



JAPAN INTERNATIONAL COOPERATION AGENCY

THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE PHASE II

FINAL REPORT

(Volume 2.1: Pavement Condition Survey Manual)

March 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

KATAHIRA & ENGINEERS INTERNATIONAL CENTRAL NIPPON EXPRESSWAY CO. LTD. ORIENTAL CONSULTANTS PASCO CORPORATION

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VOLUME 2.1

- 1. Overview of Pavement Condition Survey [PCS-Vol. 1]
- 2. Management Manual [PCS-Vol. 2]
- 3. Operation (Field survey & Data analysis) [PCS-Vol. 3]
- 4. Instruction Book of REAL Mini [PCS-Vol. 4]
- 5. Data Preparation [PCS-Vol. 5]
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- 7. Appendix 1



JAPAN INTERNATIONAL COOPERATION AGENCY DIRECTORATE FOR ROADS OF VIETNAM MINISTRY OF TRANSPORT (MOT) THE SOCIALIST REPUBLIC OF VIETNAM



THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE PHASE II

PAVEMENT CONDITION SURVEY MANUAL

Volume 2.1.1: Overview

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Administration Database	Database of PMS data storing administrative	
	information.	
Analyzed section Table (Table-3)	The final section table prepared by PC data.	
Calibration	Adjustment of devices for true value	
Camera for front image	The device for measuring the front image	
Camera for road image	The device for measuring the road image	
Crack	Damage index based on the pavement surface	
	crack.	
End point	The end position of the target route.	
Excluded section	The out of scope section for survey. For	
	example, the section that is under construction or	
	being transferred to the management of another	
	agency.	
IRI (International Roughness Index)	Damage index based on the longitudinal shape	
	on the pavement surface.	
KP (Kilometer post)	Positon of route. It is consist of Kilo-post station	
	number and distance from the Kilo-post station.	
Kilo-post station	A road sign on the side of the road to indicate	
	distances from major cities.	
Kilo-post station number	The number indicated on the kilo-post stations in	
	the side of the road.	
Laser displacement sensor	The device for measuring of longitudinal profile	
Laser scanner	The device for measuring of transverse profile	
Main control unit	The unit to control the measurement device	
Marking	Marking of the start point and end point for	
	easier recognition.	
Overlapping section	A section in which two routes overlap in terms	
	of management.	
Patching	The repaired part of partially damage area	
	(Pothole, crack, and so on).	
Pavement condition	The condition of pavement surface. The	
	pavement condition is evaluated for cracks, ruts and IRI.	
Devenuent oon dition and the line		
Pavement condition survey vehicle	Vehicle assembled with measurement devices.	

Glossary

PDCA cycle	Management cycle acronym for PLAN, DO,	
	CHECK and ACT.	
PMS	Pavement Management System.	
PMS Database	Database stored for PMS dataset.	
Power control unit	The Unit for supply and control the electric	
	power to the measurement device	
REAL Mini	Name of the pavement condition survey vehicle	
	made by PASCO CORPORATION.	
Rut	Damage index based on the transverse shape on	
	the pavement surface.	
Start point	The start position of the target route.	
Survey plan section Table (Table-1)	Table of planned survey length	
Surveyed section Table (Table-2)	Table-1 with extensions added	

AC	Asphalt Concrete
ВОТ	Build-Operate-Transfer
BST	Bituminous surface treatment
CC	Cement Concrete
DPI	Department of Planning and Investment
DRVN	Directorate for Roads of Vietnam
HDD	Hard Disk Drive
IWP	In wheel path
КР	Kilometer post
MMD	Management and Maintenance Department
OWP	Out wheel path
PC data	Pavement condition data
PCS	Pavement Condition Survey
PCSV	Pavement Condition Survey Vehicle
PDOT	Provincial Department of Transport
PPC	Provincial People's Committee
QC	Quarter-Car
RMBs	Road Management Bureaus
SB	Sub Bureaus
STEICD	Science, Technology, Environment, International
	Cooperation Department
TOR	Terms of Reference

Acronyms

1. Introduction

1.1. About This Manual

Overview (PCS-Vol.1) is one of six manuals comprising the suite of the documentation for pavement condition survey. Figure 1.1 shows the component of pavement condition survey manual. Pavement condition survey manual is divided into three parts, Overview, Operation manual and Technical manual. Documents to be referenced depend on the responsibility and work steps of stakeholders involved in pavement condition survey. Overview describes the basic items of survey that all stakeholders should refer to. Operation manual shows important matters to be referred to mainly when survey work managing. Technical manual indicates technical matters such as system and device operation methods, data definition and data preparation. Figure 1.2 shows the description of contents of each document.

This document explains the overview and measuring methods of pavement condition survey. It is a general purpose document which provides in an understanding of pavement condition survey. If there is any lack of information, addition and updates by DRVN staff would be recommended.

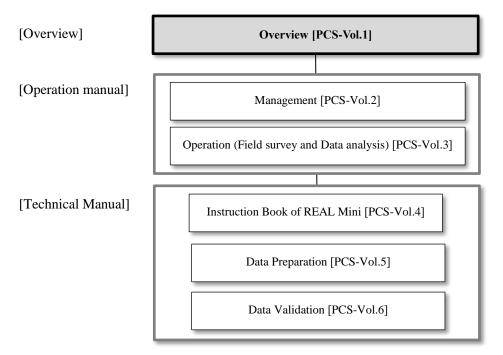


Figure 1.1 Pavement condition survey manual

[Overview]

Overview (PCS-Vol.1]

➔ Describe the overview and measuring methods of pavement condition survey. It is a general purpose document which provides in an understanding of pavement condition survey.

[Operation manual]

Management [PCS-Vol.2]

➔ Describe the management work of road administrator on pavement condition survey. It contains all management works such as the planning, supervising, and data checking on pavement condition survey describing. It is to be used by administrator who to carry out the management of pavement condition survey.

Operation (Field survey and Data analysis) [PCS-Vol.3]

➔ Describe the survey and analysis work of survey consultant on pavement condition survey. It contains the survey and analysis rule. It is to be used by surveyor and analysis operator who to carry out the pavement condition survey.

[Technical manual]

Instruction Book of REAL Mini [PCS-Vol.4]

➔ Describe the operation procedure of REAL Mini system. It contains the operation procedure of inspection vehicle and analysis system, calibration and maintenance of the inspection vehicle and so on. It is to be used by surveyor and analysis operator whose task is to carry out the deep study for operation procedure of REAL Mini system.

Data Preparation [PCS-Vol.5]

➔ Describe the contents of pavement condition data (PC data). It contains the code definition, explanation of each item of PC data and so on.

Data Validation [PCS-Vol.6]

→ Describe the data check procedure when creating the PC data. It is to be used by person whose task is to carry out the data check in pavement condition survey.

Figure 1.2 Contents of Pavement condition survey manual

2. Summary of Pavement Condition Survey

2.1. Pavement Condition Survey

1) Pavement Condition Survey

Pavement condition survey measures pavement damages such as cracks, ruts and IRI using the pavement condition survey vehicle (hereafter PCSV) on moving and make the pavement condition data files. The pavement damage expresses surface (crack), transverse (rut) and longitude (IRI) (Figure2.1).

Pavement condition survey measures not only pavement condition but also road inventory information, forward view image and position information at the same time.

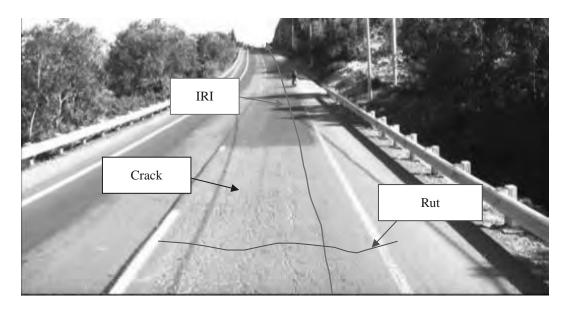


Figure 2.1 Pavement damage to be evaluated by PCS

a) Pavement Condition Survey Vehicle (PCSV)

PCSV is a measuring system for the continuous collection of the pavement condition data (Crack, Rut and IRI) and forward view image of the vehicle synchronized with distance and positional information. These data are measured by the equipment installed to the vehicle. PSCV has the following sensors (Figure2.2): CCD camera for front image, GPS, Laser Scanner, CCD Cameras for road image, Inertial Measurement Unit (IMU) and Laser Displacement Sensor. The front camera records front images of the road; GPS records locations; the laser profiler records cross section profiles to identify rut depths; The CCD camera for front image in black and white to identify cracks; IMU and laser displacement sensor identify longitudinal profile for IRI.

