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# GIS based Road Asset Management System

## TERMS OF REFERENCE

### 1. General

Mizoram is a landlocked state in North East India with Indian states of Tripura, Assam and Manipur on the North, Bangladesh on the West and Myanmar on the East as well as on the South. The size of the state is 21,087 square kilometers. The landscape is mostly rolling hills with major valleys. Most villages and town are located on hill sides. It is a growing transit point for trade with Myanmar and Bangladesh. Total length of roads in the state is about 6130 km: out of which National Highways, State Highways and District Roads constitute 24%, 3% and 26% respectively.

Government of Mizoram through Government of India has received from the International Development Association financial assistance to implement the second phase of Mizoram State Road Project which aims to upgrade 3 different sections of State Highways and Major District Roads to National Highway standard as a part of a Regional Transport Connectivity Project. Also, a part of the project is a Road Sector Modernization Plan (RSMP) aiming for gradual transformation of the PWD into a modern road agency which will carry forward and deepen various institutional development initiatives introduced earlier.

One of the components of RSMP is upgrading of the existing maintenance management system into a Road Asset Management System (RAMS) including development of an asset management strategy and asset management information system for the road network in the state to access condition of the road network, identify maintenance requirements, help allocation of resources, and keep track of executed maintenance interventions in an easy and transparent way. This TOR outlines the requirements to develop and execute such a system.

This TOR also outlines the consultant's input on preparation and execution of computerization of PWD offices.

### 2. Objectives

The objective of this consulting service is to develop and establish a robust web and GIS based Road Asset Management System (RAMS) for Mizoram roads as well as enhancing the capacity of Mizoram PWD technical staff through on-the-job training and training workshops in using RAMS to prepare Annual Road Maintenance Plan (ARMP) in order to plan and manage maintenance of road infrastructure.

The other objective is to facilitate computerization of PWD offices through preparation of a scoping report on the need for ICT infrastructure to integrate RAMS with flow of information among the Divisions, Circles, Directorates and the Headquarters of the PWD.

### 3. Scope of Services

To achieve the above objectives for 6100 km of existing motorable National Highways, State Highways, District Roads, Village Roads and City Roads as well as the bridges and culverts on them the following main activities will be required to be executed by the Consultant:

- a) Develop necessary formats and basis for collecting data on roads and cross-drainage structures in line with National Highway Authority of India (NHAI) and Pradhan Mantri Gram Sadak Yojana (PMGSY) requirements in collaboration with PWD officials as well as PWD's Technical Expert, Bridge Expert and Road Fund Expert. This will also include developing the road types and maintenance category, maintenance module and necessary costs for different maintenance regimes;
- b) Collection of road and structures data through Centerline survey with location captured at a maximum interval of 10m through Professional GPS instruments mounted on a vehicle and differential correction of the data with respect to base stations;
- c) Devise a way to incorporate in RAMS, detailed data on cross-drainage structures from Bridge Condition Survey conducted under a different program.
- d) Develop separate mobile applications for capturing (i) road inventory and surface distresses, location of cross-drainage structures, location of major retaining structures; (ii) inventory and condition assessment of bridges and culverts; geo-tagging them along with relevant photographs, validating the collected data and uploading the data to a central server. The task also includes developing User's Manuals on the apps.
- e) Develop a Main Application using Visual Studio using C# or VB.net language with GIS interface with the following functionality:
  - i. Road Register which will have details of the road network, pavement type by chainages, traffic, location of cross-drainage and major retaining structures, last resurfaced year, maintenance notes, etc;
  - ii. The register should also include available further details on bridges and other structures, landslides, etc as data subsets;
  - iii. Pavement details, traffic data, Surface Distress index (SDI) with detailed data and calculation;
  - iv. Video processing module with encoding with chainages from GPS recordings. A simplified module for pavement distress entering using manual observation of the video along with the chainage and the coordinates;
  - v. Preparation of presentable maps in online web mapping system and system for exporting to common GIS formats (shape files, geo-package etc);
  - vi. Simplified model for routine, recurrent and periodic maintenance as well as simplified models for Specific Maintenance, Rehabilitation and Upgrading of road links;

