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LINKING MOBILITY SOLUTIONS

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Development of Pavement Maintenance Management System for High Speed Road Corridors Using State-Of-Art Technologies

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Objective of the Study

Development of a pavement maintenance management system involving network of high speed road corridors towards making logical decisions about the budget requirements and allocation of funds thereof for maintenance of pavements and bridges, based on optimal life cycle costs

- **Both flexible as well as rigid pavements and bridges are included**
- **The system is capable of**
  - **Estimating the budget requirements and allocation of funds for pavement maintenance within constrained budget.**
  - **Deciding the optimal maintenance of road network within the given budget scenario.**
  - **Carrying out distress diagnostics, performance evaluation and rehabilitation and retrofitting of bridges.**

High Speed Corridors of National Highways

(covered under the study)

- Golden Quadrilateral
- North South Corridor
- East West Corridor
- Port Connectivity
- Ahmedabad Vadodara Expressway
- Mumbai Pune Expressway
- Gurgaon Expressway
- Noida Greater Noida Expressway

Location of Selected Road Sections

Six Climatic Zones Identified as per HDM-4 Classification

A. Humid & Sub-tropical Hot

B. Humid & Tropical

C. Sub-humid & Sub-tropical Hot

D. Sub-humid & Tropical

E. Semi-arid & Sub-tropical Hot

F. Semi-arid & Tropical

Performance Observations on Selected Sections Selected under the Study

Periodic Pavement Performance Data

(Three times with one year interval)

- Pavement Crust Thickness
- Pavement Structural Condition
- Pavement Functional Condition
- Pavement Surface Distress
- Road Inventory
- Pavement Maintenance History
- Vehicle Information Details
- Classified Traffic Volume Data
- Axle Load Spectrum
- Environmental Condition

PERFORMANCE OBSERVATIONS ON SELECTED SECTIONS SELECTED UNDER THE STUDY (Typical Photographs)

Test Pit Evaluation

Density Measurement During Excavation

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Core Sampling of Bituminous and Cement Concrete Layers

(A) Core Extraction on Bituminous Pavement (B) Core Extraction on CC Pavement

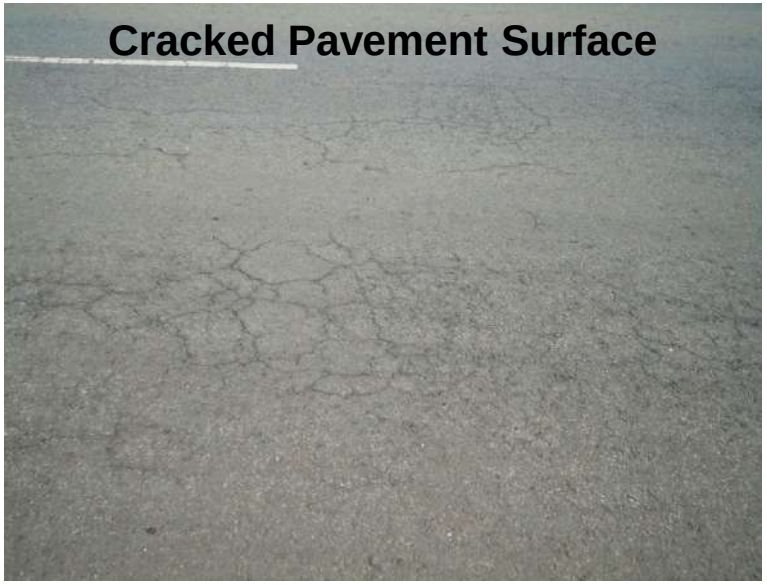
(C) Fresh Core Extracted from Bituminous Layers