In the field survey, operator uses two kinds of application modules. One is the measurement module. Other is Starting and ending point setting module. The measurement module is to control a start and end point of survey and display status of the system. Starting and ending point setting module is set the start/end position to collect data for analysis.

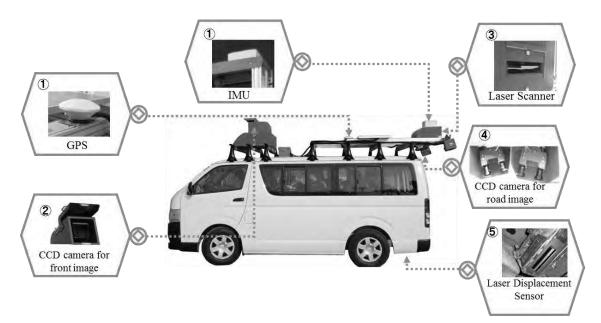


Figure 2.2 PCSV (REAL Mini)

Module Module window		Description
Measurement module		To control and monitor the measurement
Starting and ending point setting module		To set the starting point and ending point in the measurement data.

Table 2.1 Applications of REAL Mini

b) Applications for PC Data preparation

PCSV also has the dedicated applications for preparing the pavement condition data (hereafter PC data) file. There are four applications, data convert, data analysis, location setting and data processing. Table 2.2 shows the component of applications for preparing the PC data. Figure 2.3 shows the work flow of preparing the PC data using applications.

Operator converts the measurement data of PCSV to analysis data using Data convert module. And then, Operator analyzes the analysis data using Data analysis module. Data analysis module output the each result file (Rut depth, Cracking ratio/index, IRI) and list of front image and coordinates. Next, Operator set the location information to analysis data using Location setting module. Location setting module outputs the location data of road facility, intersection, changing lane, and so on. Finally, Operator processes the analysis data. Data processing module outputs the PC data for PMS using the output data of analysis and location module.

5

No.	Module	Module window	Description
1	Data convert module		Convert the measurement data to analysis data.
2	Data Analysis module		Analysis the crack, rut, IRI. and Output the each result file and FV image list.
3	Location Setting module		Set the position of KP, structure, intersection, peculiar condition and so on. And output the position file based on setting result.
4	Data Processing module		Prepare the PC data file from the data of analysis and location setting application.

Table 2.2 Applications for PC data preparation

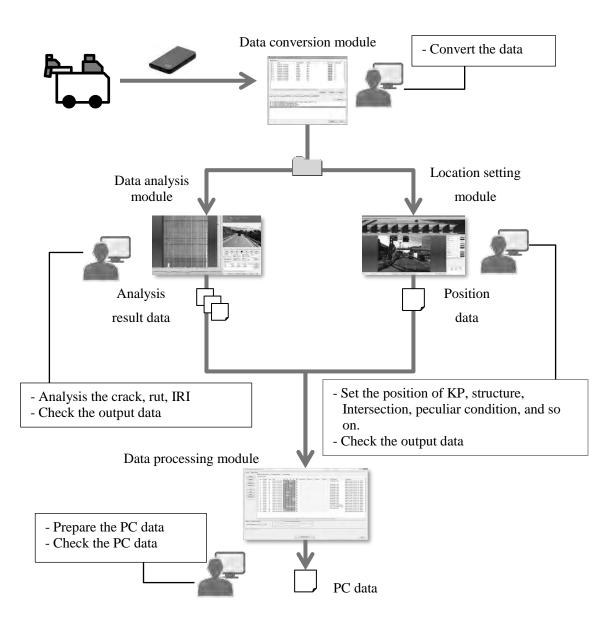


Figure 2.3 Work flow for PC preparation

2) Pavement Condition Data (PC data)

PC Data file is result of road surface damage status by pavement condition survey. Damage of road surface is evaluated by crack rate, rut depth, IRI and MCI. These evaluated data are prepared for every 100 m unit section. Description of evaluation item of road surface damage is shown in Table 2.3. If you would like to know detail information, refer to chapter 4 for details.

Item	Content	Description	Note
Crack	Crack ratio [%]	Crack ratio is calculated by	In case of AC, BST
	Patching [%]	damaged area per total area	
	Pothole [%]	grids.	
	Crack index [cm/m2]	Crack index is calculated by	In case of CC
		crack length of damaged	
		per total area	
Rut	Rut depth	Average rutting depth	
(Average,)[mm] within unit secti		within unit section (100m)	
	Rut depth (Max) [mm]	Maximum rutting depth	
		within unit section (100m)	
IRI	IRI [mm/m]	Total Axial displacement of	
		QC model in unit section	
		(100m)	
MCI	Integrated condition	automatic calculated by 3	
	index using above 3	damaged values	
	damage items		

Table 2.3 Evaluation item of road surface damage

2.2. The Importance to Conduct the Constantly Pavement Condition Survey

Since pavement condition survey should is not completed at once, it should be carried out continuously. Time-series database will be established by continuously conduction of pavement condition survey. Time-series database is utilized for management and evaluation for pavement maintenance work.

- Survey Plan

Long-term survey plan shall be prepared. In survey plan, the following points shall be considered.

- <u>Capacity of PCSV</u>
 Survey length that can be carried out in a year is decided according to the number of PCSV.
- <u>Secure human resource</u> Engineers for field survey work and data analysis work
- Budget for survey Secure enough budgets for PCS
- Compatibility with progress of previous 5-year pavement maintenance plan Decide next timing of survey based on the progress of 5-year pavement maintenance plan with previous PC data

- Survey scheme

- <u>One time survey scheme</u> All road networks is surveyed in one time
- Equalization of survey length Survey length is equalized for each fiscal year

Figure 2.4 shows a survey scheme of equalization of survey length. In case that road network of 1500km is surveyed in 3 years, road network is divided into 3 groups (A, B, and C). In that case, survey length in one year is 500km. Road network in Group A is measured in the first year. Next survey in Group A is conducted in the 4th year after completion of all network survey.

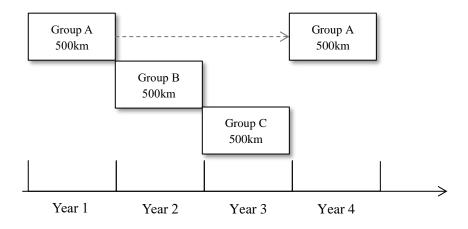


Figure 2.4 Sample of survey scheme (equalization of survey length)

2.3. Work Allocation on Pavement Condition Survey

Pavement condition survey work is divided into four steps, 1) Survey Plan, 2) Measurement, 3) Data Analysis and Data Processing, and 4) Data Check and Data Install. List of work item and assignment on Pavement Condition Survey is shown in table 2.4. Responsible division of DRVN in pavement condition survey is shown in Figure 2.5.

- DRVN (DPI, MMD, STECID and IT Center)

<u>DRVN is Top manager of pavement condition survey</u> (hereinafter, this is called "Top manager"). In the future, RMBs or PDOT can become top manager of the pavement condition survey. Role of top manager are as follows;

- Approve the survey plan
- · Check the progress of the pavement condition survey based on RMBs report
- Manage the PCSV
- Approve the completion of the pavement condition survey
- Install the PC data to PMS server (IT Center)

- RMB (DPI, MM, SB)

RMBs are manager of each work in pavement condition survey (hereinafter, this is called

"Work manager"). Role of work manager are as follows;

- Prepare the survey plan
- Supervise the work of the survey consultant
- · Submit the plan, progress report and complete PC data to top manager

- Survey consultant

Survey consultant conducts the below contents.