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- vii. Division and state-wise summary for the Annual Road Asset Maintenance Plan (ARMP) to be submitted to the Mizoram Road Fund Board (RFB);
  - viii. RFB allocation for each division, Contract packing according to the allocation by RFB;
  - ix. The Main App shall be a self-updating type running from the server so that the users always get the latest version;
  - x. Operating manual for the Main App;
- f) Use Postgre SQL or similar enterprise grade open source database system which would include a GIS extension;
  - g) Identification of at least 60 numbers of strategically located traffic count stations to cover the network and conduct 3-day traffic counts at the stations and statistically determination of AADT for each of the defined road links;
  - h) Design and establish an information management architecture suitable for the IT infrastructure and other resources available with the Employer;
  - i) Divide the road network into links and nodes using the existing naming convention to the possible extent, else devise a scientific way to divide the network into an assemblage of manageable links;
  - j) Conduct Road Condition Survey using vehicle mounted geo-stabilized video camera and translate the streaming data to road condition data through an appropriate software. The task also includes validation of the captured data through comparing with sample data from vehicle mounted laser scanners;
  - k) Axle-load survey at 20 different locations covering the network to review the loading scenario;
  - l) Pitting at 20 different locations covering the network and testing the retrieved material at the PWD laboratory to capture data on road sections of different hierarchy, age, topography and maintenance history;
  - m) Develop a web-based Road Information System covering the road network with defined data input process and GIS-based graphical output interface including cross-drainage structures, major retaining structures, landslides, etc;
  - n) Provide on-the-job training to 3 numbers of PWD Engineers and one IT staff on data collection, interpretation, validation, analysis, compilation, updating and retrieving as well as managing the GIS-based graphical user interface;
  - o) Conduct 5 training workshops in collaboration with other experts on Bridge, Road Fund, Capacity Building, etc, with the Employer to train PWD/ RFB Executive Engineers, Engineers and Junior Engineers from all Division and Circle offices on data collection, uploading data in the system, data retrieval and preparation of ARMP;

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- p) Prepare the basis and demonstrate preparing ARMP for the first year including support PWD to organize the first ARMP workshop and sensitization of senior PWD technical staff on input/output requirements of the RAMS;
  - q) Provide advisory services for at least one year after developing and establishing the RAMS to the Employer to institutionalize the RAMS as an integral responsibility of a specialized cell;
  - r) Prepare basis for a pavement lifecycle study using HDM4 to determine the pavement deterioration rates and most economical intervention method and cycle including collection of additional data for this (e.g. pavement CBR, structural strength, pavement roughness and distress);
  - s) Develop a RAMS specific web page to facilitate uploading, downloading and viewing data generated on roads, cross-drainage structures, landslides, major retaining structures, etc. as well as formats with the link to the page provided on the Employer's web portal;
  - t) Draw up a scoping report on the need for computerization of the Headquarters, Circles and Divisions of the PWD:
    - i. Inventorying of the existing IT setup of the offices;
    - ii. Assessment of IT infrastructure gap to implement RAMS and other data traffic among the offices;
    - iii. Draw up plan for necessary IT setup maximizing the use of the existing hardware;
    - iv. Prepare system architecture; compile bill of quantities for IT hardware, software and services to be procured; prepare cost estimate; draft specifications; suggest on the implementation arrangement.
  - u) Assist in computerization of the Headquarters, Circles and Divisions of the PWD:
    - i. Provide expert's advice during the bid evaluation process;
    - ii. Supervise the implementation;
    - iii. Provide expert's advice to facilitate issuing Acceptance Certificate against the procurement made.

#### **4. Duration of Services**

A total of 18 months period is estimated for the services as follows:

##### Phase 1:

- a) Computerization of PWD: Scoping report on the need for computerization within 2 months;
- b) RAMS Preparation: Data collection, development and implementation of RAMS, and trainings within 6 months.