Structural Evaluation

Deflection Measurements on a Test Section Using Benkelman Beam on NH-4B

Deflection Measurements on a Test Section Using Benkelman Beam

Surface Condition Survey on Flexible Pavements

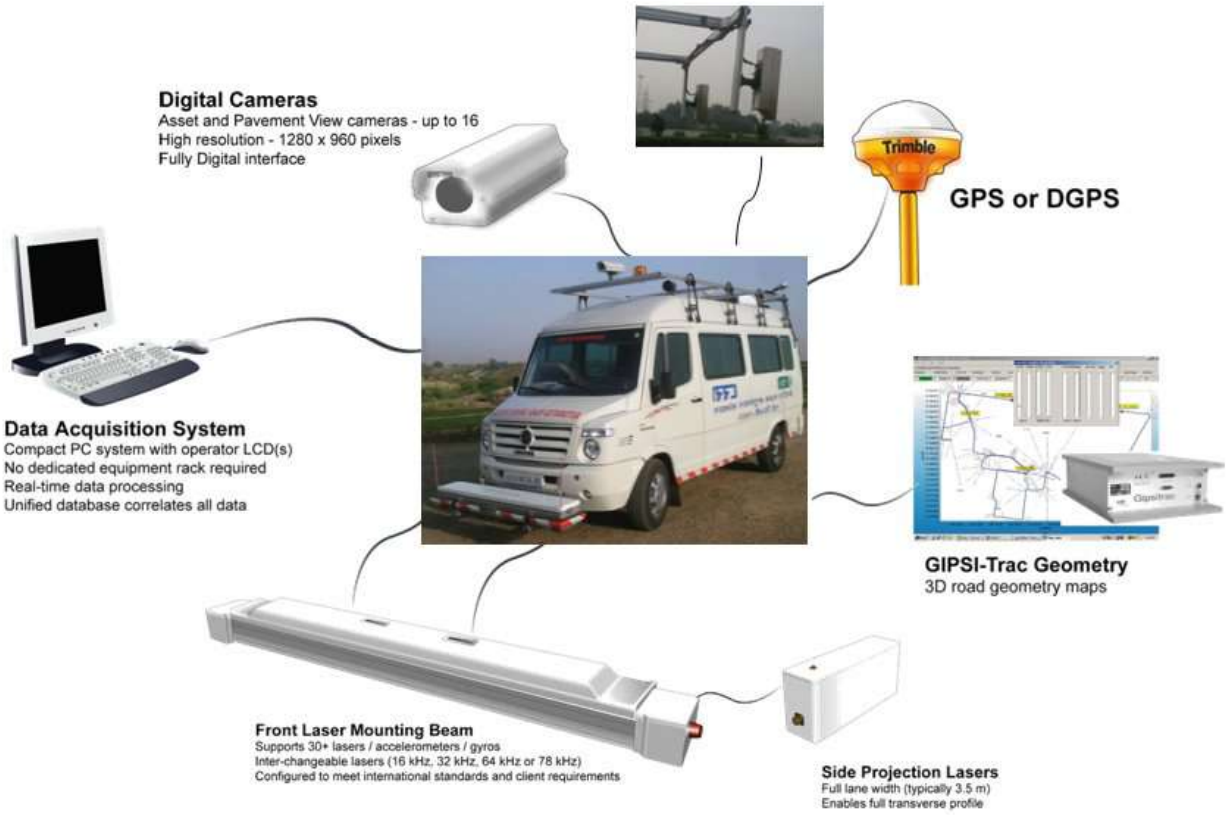


Surface Condition Survey on Rigid Pavements

Axle Load Survey Using Weigh-In-Motion (WIM) System

Road Inventory and Pavement Condition Survey Using Automated Road Survey System