- Preparation of implementation plan
- Measurement
- Data analysis
- Data processing

No.	Work Item	DRVN (Top manager)	RMMBs (Work manager)	Survey Consultant
1	Survey plan	• Approve the survey plan	 Preparation of survey plan Submit the survey plan to DRVN Assign Survey consultant 	• Preparation of Implementation plan
2	Field survey	 Management of PCSV Check the progress report form RMBs 	 Supervise field work (Progress, Problem) Report the progress to DRVN 	• Field survey
3	Data analysis	• Check the progress	• Supervise data work	• Data analysis
	Data Processing	report form RMBs	(Progress, Problem)	Data processing
4	Data check Data install	 Approve the completion of the pavement condition survey Install PC data (IT center) 	 Data check Submit PC data to DRVN 	• Correct data
	Work	items	DRVN (DPI, MMD, STEIC) \Rightarrow RMBs or PDOT (In future)	
		ey Plan	RMBs (DPI & MM)	
	2 Field Survey RMBs (SB)			
	3 Data analysis & processing RMBs (DPI & MM)			
	4 Data	check	RMBs (DPI &SB & MM)	

Figure 2.5 Responsible division of Pavement Condition Survey

IT Center

3. Understanding of pavement condition data

Data install

In this chapter, some definitions of pavement condition data are described here for better understanding.

3.1. Definition of section length

The unit section length of PC data is evaluated in 100m section basically. However, there are five special cases that the section length is shorter than 100 m.

Case -1 Start and end point of structure

When the position of start and end point of the structure, such as bridge and tunnel, is different from the position of the breakpoint of the 100m section, PC data is divided at the position of the start and end point of its structure.

Case-2 Distance between kilometer-posts

The distance between kilometer-posts installed in the field is defined as 1000m on the inventory data generally 1000m. However when actual distance between kilometer-posts is measured by PCSV, the actual distance is used for section length on PC data. If the actual distance is not exactly 1000m, the fractions number is considered in the last section. In that case, the length of last section is sometimes less than 100m.

Case-3 Route length

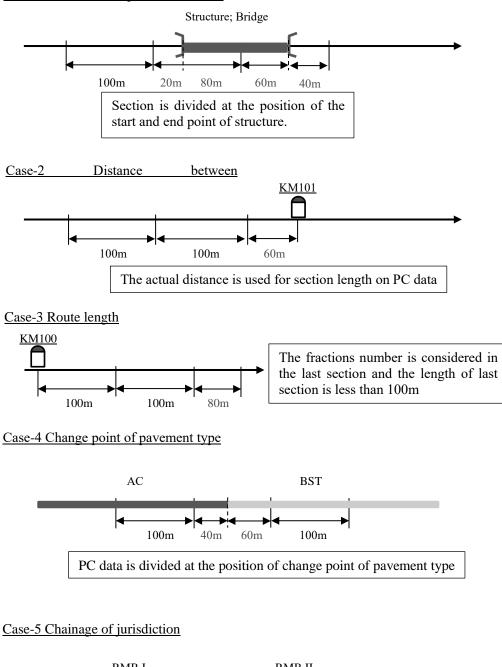
The section of PC data is prepared for each route. Certainly route length is not often an aliquot number by 100. In that case, the fractions number is considered in the last section and the length of last section is less than 100m.

Case-4 Change point of pavement type

During survey on site, pavement type, such as AC, BST, CC and others, is identified. Change point of pavement type is different from the position of the breakpoint of the 100m section, PC data is divided at the position of change point of pavement type.

Case-5 Chainage of jurisdiction

The section of PC data is divided at the chainage of jurisdiction border. In that case the section length with jurisdiction border is sometimes less than 100m.



Case -1 Start and end point of structure

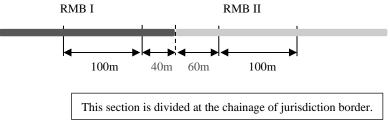


Figure 3.1 Cases of length definition in PC data

3.2. Kilometer Post Information (From-To)

Kilometer Post Information (From-To) is indicating the information of kilo-post station installed on site and distance from the nearest kilo-post station on the starting point side in units of 5m. Kilometer Post Information is defined by combination between kilo-post station number as "Km" and distance from kilo-post station as "m".

Explanation of figure 3.2

Starting point of section A is located on 500m distance from kilo-post station number 3, and end point of section A is located on 600m distance from kilo-post station number 3. In this case, Kilometer Post Information of section A is described as follows;

From_Km	: 3
From_M	: 500
To_Km	: 3
To_M	: 600

Kilo-post station number

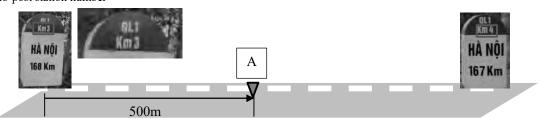


Figure 3.2 Conceptual Diagram of Kilometer Post

If there is a missing kilo-post station on site, a position is defined as from nearest kilo-post station on the starting point side, not from missing station. In that case, number of station number in m is over that 1,000m. If a kilo-post station number has an alphabet such as "14B", it can be assumed that it is missing kilo-post station.

Explanation of figure 3.3

Starting point of section A is located on 1400m distance from kilo-post station number 5, and end point of section A is located on 1500m distance from kilo-post station number 5. In this case, Kilometer Post Information of section A is described as follows;

From_Km	: 5
From_M	: 1400
To_Km	: 5
To_M	: 1500

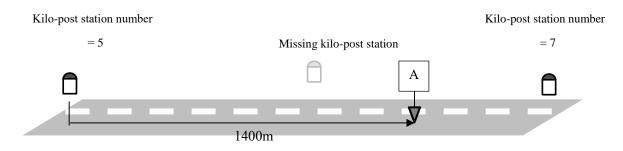


Figure 3.3 Conceptual Diagram of Kilometer Post (Missing kilometer)

3.3. Multi lane data

When lane number is multiple, each lane shall be surveyed separately. Data analysis and processing work is also done lane by lane. Therefore, PC data is prepared separately lane by lane. Lane position can be identified by the number of "Lane_Position_Number" on the PC data.

To keep compatibility of the position between adjacent lanes, first PC data of 1st lane is prepared. After that, the data of 2nd lane and 3rd lane is prepared with same attributes of location information as 1st lane.

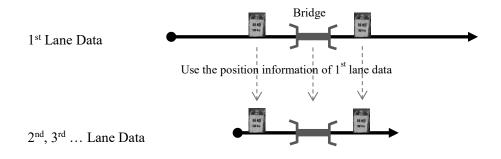


Figure 3.4 Reflect 1st lane information to multiple lane

3.4. Peculiar Condition

Peculiar condition is identified as a peculiar damage which cannot be evaluated by determined definition of pavement damage with crack interpretation way. Peculiar condition code is entered in case that a peculiar condition is found within an evaluation unit range. In cases that there are more than two kinds of peculiar condition are found within one evaluation unit range, the highest priority code number shall be entered.

Item	Description	Image	Priority
1.Broken	Once paved sections, but there is serious damage which cannot be evaluated.		High
2.Unpaved or unidentified Pav. Type	Unpaved: never paved. Unidentified Pavement type: besides, AC, CC and BST.	Alter and a	
3.Wet Condition	The lane is covered with water or wet.		
4.Other damage	Other type damages that cannot be judged as cracking. (Ex. Raveling, Scratch, etc.)		
5.Invisible	Surface cannot be seen due to coverage of pavement surface by other objects, such as sand, soil, construction material, etc.		
6.Under construction	Ongoing construction work on the survey lane.		Low

4. Method of measuring and analysis of pavement condition

This chapter describes the method of measuring and analysis of each evaluation item in pavement condition.

4.1. Crack

1) Introduction

The objective of this chapter is to show evaluation and calculation method of cracks on pavement surface. The results of these measurements are evaluated as the crack ratio for asphalt pavements and the crack index for concrete pavements.