Phase 2

- c) Computerization of PWD: Assist in implementation and system maintenance: throughout the remaining contract period;
- d) RAMS Operation (starts after successful completion of Phase 1): Operation and maintenance of the system, and advisory services throughout the remaining contract period;

**5. The Consultant's Team and Inputs**

The proposed services under this Terms of Reference shall be carried out by using a team with adequate qualifications and experience in developing and managing RAMS

**5.1. Staff Inputs**

Key Professionals	Inputs in person-month		
	Phase 1	Phase 2	Total
a) Team Leader/ Roads Asset Management Expert	6	3	9
b) Road Condition Survey Engineer 1	5	2	7
c) Road Condition Survey Engineer 2	5	0	5
d) Web/online GIS/Android Programmer 1	4	2	6
e) Web/online GIS/Android Programmer 2	4	0	4
f) Application Programmer	4	4	8
g) System Engineer	2	2	4
<b>Total Staff Inputs</b>	<b>30</b>	<b>13</b>	<b>43</b>

Note:

*The above list of key professionals and estimated person month is for reference only. The Consultant is responsible to review the required services and may propose own requirements for the key professionals and other support staff (eg: Junior Programmers, Surveyors with helpers, CAD operators, traffic enumerators, Office Manager, IT Technicians, laborers with digging tools, etc.) required to complete the proposed services in a satisfactory manner.*

*Financial proposal should include rental of all the Professional GPS, drones, geo-stabilized vehicle mountable video camera and other survey equipment as well as laptops with necessary software to develop the system, transportation and other logistics, direct and indirect costs necessary to render the services and reporting.*

*The Financial proposal should also include organization of Training Workshops and ARMP Workshops at various locations within Mizoram and complete the required jobs as mentioned in the TOR.*

## 5.2. Qualifications of Key Personnel

The broad qualifications of the Key personnel are given below:

- a) Team Leader/ Roads Asset Management Expert
  - Education: Bachelor's Degree in Civil/ Highway Engineering, preferably Master's Degree in Maintenance Management/ Construction Management; Certified training on GIS and HDM4;
  - Experience: Over 15 year general experience in road design/ construction/ maintenance with at least 5 year specifically in development of Road Maintenance Plans for National Highways and Feeder Roads as well as 5 year in development and implementation support on Road Management Information System; Training of Engineering staff; Completion of at least 2 similar assignments in a different country in the region.
- b) Road Condition Survey Engineers
  - Education: Bachelor's Degree in Civil Engineering;
  - Experience: Over 10 year general experience in road design/ construction/ maintenance; at least 3 year specific experience in conducting Road Inventory and Road Condition Surveys, Professional GPS operation, online GIS database and providing training on use of the online systems for road inventory, GIS and preparation of ARMP.
- c) Web/online GIS/Android Programmer
  - Education: Bachelor's Degree in Computer Science, Computer Engineering, or Information Technology. Alternatively, Bachelor's Degree in Civil Engineering with 5 year experience in program development using GIS;
  - Experience: Over 5 years of experience in web development and online GIS programming using open layers/geo server. Should have completed and maintained at least 2 projects with application at national or state levels for managing road/infrastructure system along with online GIS mapping systems. Should have developed at least 4 android apps for GIS data capture and construction activities monitoring.
- d) Application Programmer
  - Education: Bachelor's Degree in Computer Science, Computer Engineering, or Information Technology. Alternatively, Bachelor's Degree in Civil Engineering with 5 year experience in program development using Visual Studio;
  - Experience: Over 5 year experience in application development using Visual Studio using C# or vb.net and GIS programming using Postgre SQL/Post GIS. Should have completed and maintained at least 2 projects with application at national or state levels for managing road/infrastructure system along with online GIS mapping systems using Postgre SQL/Post GIS.