Road Inventory and Pavement Condition Survey Using Automated Road Survey System

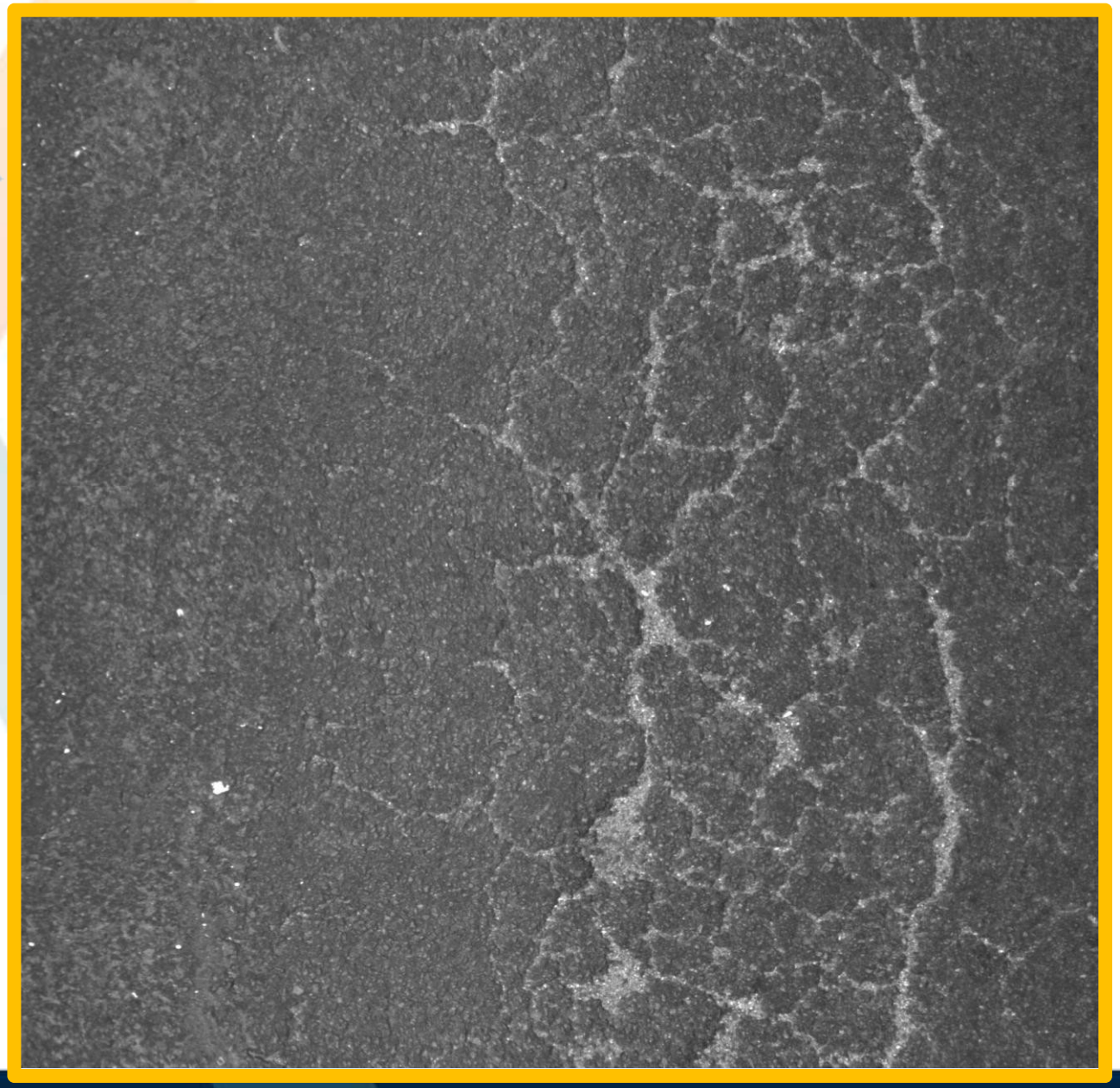


ARSS-Rut Scanner

Pavement Surface Imaging Technique