2) Measurement Tools

PSCV uses the Area Photo Method which captures images for every fixed area while consecutively overlapping these images of the pavement surface by using CCD cameras.

PCSV operates to synchronize the crack detection devices with the vehicle speed. Therefore, continuous series of images of the pavement surface can be captured. The cracks are deducted from these images and are summarized as the crack ratio or the crack index.

3) Summary of the results

Apply the 0.5m square grids onto the images of the pavement surface which are obtained from the field survey. Calculate the crack ratio by following method.

- a) Summary of the asphalt pavement. (refer Note 1 and 2)
 - i) The grids with one linear crack and with more than two linear cracks will be counted separately.
 - ii) For the patch, visually estimate the area of each grid occupied by the patch and count them separately according to the following three classes.
 - a. 0% or more and less than 25%
 - b. 25% or more and less than 75%
 - c. 75 % or more
 - iii) For the pothole, visually estimate the area of each grid occupied by the pothole and count them separately according to the following three classes.
 - a. 0% or more and less than 25%
 - b. 25% or more and less than 75%

c. 75 % or more

- iv) Calculate the crack area of each grid as follows.
 - If a grid contains one crack, assume that 0.15 m^2 of the crack is produced.
 - If a grid contains more than two cracks, assume that 0.25 m² of the cracks is produced.
 - If the area of the patch is 0% or more and less than 25%, assume that the crack area is 0 m^2 .
 - If the area of the patch is 25% or more and less than 75%, assume that the crack area is 0.125 m².
 - If the area of the patch is 75 % or more, assume that the crack area is 0.25 m^2 .
 - If the area of the pothole is 0% or more and less than 25%, assume that the crack area is 0.03 m².
 - If the area of the pothole is 25% or more and less than 75%, assume that the crack area is 0.125 m².
 - If the area of the pothole is 75 % or more, assume that the crack area is 0.25 m².
- v) Calculate the crack ratio of each unit (100m) by using the formula shown in 4
 .1. as one places of decimal.

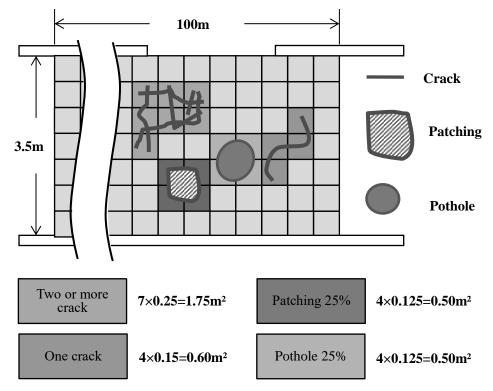
The crack ratio(%) =
$$\frac{\text{the crack area}(m^2)}{\text{Survey Section area}(m^2)} \times 100$$
 ------(4.1)

Note 1:

As the lane width is not always multiples of 0.5m, the length of the end of the grid may sometimes be less than 0.5m. For example, assume that the grid area is Am^2 . The grid area at the end is calculated as follows. If the grid has one linear crack, the crack area is calculated as 0.6xA m². If the grid has more than two linear cracks, the crack area is calculated as Am^2 . For the patch, the grid area occupied by the patch is classified as 0% or more and less than 25%, 25% or more and less than 75% and 75% or more. The patch area is calculated as 0 m², 0.5xA m² and Am² respectively.

Note 2:

In the case of containing both cracks and patches in a grid, the grid is considered as a crack grid.



Crack ratio = $((1.75+0.60+0.50+0.50)/(3.5\times100))\times100 = 1.0\%$

Figure 4.1 Example of Calculations of the Crack Ratio

- b) Summary of the concrete pavement (refer Note 3 and 4)
 - Visually measure the length of cracks in each grid and count the number of the grids separately according to the following six classes.
 - a. Total crack length is 25cm 50cm in the grid
 - b. Total crack length is 50cm 75cm in the grid
 - c. Total crack length is 75cm 100cm in the grid
 - d. Total crack length is 100cm 125cm in the grid
 - e. Total crack length is 125 150cm in the grid
 - f. Total crack length is over 150cm in the grid
 - ii) Calculate the length of cracks separately according to the following three classes.
 - If total crack length is 0cm 25cm in the grid, assume that 0cm of the crack length is produced.
 - If total crack length is 25cm 50cm in the grid, assume that 25cm of the crack length is produced.

- If total crack length is 50cm 75cm in the grid, assume that 50cm of the crack length is produced.
- If total crack length is 75cm 100cm in the grid, assume that 75cm of the crack length is produced.
- If total crack length is 100cm 125cm in the grid, assume that 100cm of the crack length is produced.
- If total crack length is 125cm 150cm in the grid, assume that 125cm of the crack length is produced.
- If total crack length is over150cm in the grid, assume that 150cm of the crack length is produced.
- iii) Visually measure the area of each patch in the grid, count the number of the grids separately according to the following three classes. They are 0% or more and less than 25%, 25% or more and less than 75%, and 75% or more of the area of the grid.
- iv) Calculate the area of the patch separately according to the following three classes.
 If the area of the patch is 0% or more and less than 25%, its area is 0 m². If the area of the patch is 25% or more and less than 75%, its area is 0.125 m². If the area of the patch is 75 % or more, its area is 0.25 m².
- v) Calculate the crack index of each unit (100m) by using the formula shown in 4.2 as one places of decimal. Crack index is calculated from crack length and patching. The crack area is calculated by crack length multiply damage width of the pavement due to crack. The damage width is 0.3 m. In order that the unit of patching is converted from "m²" to "cm", Patching value is divided by 0.3 and multiplied 100.

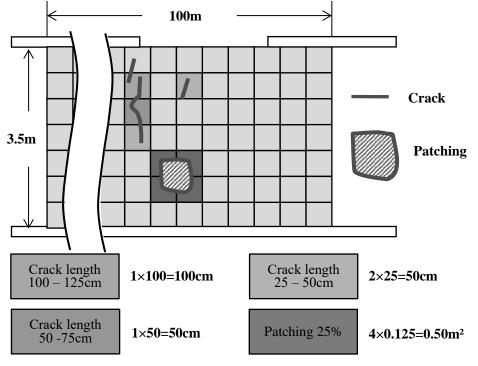
The crack Index(cm/m²) =
$$\frac{Accumulate \ crack \ length(cm) + \left(\frac{Patch \ Area(m^2) \times 100}{0.3(m)}\right)}{Survey \ Section \ area(m^2)} \quad ---- (4.2)$$

Note 3:

As the lane width is not always multiples of 0.5 m, the length of the end of grid may be sometime less than 0.5 m. If the crack develops in the transverse direction and extends to the end of the grid, assume that the transverse direction of the grid length is defined as A cm. The crack length is calculated as follows. If the crack length is 25cm in the grid, its length is 0.5 x A cm. The patch area is calculated as 0 m², 0.5xB m² and B m² respectively assuming that a grid area is B m².

Note 4:

In the case of containing both cracks and patches in a grid, the length of cracks and the area of patches are calculated separately and summarized.



Crack index = $((100+50+50)+(0.5/0.3)\times 100)/(3.5\times 100) = 1.1 \text{ cm/m}^2$

Figure 4.2 Example of Calculations of the Crack Index

4.2. Rut

1) Introduction

The objective of this section is to show how to measure the rut depth which develops on the wheel path by friction, deformation of the pavement, or the flow of the asphalt composite materials.

2) Measurement Tools

PCSV uses the laser scanner for measurement of transverse profile. Transverse profile is measured in each 1meter.

3) Summary of the results

Rut depth is calculated by following method.

 When the convex in the middle of the lane is higher than the convex of both the shoulder and the center side lines, the values of the rut depth will be measured as D1 and D2 in mm by using the method shown on Figure 4.4 a).

- When the convex in the middle of the lane is lower than the convex of both the shoulder and the center side lines, the values of the rut depth will be measured as D1 and D2 in mm by using the method shown on Figure 4.4 b).
- iii) The larger of the values of D1 or D2 is selected as the rut depth of the transverse profile.
- iv) Finally, calculate the average of rut depth and maximum of rut depth in each unit (100m).

