION AND USE OF PLANNING TOOLS

For the HIS application, the Consultant should employ a widely used economic assessment model (HDM-4) that can conduct both strategic and project level analyses at the appropriate organizational

levels. This model is founded on strong engineering and economic priority principles. The HPRIDC/HPPWD should be consulted during the completion of this task.

The consultant must complete the following supporting tasks:

- Analysis of the strategic budgeting;
- Technical assessments at the network level;
- Planning and optimizing multi-year road projects within budgetary restrictions;
- And projecting network condition under various budget scenarios.

The software will show an annualized, optimized work schedule for various budget categories and work classes, including periodic renewals (based on carefully gathered data), routine maintenance (based on standards to be developed using the age of the surface, type of road, and overall condition index), emergency maintenance (based on standards), and special repairs based on the indicative budget provided by HPRIDC/HPPWD. Given logistical and other factors, the user ought to be able to modify these programs to get the best software possible.

The RAMS's database will provide automatic sectioning, allowing for the creation of road segments based on parameters including condition, inventory, and traffic. The process of sectioning must be participatory, and the final portions must be adjustable by the user.

The reporting structure must permit the graphical presentation of both past and future data:

a. HI-Low graphs and the Strip Map View
b. Scatter plot graphs
c. Video analysis
d. Geographical perspectives
e. view of the predicted road deterioration
f. Permit customizable variables to specify new analytical viewpoints

Network use, traffic volume and loadings, annual vehicle miles traveled, annual ton miles traveled by each type of vehicle.

7. TECHNOLOGY AND SOFTWARE INPUTS

The replacement, upgrade, modification, and implementation of software takes nine months in total. The Consultant is free to supply his own selection of important individuals to handle the necessary skill mix and to list them in his staffing and work schedules. Skills that may be necessary for the efficient provision of services, as anticipated by the consultants, shall either be offered as part of support person skills. The bid application should include the qualifications of the key staff members. After the three-year project, software implementation support will continue for an additional year.

To enable the HPRIDC/HPPWD to measure themselves in terms of quick and accurate reporting, data updating, improved network conditions, and executing within budgets and timelines, indicators for the assessment of the performance and impacts of the RAMS were developed. Collaboration between the Consultant and workers at the Head Office and Zonal levels would be expected. The Consultant will hold three workshops in which a large number of HPRIDC/HPPWD professionals will participate to discuss their objectives for the GIS-based HIS and to contribute to its effective use and sustainability.

A. SOFTWARE'S TECHNICAL AND FUNCTIONAL REQUIREMENTS

The consultant's proposal to replace or upgrade the current RMS software with RAMs will be judged according to the following standards. The technical proposal of consultants will be assessed using the following data. This is true for the GIS, database, and economic modules.

TECHNICAL REQUIREMENTS

a. Language: English must be used for the interface's menus, displays, reports, and documentation.
b. Number of Users: It is estimated that both online and offline systems will require access to the program from up to 100 users concurrently. However, there shouldn't be any restrictions on how many people can register or how many users can be active at once.
c. GIS: The Consultant is free to use the HPRIDC/HPPWD-current GIS or any other open, freely accessible platform, such as open street map, Google maps, etc., and it must be interfaced with RAMS in accordance with the ToR criteria.
d. Field Data Collection Devices: The RAMS should be compatible with portable field data collection tools, such as smartphones and tablets, into which data may be transferred, checked for accuracy or changed while in the field, and then later synchronized through WiFi or Data.
e. Web Enabling: The HIS must offer an interface that makes RAMS data accessible to other programs, such as a display on client websites. This is anticipated to include, at the very least, a map that is connected to summary information about traffic volumes, pavement inventory, and pavement condition.

FUNCTIONAL REQUIREMENTS

a. Terminology: All Screen Labels, Menu Items, and Reports should be able to be customized in English according to the norms.
b. Network reference: Various network reference strategies should be supported by the RAMS. The linear distance from the beginning of each road segment, the linear distance from the beginning of each road, and the distance from established location reference points should all be included.
c. Cross-Sectional Positioning: To allow data to be referenced laterally to a location on a road section, in terms of lanes, shoulders, ditches, verges, etc., the RAMS should support various cross-sectional positioning models.
d. Schematic Line Diagrams/Strip Maps: The RAMS ought to make it possible to create schematic line diagrams and/or strip maps that are annotated with any data kept in the RAMS.
e. The matic mapping should be possible, and certain attributes of the road segment, as contained in the RAMS, should be able to be viewed from the GIS, utilized as screen labels, and available. All section-wide attributes, such as the section identification, road identifier, the established direction of the section, road classification, IRI, PCI, and others, should be included in this list.

❖ CONCLUSIONS

- The following conclusions has been made on the basis of this study. Importance of highway Information has not remained confined to highway decision used but it is useful to the road makers Construction and Maintenance division in India are still using conventional method of information management has been modernized by using Are View software. This enables the user to view the

map directly on computer screen. The database maintained according to each theme can be visualized simultaneously on the screen.

- PWD is responsible for maintaining highway information system. The road user generally use the signboard to acquire the further information of road. On the other hand, PWD has to maintain the full database of the road. In the present work, database has been developed for each km of highway. This database consist of various road parameters such as terrain characteristic distress type, traffic data, sign board, highway amenities etc which can be used by common road user as well as the construction and maintenance divisions.
- Each stretch is likely to give information of percentage of cracking to give the remedial measure for each km of stretch.
- Using GIS in highway Information system, data can be easily retrieved and updated.
- This type of HIS can improve the quality and availability of relevant data that will fully affect the quality of decision.

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