Pavement Surface Imaging Technique

Pavement Surface Image



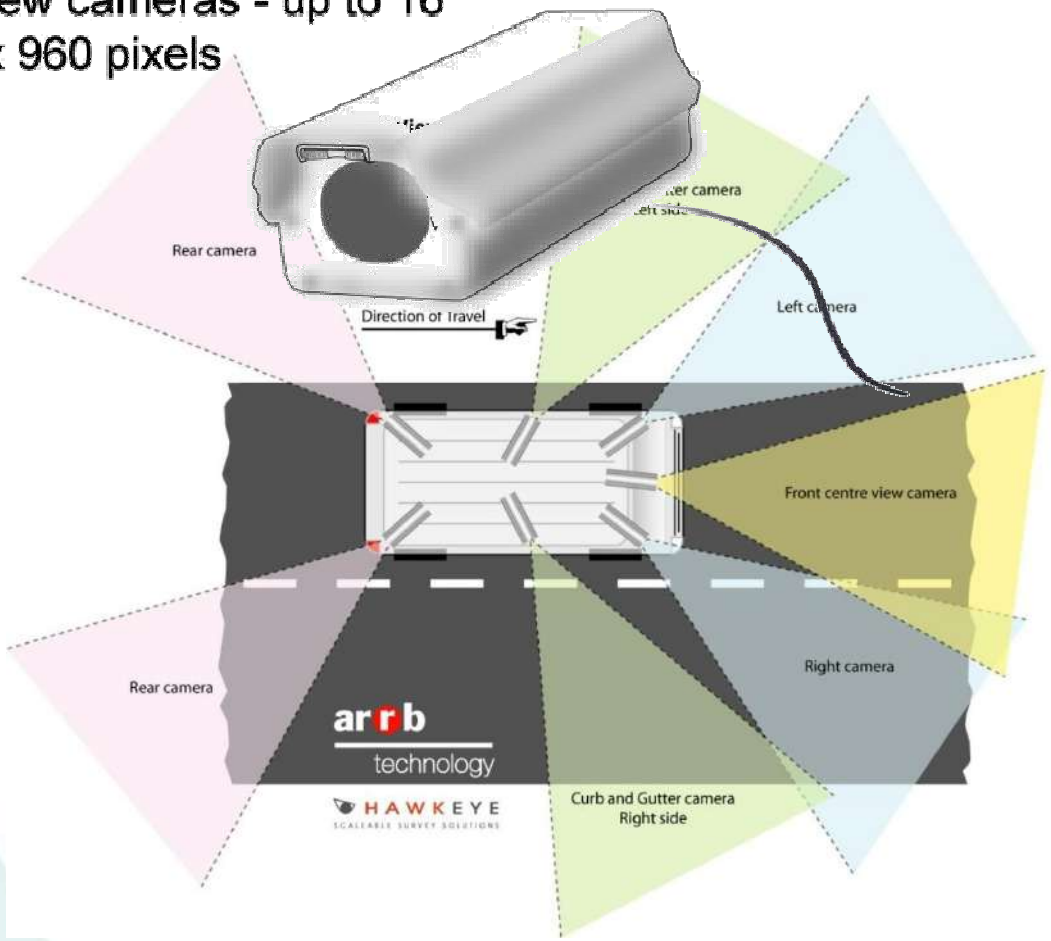
Road Asset Camera

Digital Cameras

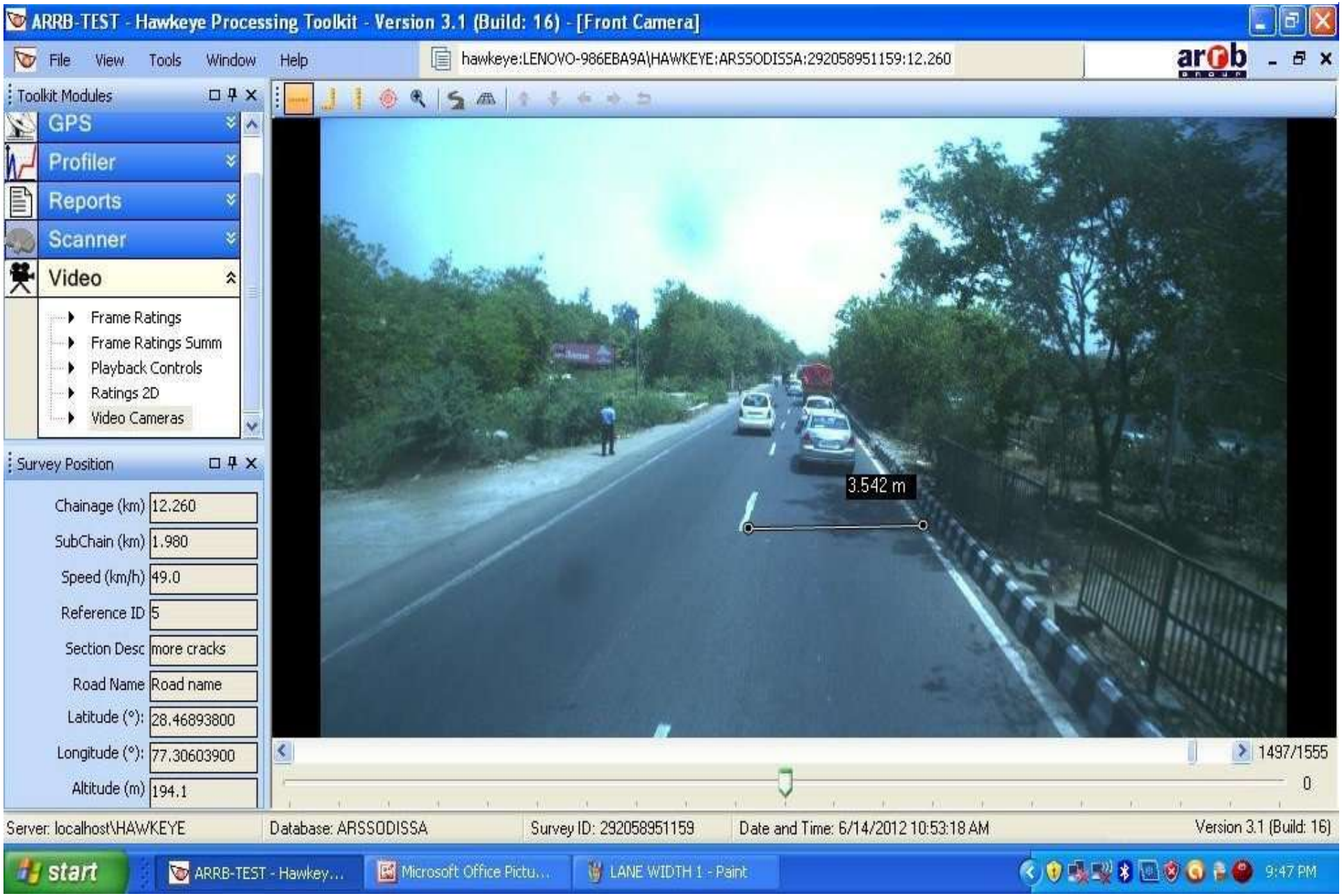
Asset and Pavement View cameras - up to 16