- Average of rut depth

Average value of rut depth for all value within unit section (100m)

Average of Rut depth (mm) = $\frac{\text{the sum total of Rut depth of all transverse profile in 100m}}{\text{Number of transverse profile in 100m}}$

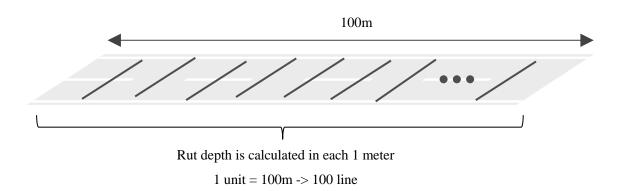
---- (4.3)

- Maximum of rut depth

Maximum value of rut depth within unit section (100m)

Maximum of Rut depth (mm) = the Maximum rut depth of all transverse profile in 100m

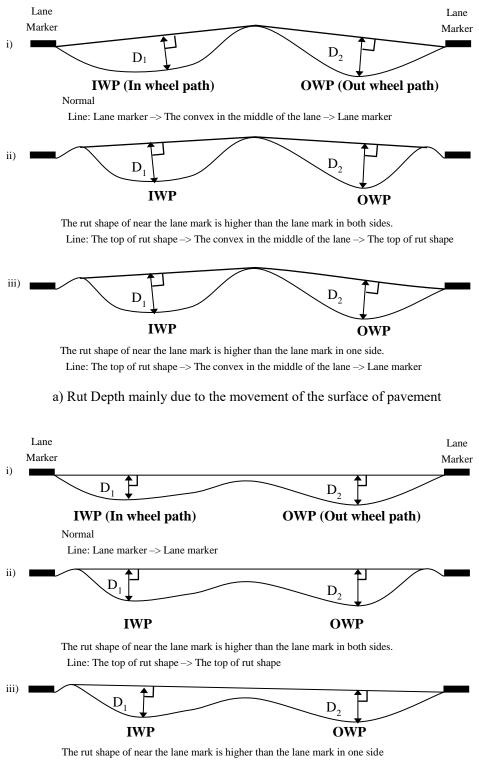
---- (4.4)



Average of Rut depth = Sum of total rut depth within 100 line / 100

Maximum of Rut depth = Maximum value of rutting depth within100 line

Figure 4.3 Calculation method of average and maximum of rut depth



Line: The top of rut shape -> Lane maker

b) Rut Depth mainly due to the friction of the surface of pavement

Figure 4.4 The Definition of Rut Depth

4.3. IRI

1) Introduction

International Roughness Index (IRI) is the roughness index measured by longitudinal road profiles. It is calculated using a quarter-car vehicle math model, whose response is accumulated to yield a roughness index with units of slope (mm/m). This chapter explains how to obtain the IRI which evaluates the roughness of the pavement surface.

The survey method of IRI is classified 1 to 4 depending on the method of the surface profilers. The PCSV introduced in DRVN has roughness measurement method of Class 2.

The PCSV measures longitudinal profile of out wheel path by the laser displacement sensor and IMU, and IRI value is calculated based on the Quarter-Car simulation (QC simulation).

Class	Road roughness measurement method	IRI calculation method
1	Leveling	Measure the longitudinal profile with the leveling method at an interval of 250mm or less and calculate the IRI from QC simulation.
2	Any device for longitudinal profiler (any)	Measure the longitudinal profile using any longitudinal profiler and calculate the IRI from QC simulation.
3	RTRRMS (response type road roughness measurement system)	Measure the roughness index of any scale by using a RTRRMS (response type road roughness measurement system), and convert to IRI by correlation equation.
4	Physical and visual experience of the inspector riding the patrol car.	IRI is judged based on the physical and visual experience of the inspector riding the patrol car.

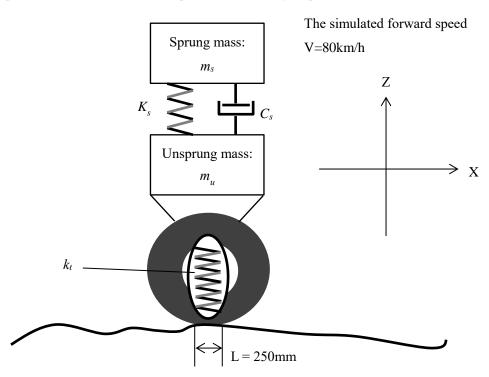
Table 4.1 Measuring methods for road roughness and IRI calculation methods

2) Measurement Tools

The longitudinal profile is measured by using a laser displacement meter and accelerometer equipped in the survey vehicle.

3) IRI Calculation Procedures

Calculate IRI by using QC simulation with longitudinal profile data measured by PCSV. QC simulation is a quarter model which extracts one wheel from a regular car with two axes and four wheels. It is expressed as a dynamics system shown on Figure 4.5. IRI is a ratio of the accumulated values of movement displacements (mm) of the vertical direction and the survey distance (m) at a consistent vehicle speed. IRI is calculated in each unit (100m). IRI is calculated in the following series



of equations of motion which are equation (4.5) through equation (4.7).

Figure 4.5 Quarter-Car (QC) Model

$$\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}\mathbf{h}_{ps} - \dots (4.5)$$

$$\mathbf{x} = [\mathbf{z}_{s}, \dot{\mathbf{z}}_{s}, \mathbf{z}_{u}, \dot{\mathbf{z}}_{u}]^{T}$$

$$\mathbf{A} = \begin{pmatrix} 0 & 1 & 0 & 0 \\ -\mathbf{k}_{2} & -\mathbf{c} & \mathbf{k}_{2} & \mathbf{c} \\ 0 & 0 & 0 & 1 \\ \mathbf{k}_{2}/\mathbf{c} & \mathbf{c}/3 & -(\mathbf{k}_{1} + \mathbf{k}_{2})/3 & -\mathbf{c}/\mu \end{pmatrix}$$

$$\mathbf{B} = [0, 0, 0, \mathbf{k}_{1}/,]^{T} - \dots (4.6)$$

 $h_{ps} =$ Smoothed profile elevation

 z_s = Height (vertical coordinate) of the sprung mass

 \dot{z}_s = Derivative of Height (vertical coordinate) of the sprung mass

 $z_u =$ Height (vertical coordinate) of the unsprung mass

 \dot{z}_u = Derivative of Height (vertical coordinate) of the unsprung mass

The following values are the normalized parameters.

 $c = c_s/m_s = 6.0$ $k_1 = k_t/m_s = 653$ $k_2 = k_s/m_s = 63.3$ $\mu \ 6m_u/m_s = 0.15$

Where

- $c_{s}\,:\,Suspension$ damping rate
- k_s : Suspension spring rate
- kt : Tire spring rate
- m_s : Sprung mass (portion of vehicle body mass supported by one wheel)
- m_u : Unsprung mass (mass of the wheel, tire, and half of the axle/suspension)
- L : Length of the profile

Equation 4.5 is solved by inputting the h_{ps} value. Then IRI is calculated by using equation (4.6). The simulated forward speed is defined as 80km/h.

$$IRI = \{\int_{0}^{L/V} |\dot{z}_{s} - \dot{z}_{u}| dt\}/L \quad \dots \quad (4.7)$$

4.4. MCI

In order to evaluate pavement condition, an evaluation method using comprehensive index, MCI (Maintenance Condition Index) is considered. MCI had been used by MLIT (Ministry of Land, Infrastructure, Transport and Tourism) in Japan as an index for the pavement evaluation until 2005.