- e) System Engineer
- Education: Bachelor's Degree in Computer Science, Computer Engineering, or Information Technology;
  - Experience: Over 5 year experience in setting up the server system in Linux/Windows with Postgre SQL/ Post GIS, Geo-server, web hosting, web services. Should have completed and maintained at least 2 projects with application at national or state levels for managing road/infrastructure system along with online GIS mapping systems using Postgre SQL/Post GIS, web services for android applications etc.

## **6. Main Deliverables**

The Consultant should be able to provide the following within 6 months of the contract:

- a) Web based RAMS with a user-friendly GIS interface;
- b) A mobile app for capturing road inventory as well as condition and uploading of data;
- c) A mobile app for capturing bridge inventory as well as condition assessment and uploading of data;
- d) User's manuals on RAMS and the apps;
- e) Data on alignment, condition, traffic and pavement type on the system for all motorable roads in the form of links and nodes;
- f) Preparation and development of ARMP for the first year;
- g) Training workshops and on the job trainings of the Employer's technical staff covering data generation, uploading, management, visualization and interpretation;

## **7. Obligations**

### **7.1. Employer's obligations**

The Employer shall provide the following:

- a) Information and access on road and bridge available with the PWD including the maintenance type, cost parameters for maintenance and construction of roads and bridges;
- b) Office working space with access to electricity, internet, and photocopy facility for the consultant's team as well as access to the servers and computers;
- c) 2 (two) numbers of qualified engineering staff and 1 (one) IT staff to be attached to the consultant's team as trainee for the on-the-job training;
- d) Facilitate the field survey works including providing /associating with the local Engineers of PWD working in the area;
- e) Access to PWD laboratories as necessary to conduct material testing,
- f) Provide space/ hall for training /ARMP workshops at PWD area;



## **7.2. Consultant's obligations**

In order to achieve the objective by covering the Scope of Services stated above, the consultant is required to fulfill the following additional obligations:

- a) Mobilization of their staff, with accommodation, transport and other logistics required to execute the services in Aizawl city and in the field provided;
- b) Bring, operate and maintain Professional GPS, drones, geo-stabilized vehicle mountable video camera and other survey equipment as well as laptops with necessary software for use during the contract period. The Consultant shall take back all such equipment as soon as their function is over;
- c) Rent and manage the necessary vehicle/ transport for the field level data collection using the GPS and video recorders, including mobilization of necessary field level staff and workers with logistics and accommodation provided;
- d) Proper use of equipment and asset provided by the Employer. These equipment shall be used only for project purpose and handed back in good condition;
- e) Prepare training curricula, develop training material/ handouts and conduct trainings to the PWD technical staff as Users of the system;
- f) During the system development, data collection and populating data, the consultants shall include at least 4 engineers/ IT staff from the PWD and conduct on the job trainings treating them as their team members;
- g) Demonstrate the use of RAMS including it's use in preparing the ARMP;
- h) Implementation supervision of Computerization of PWD by different suppliers;
- i) Available for the necessary support and training during the operation phase for 12 months after completion of the development Phase 1.

## **8. Reporting Requirements**

The Consultant is required to submit the following reports in 5 hard copies and a soft copy:

- a) Inception Report: within 2 weeks following the contract;
- b) Monthly Report: within 1<sup>st</sup> week of every calendar month for both phases;
- c) Demonstration of RAMS and mobile app together with data on Core Road Network: within 3 months of the contract;
- d) Scoping Report on Computerization of PWD: within 3 months of the contract;
- e) Complete installed and operational RAMS with data and manuals: within 5 months of the contract;
- f) Training Report: within 2 weeks of organizing each of the 5 training workshops and 1 ARMP workshop;



- g) System Audit Report: within 2 weeks of the completion of installation of the IT hardware and software for Computerization of PWD offices by a different vendor;
- h) Phase 1 Completion Report with software: within 1 month after completion of Phase 1 activities;
- i) Final Completion Report with software: within 1 month after completion of Phase 2.