High resolution - 1280 x 960 pixels

Fully Digital interface



Asset Camera Measurements



Road Parameters Measured Using Automated Road Survey System

- ✓ Longitudinal Profiling (International Roughness Index)
- ✓ Transverse profiling (Rut Depth)
- ✓ Pavement Texture (Mean Profile Depth)
- ✓ Cross Slope (%)
- ✓ Gradient (%)
- ✓ Rise+Fall (m/km)
- ✓ Rise +Fall (No. per km)
- ✓ Horizontal Curvature (degree/km)
- ✓ GPS coordinates (X, Y, Z) viz. longitude, latitude & altitude using Real Time-DGPS
- ✓ Pavement Surface Imaging for Distress Measurement
- ✓ Video imaging for Roadside furniture / Road asset

Development of PMMS

- **Data Management and Information System on GIS based Software**
- **Management System for Maintenance Planning Using HDM-4**

Development of Data Management and Information System

Creation of Database in SQL Server

The database in respect of the following corridors has been created

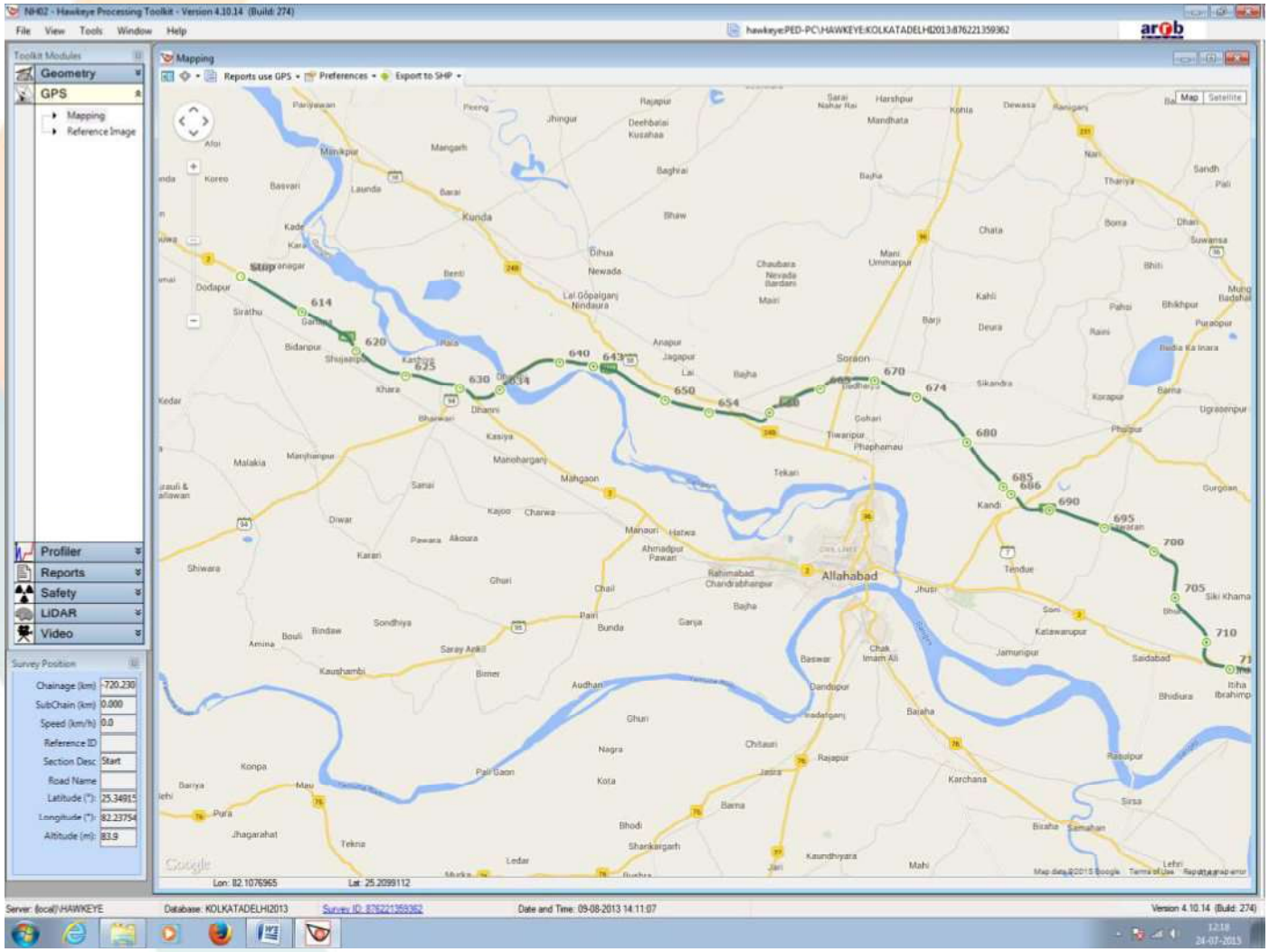
- **Golden Quadrilateral Road Network**
  - **Delhi-Mumbai and Mumbai-Delhi**
  - **Mumbai-Chennai and Chennai-Mumbai**
  - **Chennai-Kolkata and Kolkata-Chennai**
  - **Kolkata-Delhi and Delhi-Kolkata**
- **North-South Corridor**
  - **Jalandhar-Kanyakumari and Kanyakumari-Jalandhar**
- **East West Corridor**
  - **Silchar-Porbandar and Porbandar-Silchar**

……..Development of Data Management and Information System

Data Processing and Viewer Softwares has been used to manage and view the database and attribute information for each of the road corridor in GIS environment

- **Simultaneous viewing of all data (IRI, Rut Depth, Texture, Geometry, ROW Video, Pavement Surface Image, GPS Coordinates etc.)**
- **Measurement of Carriageway Width, Lane Width, Shoulder Width etc. using ROW Video**
- **Measurement of Pavement Surface Distress (Cracking, Ravelling, Pothole etc.) using Pavement Surface Images**
- **Graphical View of data**
- **Export to Excel File Format for Report Generation**
- **Export to Shape File Format for GIS Compatibility**
- **Export to HDM-4 File Format for HDM-4 Input**