MCI is given by following equations;

$MCI = 10 - 1.48C^{0.3} - 0.29D^{0.7} - 0.48\sigma^{0.2} - \dots + (4.8)$
$MCI_0 = 10 - 1.51C^{0.3} - 0.3D^{0.7} - \dots $ (4.9)
$MCI_1 = 10 - 2.23C^{0.3} - \dots + (4.10)$
$MCI_2 = 10 - 0.54D^{0.7} - \dots + (4.11)$

Here, MCI _i : Maintenance Control Index				
C: Crack ratio (%)				
D: Rut depth (mm)				
σ : Evenness (mm)				

where C is cracking rate (%), R is mean value of rutting depth (mm) and σ is longitudinal evenness (mm). MCI is given by minimum value among the results getting from equation (4.8), (4.9), (4.10) and (4.11), and full mark (no damage) is 10points.

Longitudinal evenness is defined by following method;

- Measure the height from the road surface to vehicle by 3 sensors located in 1.5m interval (Figure 4.6)
- Measure the height in every 1.5m
- Calculate the height of longitudinal profile from height of each sensor by equation (4.12)
- Calculate the Evenness from the height of longitudinal profile by equation (4.13)

 $H = (h_1 + h_3) / 2 - h_2 - \dots (4.12)$ $\sigma = \sqrt{(\sum H^2 - (\sum H)^2 / n) / (n - 1)} - \dots (4.13)$

- *H* : Height of longitudinal profile (mm)
- h_i : Height from the road surface measured by each sensor (mm)
- n: number of height
- σ : Evenness (mm)

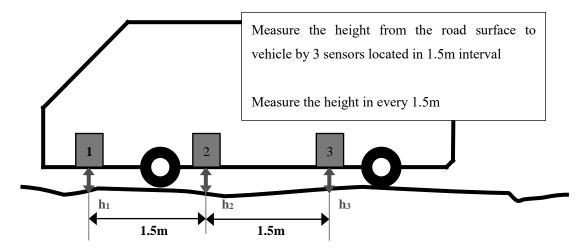


Figure 4.6 Measurement method for evenness

Longitudinal evenness can be conversed from IRI using following equation.

 $\sigma = (IRI - 0.75) / 1.47$ ------ (4.14)

Crack index for shall be converted into cracking ratio for MCI calculation using equation (4.16).

Figure 4.7 shows the case that there is one crack in one square meter. In this case, crack ratio for AC is 30%. On the other hand, crack index for CC is 100 cm/m^2 . The conversion factor between Crack ratio and Crack index can be defined by the following equation;

Crack index: Crack ratio = $100(cm/m^2)$: 30 (%) ------ (4.15)

Then the equation for conversion from crack index to crack ratio by equation (4.15) is as follows;

Crack ratio = $\min(\frac{30 \times \text{Crack index}}{100}, 100) = \min(\frac{30/30 \times \text{crack index}}{\frac{100}{30}}, 100)$ = $\min(\text{Crack index}/3.33)$ ------(4.16)

Crack index shall be divided by 3.33 to convert to Crack ration and maximum Crack ratio is not exceed 100%.

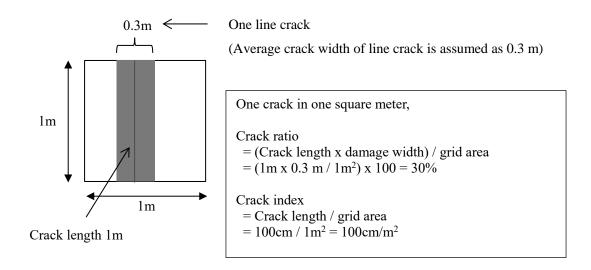


Figure 4.7 Example of one crack in one square meter

From the above definition of MCI, MCI depends much on cracking rate and rutting depth, so it expresses mainly the quantity of cracking and rutting on pavement surface. This concept is based upon that cracking ratio and rutting depth are as the important Indices for judgment of repair pavement. This concept is very close to PSI (Present Serviceability Index) developed in USA.



JAPAN INTERNATIONAL COOPERATION AGENCY DIRECTORATE FOR ROADS OF VIETNAM MINISTRY OF TRANSPORT (MOT) THE SOCIALIST REPUBLIC OF VIETNAM



THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE PHAE II

PAVEMENT CONDITION SURVEY MANUAL

Volume 2.1.2: Management

MARCH 2018

JICA PROJECT TEAM

Record of updates

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Glossary

Administration Database			
	Database of PMS data storing administrative		
	information.		
Analyzed section Table (Table-3)	The final section table prepared from PC data.		
Calibration .	Adjustment of devices for true value		
Camera for front image	The device for measuring the front image		
Camera for road image	The device for measuring the road image		
Crack	Damage index based on the pavement surface		
	crack.		
End point '	The end position of the target route.		
Excluded section 7	The out of scope section. For example, the		
	section that is under construction or being		
1	transferred to the management of another agency		
	are in this excluded section.		
IRI (International Roughness Index)	Damage index based on the longitudinal shape		
	on the pavement surface.		
KP (Kilometer post)	Positon of route. It is consist of Kilo-post station		
1	number and distance from the Kilo-post station		
1	number.		
Kilo-post station	A road sign on the side of the road to indicate		
	distances from major cities.		
Kilo-post station number	The number indicated on the kilo-post stations in		
1	the side of the road.		
Laser displacement sensor	The device for measuring the longitudinal		
1	profile		
Laser scanner	The device for measuring the transverse profile		
Main control unit	The Unit for control the measurement device		
Marking	Marking of the start point and end point for		
·	easier recognition.		
Overlapping section	A section in which two routes overlap in terms		
.	of management.		
Patching '	The repaired part of partially damage area		
	(Pothole, crack, and so on).		

Pavement condition	The condition of pavement surface. The pavement condition is evaluated for cracks, ruts and IRI.		
Pavement condition survey vehicle	Vehicle assembled with measurement devices.		
PDCA cycle	Management cycle acronym for PLAN, DO, CHECK and ACT.		
PMS	Pavement Management System.		
PMS Database	Database stored for PMS dataset.		
Power control unit	The Unit for supply and control the electric power to the measurement device		
REAL Mini	Name of the pavement condition survey vehicle made by PASCO Corporation.		
Rut	Damage index based on the transverse shape on the pavement surface.		
Start point	The start position of the target route.		
Survey plan section Table (Table-1)	Table of planned survey length		
Surveyed section Table (Table-2)	Table-1 with extensions added		

<u>Acronyms</u>

AC	Asphalt Concrete	
BOT	Build-Operate-Transfer	
BST	Bituminous surface treatment	
CC	Cement Concrete	
DPI	Department of Planning and Investment	
DRVN	Directorate for Roads of Vietnam	
HDD	Hard Disk Drive	
IWP	In wheel path	
KP	Kilometer post	
MMD	Management and Maintenance Department	
OWP	Out wheel path	
PC data	Pavement condition data	
PCS	Pavement Condition Survey	
PCSV	Pavement Condition Survey Vehicle	
PDOT	Provincial Department of Transport	
PPC	Provincial People's Committee	
QC	Quarter-Car	
RMBs	Road Management Bureaus	
SB	Sub Bureaus	
STEICD	Science, Technology, Environment, International	
	Cooperation Department	
TOR	Terms of Reference	

1. Introduction

1.1. About This Manual

Management (PCS-Vol.2) is one of six manuals comprising the suite of the documentation for pavement condition survey. Figure 1.1 shows the component of pavement condition survey manual. Pavement condition survey manual is divided into three parts, Overview, Operation manual and Technical manual. Documents to be referenced depend on the responsibility and work steps of stakeholders involved in pavement condition survey. Overview describes the basic items of survey that all stakeholders should refer to. Operation manual shows important matters to be referred to mainly when survey work managing. Technical manual indicates technical matters such as system and device operation methods, data definition and data preparation. Figure 1.2 shows the description of contents of each document.

This manual explains the contents, procedure and explanation of management work on pavement condition survey conducted by administrator. It is to be used by administrator who to carry out the management of pavement condition survey. If there is any lack of information, addition and updates would be recommended.

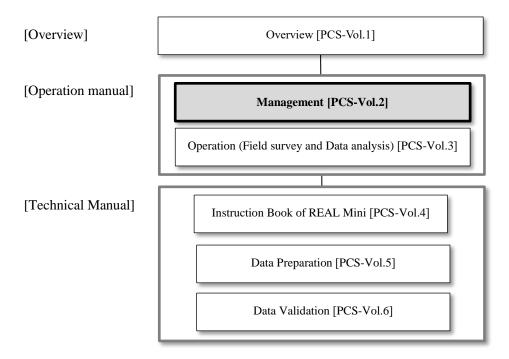


Figure 1.1 Pavement condition survey manual

[Overview]

Overview (PCS-Vol.1]

➔ Describe the overview and measuring methods of pavement condition survey. It is a general purpose document which provides in an understanding of pavement condition survey.

[Operation manual]

Management [PCS-Vol.2]

➔ Describe the management work of road administrator on pavement condition survey. It contains all management works such as the planning, supervising, and data checking on pavement condition survey describing. It is to be used by administrator who to carry out the management of pavement condition survey.

Operation (Field survey and Data analysis) [PCS-Vol.3]

➔ Describe the survey and analysis work of survey consultant on pavement condition survey. It contains the survey and analysis rule. It is to be used by surveyor and analysis operator who to carry out the pavement condition survey.

[Technical manual]

Instruction Book of REAL Mini [PCS-Vol.4]

➔ Describe the operation procedure of REAL Mini system. It contains the operation procedure of inspection vehicle and analysis system, calibration and maintenance of the inspection vehicle and so on. It is to be used by surveyor and analysis operator whose task is to carry out the deep study for operation procedure of REAL Mini system.

Data Preparation [PCS-Vol.5]

→ Describe the contents of pavement condition data (PC data). It contains the code definition, explanation of each item of PC data and so on.

Data Validation [PCS-Vol.6]

→ Describe the data check procedure when creating the PC data. It is to be used by person whose task is to carry out the data check in pavement condition survey.

Figure 1.2 Contents of Pavement condition survey manual

1.2. Summary of Pavement Condition Survey and Work Allocation

1) Pavement Condition Survey

Pavement condition survey (PCS) measures pavement damages such as cracks, ruts and IRI using the pavement condition survey vehicle (hereafter PCSV) on moving and make the pavement condition data files. The pavement damage expresses surface (crack), transverse (rut) and longitude (IRI) (Figure 1.3). The PCSV assembled some devices such as laser scanner and cameras for the pavement damages measurement (Figure 1.4).

Pavement condition survey measures not only pavement condition but also road inventory information, forward view image and position information at the same time.

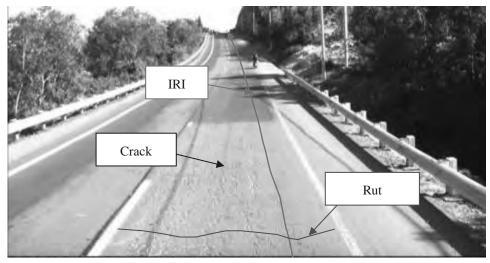


Figure 1.3 Pavement damage to be evaluated by PCS

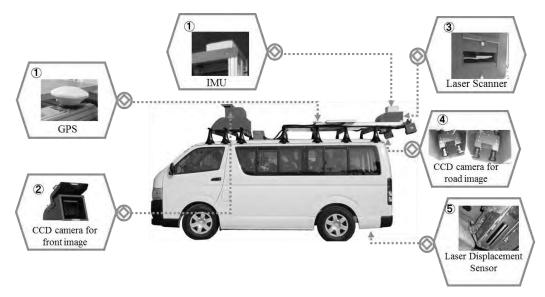


Figure 1.4 PCSV (REAL Mini)

2) Pavement Condition Data

PC Data file is result of road surface damage status by pavement condition survey. Damage of road surface is evaluated by crack rate, rut depth, IRI and MCI. These evaluated data are prepared for every

100 m unit section. Description of evaluation item of road surface damage is shown in Table 1.1. For more detail information, refer to the manual of "Overview [PCS-vol.1]".

Item	Content	Description	Note
Crack	Crack ratio [%]	Crack ratio is calculated by	For AC, BST
	Patching [%]	damaged area per total area	
	Pothole [%]	grids.	
	Crack index [cm/m ²]	Crack index is calculated by	For CC
		crack length of damaged	
		per total area	
Rut	Rut depth	Average rutting depth	
	(Average,)[mm]	within unit section (100m)	
	Rut depth (Max) [mm]	Maximum rutting depth	
		within unit section (100m)	
IRI	IRI [mm/m]	Total Axial displacement of	
		QC model in unit section	
		(100m)	
MCI	Integrated condition	automatic calculated by 3	
	index using above 3	damaged values	
	damage items		

Table 1.1 Evaluation item of road surface damage

3) Work Allocation of Manager on Pavement Condition Survey

Pavement condition survey can be divided into four steps, 1) Survey Plan, 2) Measurement, 3) Data Analysis and Data Processing, and 4) Data Check and Data Install. List of work item and assignment on Pavement Condition Survey is shown in Table 1.2. Responsible division of DRVN in pavement condition survey is shown in Figure 1.5.

- DRVN (DPI, MMD, STECID and IT Center)

DRVN has a responsibility of Top manager of pavement condition survey (hereinafter, this is called "Top manager"). In the future, RMBs or PDOT can become top manager of the pavement condition survey. Role of top manager are as follows;

- Approve the survey plan
- · Check the progress of the pavement condition survey based on RMBs report
- Manage the PCSV
- · Approve the completion of the pavement condition survey
- Install the PC data to PMS server (IT Center)

- RMB (DPI, MM, SB)

<u>RMBs</u> manages all works in pavement condition survey (hereinafter, this is called "Work manager"). Role of work manager are as follows;

- Prepare the survey plan
- Supervise the work of the survey consultant
- · Submit the plan, progress report and complete PC data to top manager

- Survey consultant

Survey consultant conducts the below contents.

- Preparation of implementation plan
- Measurement
- Data analysis
- Data processing

In case the pavement condition survey would be conducted in the road managed by Expressway Company or PDOT, the below responsibility assignment of all work on pavement condition survey should be determined.

	Table 1.2 Work item and Assignment on Tavement Condition Survey				
No.	Work Item	DRVN (Top manager)	RMMBs (Work manager)	Survey Consultant	
1	Survey plan	• Approve the survey plan	 Preparation of survey plan Submit the survey plan to DRVN Assign Survey consultant 	• Preparation of Implementation plan	
2	Field survey	 Management of PCSV Check the progress report form RMBs 	 Supervise field work (Progress, Problem) Report the progress to DRVN 	• Field survey	
2	Data analysis	• Check the progress	• Supervise data work	• Data analysis	
3	Data Processing	report form RMBs	(Progress, Problem)	• Data processing	
4	Data check Data install	 Approve the completion of the pavement condition survey Install PC data (IT center) 	 Data check Submit PC data to DRVN 	• Correct data	
	Work items $DRVN (DPI, MMD, STEICD)$ $\Rightarrow RMBs or PDOT (In future)$				
	1 Survey Plan RMBs (DPI & MM)				
	2 Field Survey RMBs (SB)				
	3 Data analysis & processing RMBs (DPI & MM)				
	Data	check	RMBs (DPI &SB & MM)		
		n - M	TT C		

Table 1.2 Work item and Assignment on Pavement Condition Survey

Figure 1.5 Responsible division of Pavement Condition Survey

IT Center

1.3. Referential Document of This Operation Manual

Data install

This operation manual refers to the below manual and standard document as detail specification or procedure. Refer to the below manuals or documents in detail.