……..Development of Data Management and Information System

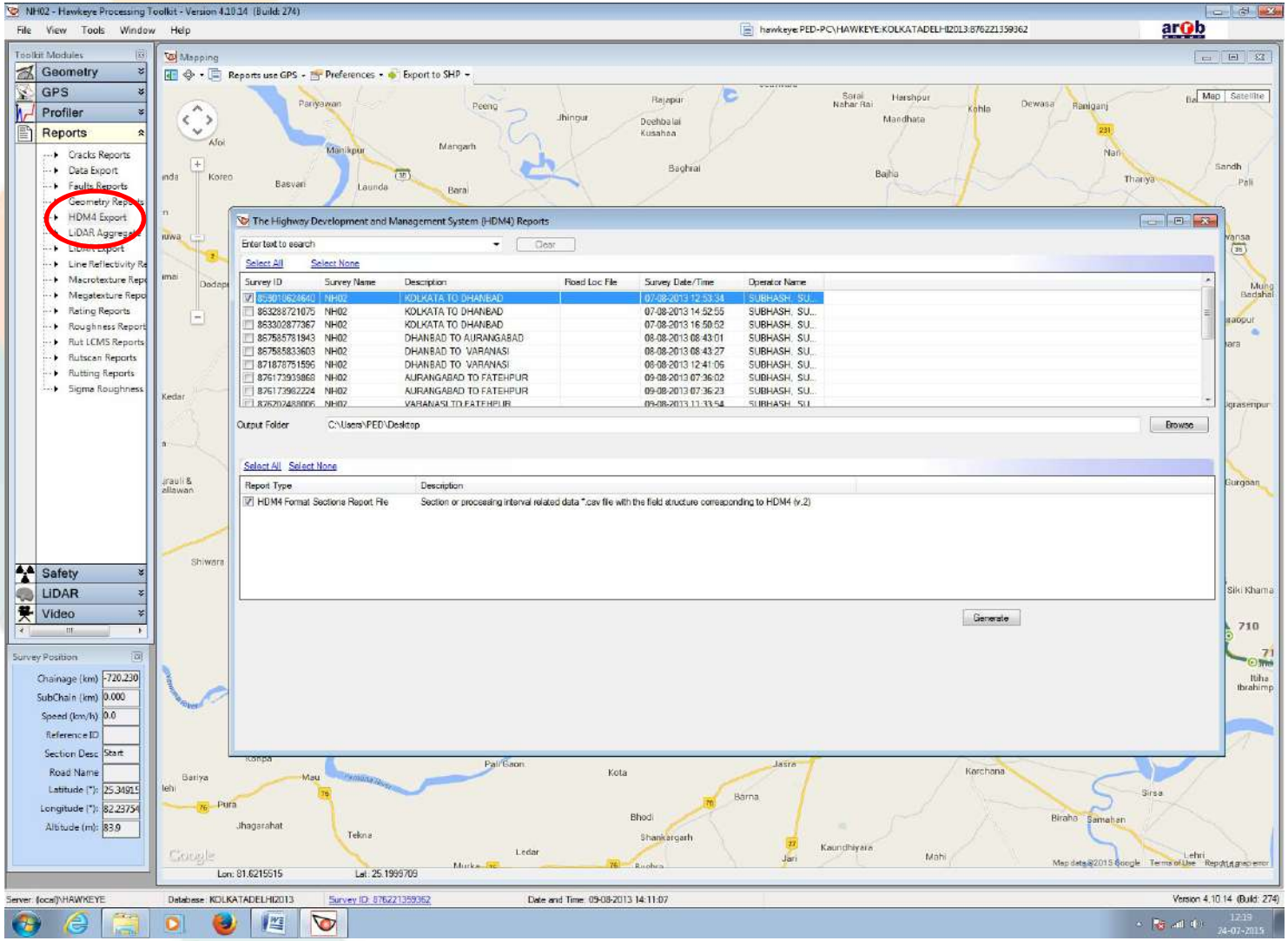


A View of the GIS Map Generated for a Road Section (Kolkata-Delhi Corridor)

……..Development of Data Management and Information System

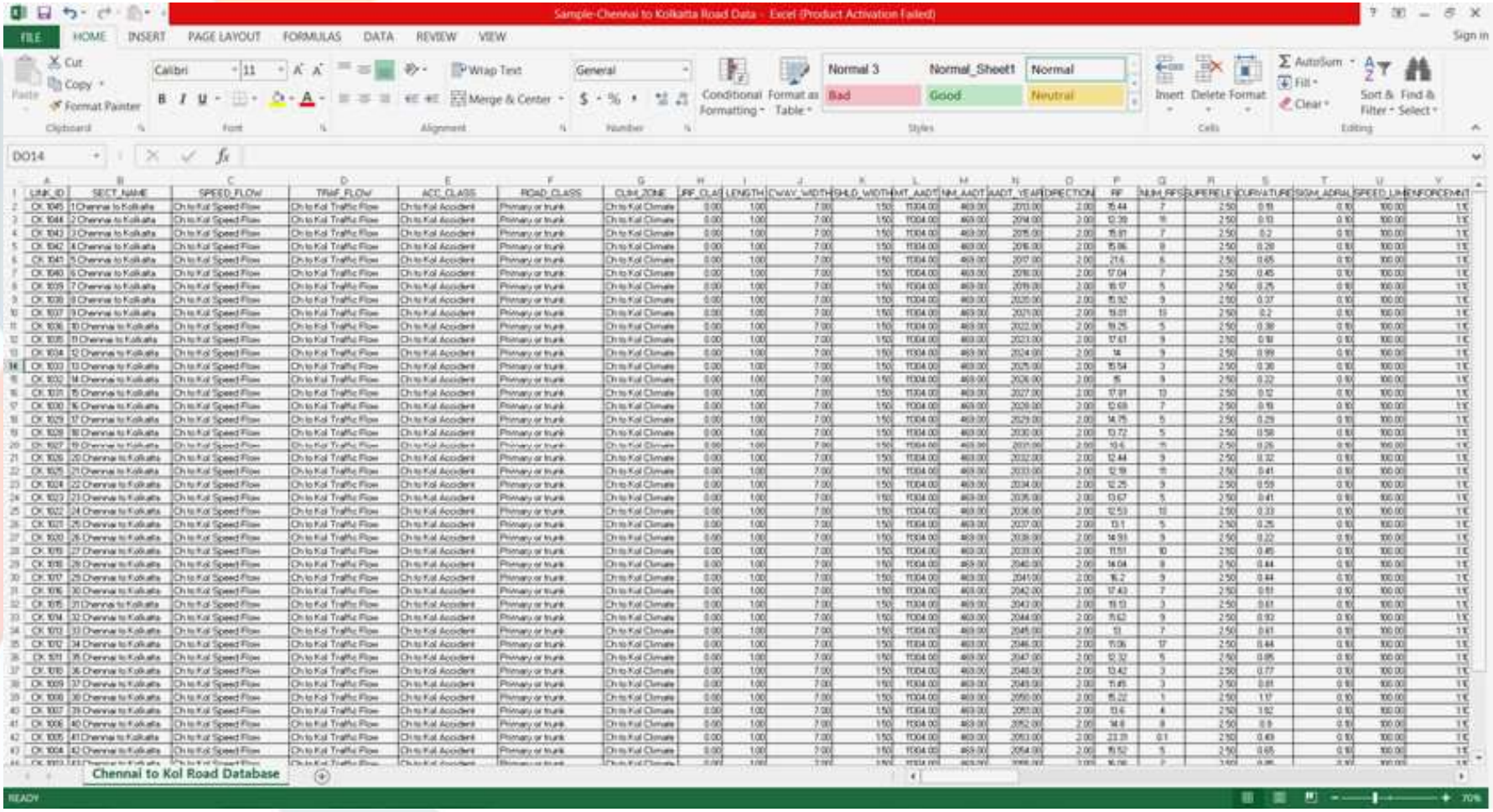
A View of Road Information System showing all Data along with GIS Map and Right-of Way Images

……..Development of Data Management and Information System



A Typical View of HDM-4 Export Module

……..Development of Data Management and Information System



A Typical View of Export File

Calibration and Validation of HDM 4 Deterioration Models For Indian Conditions

Six Climatic Zones Identified as per HDM-4 Classification

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Calibration Factors for Flexible and Rigid Pavements Developed for Six Climatic Zones

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Road User Cost Study

- Delhi
- Mumbai
- Kolkata
- Chennai
- Hyderabad
- Ludhiana
- Vijayawada

Traffic and Road Related

- Free Speed
- Speed – Flow
- Road Geometrics Data

Vehicle Operating Cost Data

- Collection of real life data on vehicle operating costs from the actual vehicle owners / operators

Travel Time Cost

- Passenger's Time Cost
- Goods Time Cost

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Development Management System For Maintenance Planning

By using

- **HDM-4 Calibration Factors**
- **Road Information System Data**
  (Performance and Inventory data)
- **Road User Cost Models**

Pavement Maintenance Management System for High Speed Road Corridors using HDM-4 has been Developed

Conclusion/Outcome

- **The PMMS developed under this study shall assist/enable engineers and decision/policy makers to pre-conceive the requirement of funds for maintenance of road network in order to bring them to a desired level of serviceability.**

- **The system developed will also assist in minimising wasteful losses occurring every year on account of poorly maintained roads.**

- **It will also provide powerful tool to the road authorities in allocating maintenance funds in a rational and judicious/manner and in prioritizing the maintenance tasks/ treatments in view of limited resources.**

- **The use of state-of-art technologies based on Global Positioning System, Geographical Information System, Laser, WIM, and image processing techniques is the key of success for accurate and timely collection of time series data on the huge road network as covered under this study.**

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Thankyou for your kind attention