1) Survey plan

- Format of TOR (Appendix 1)
- Format of implementation Plan (Appendix 2)
- Format of Survey Plan Section Table(Appendix 3)
- Data Preparation [PCS-Vol.5]

2) Field survey

- Format of Calibration Report (Appendix 4)
- Format of Surveyed Section Table(Appendix 5)
- Format of Measurement Report (Appendix 6)
- Operation (Field survey and Data analysis) [PCS-Vol.3]
- Instruction book of REAL Mini [PCS-Vol.4]

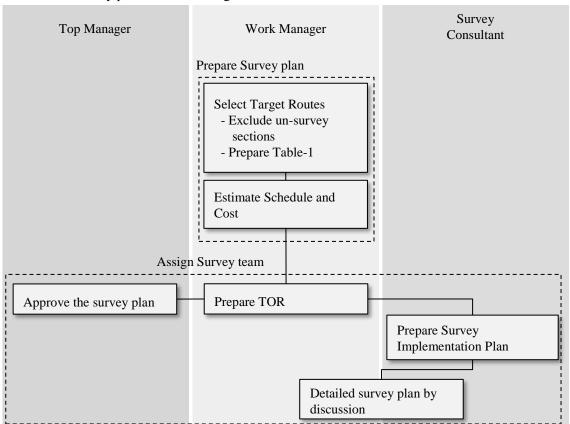
3) Data analysis and Data processing

- Format of Data Analysis Report (Appendix 7)
- Format of Analyzed Section Table(Appendix 8)
- Operation (Field survey and Data analysis) [PCS-Vol.3]
- Instruction book of REAL Mini [PCS-Vol.4]

4) Data check and data install

- Data Preparation [PCS-Vol.5]
- Data Validation [PCS-Vol.6]

2. Survey Plan



Work flow of survey plan is shown in Figure 2.1.

Figure 2.1 Work flow of survey plan

2.1. Prepare Survey Plan

Work manager prepares the survey plan for conducting of the pavement condition survey work. Work manager prepares the "Survey Plan Section Table (Table-1)" after selection of target routes and sections. Work manager estimates the schedule and cost for work based on the planed survey length.

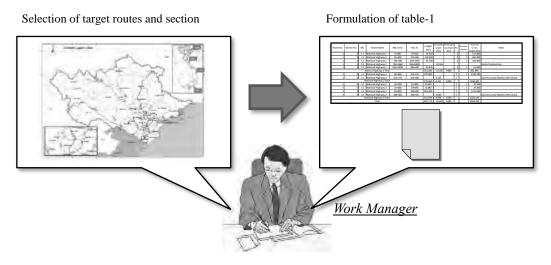


Figure 2.2 Preparation of Survey plan

[Section Table]

Three kinds of Section Table are prepared in the Pavement condition survey work. The Section Table is the information of section length in the target routes of PCS. Section Table is used for checking the section length in each work (Plan, Survey, and Analysis). Contents of section table are shown in Table 2.1.

Section Table	Information	Prepared by	Timing	Note
Survey plan section table (Table-1)	Survey Planned Section	Work manager	When preparing of Survey Plan	Information of Target section for PCS
Surveyed section table (Table-2)	Surveyed Section	Survey consultant	After field survey	Section information of after field work
Analyzed section table (Table-3)	Analyzed Section	Survey consultant	After Data Analysis	Section information of after analysis work (Section of PC data)

Table 2.1 Contents of section table

1) Select Target Route

Work manager selects the pavement condition survey routes. Selected survey routes are aggregated in the below information using Road inventory (RI) data of PMS

Route number, Route name

- <u>Survey length (Lane, Direction (Right/Left))</u>
- The KP number of overlapping starting and ending point

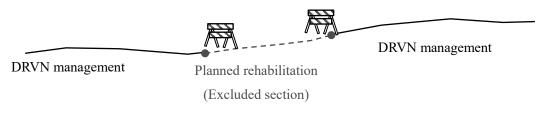
- Excluding sections from survey

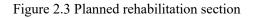
Excluding sections from survey are selected by Work Manager. Planned construction or repair sections and sections where management was transferred shall be considered as excluding sections in Table **2.2**.

Excluding sections	Description
Planned construction or repair	Out of management due to transferred to BOT
sections	company
Sections where management was	Out of management due to transferred to other
transferred	road administration agency

Table 2.2 Excluding sections from survey

• <u>The section with planned large scale rehabilitation during the pavement condition survey.</u>





• The section with planned transfer of management for PPC, BOT or other agency.

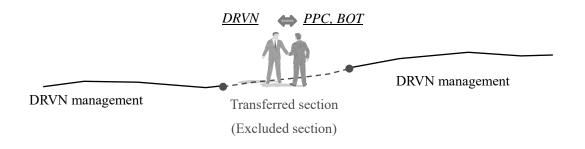


Figure 2.4 Transferred section

- Preparation of Survey Plan Section Table (Table-1)

Work Manager shall prepare the Survey Plan Section Table (Table-1) as the following steps;

• Road Inventory Data

(Road Category, Road No., Road No., Supplement, RMBs, SBs, Direction, Lane Position, KP)

- Section length
- (Section length, Exclude length, Overlapping length and Planed survey length)
- Note

Road Inventory data shall be downloaded from PMS Database through the Web-System. Section length is calculated as the following equation;

Section length = ("To KP" - "From KP") x 1000 + ("To M" – "From M")

Calculated section length values (Section length, Exclude length, Overlapping length and Planed survey length) are inputted into each column. For excluding sections as showing in Figure 2.3 and Figure 2.4, the reason of excluding is written in Note column. For Overlapping sections, the target route name of overlapping is written in Note column.

Finally, total survey length is calculated.

```
Total survey length =
```

(Total section length) – (Total excluding section length and overlapping sections)

Work Manager shall check all information of targeted survey sections, and prepare the final table as "Survey Plan Section Table (Table-1)".

Survey Plan Section Table (Table-1) will be referred when TOR preparation and survey on site. In case that road inventory information in the database is not sufficient to prepare survey plan, e.g. new constructed roads, Expressway or roads managed by other road administration agencies), Work Manager shall collect necessary information for Table-1 preparation. The methodology to prepare New Road Code is descried in the manual of "Data Preparation [PSC-Vol.5]"

Road Category	Road No.	Supplement	Branch No.	Road Name	RMBs	SBs	Direction	Position	From_KP	From_M	TO_KP	To_M	Length	Excluded Length	Overlapping	Survey Length	Note
1	1		0	NH1	RMB II	SB II.1	Right	1	285	400	321	800	83000	36400			Under Condtructio
1	1		D	NH1	RMB II	SB II.1	Right	1	521	800	330	0	12			8200	
1	1		0	NH1	RMB II	SB II.1	Right	1	330	0	368	400		38400			Under Condtructio
1	1	0	0	NH1	RMB II	SB 11.2	Right	1	383	0	423	600	84000	40600		· · · · · · · · · ·	Under Condtructio
1	1	0	0	NH1	RMB II	SB 11.2	Right	1	423	600	425	875				2275	
- 1	1	0	0	NH1	RMB II	SB 11.2	Right	1	425	875	449	300		28425			Under Condtructio
1	1	C	0	NH1	RMB II	SB 11.2	Right	1	449	300	451	0				1700	
1	1	C	0	NH1	RMB II	SB 11.2	Right	1	451	0	458	0		7000			Under Condtructio
1	1	0	0	NH1	RMB II	SB 11.2	Right	1	458	0	467	0				9000	
1						CR II.S		1	467	0	468	0	128000	1000	1000		Under Condtructio
						1.1						200		22400			
	-			NILLA	DAAR ()	CD 11 2	1				Ζ.					-	
	_	-			_		_										
1	1	0	0	NH1		SB 11.3		2	481	0	104	400	-	20200			Illador Candanasi
1	1	0	0	NH1 NH1	RMB II	SB 11.3	Left	2	484	0	504	400	6800	20400			
1	1	0	000000000000000000000000000000000000000	NH1 NH1 NH1	RMB II RMB II	SB 11.3 SB 11.3	Left Left	22	484 509	0	509	880	5800	20400 880			
11111	1	000000000000000000000000000000000000000	0 0 0	NH1 NH1 NH1 NH1	RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3	Left Left Left	22	484 509 509	0 0 880	509 514	880 800		880		4920	Under Condtructio
1 1 1 1 1			0 0 0 0	NH1 NH1 NH1 NH1 NH1 NH1	RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3	Left Left Left Left	2 2 2 2 2 2 2 2	484 509 509 517	0 0 880 900	509 514 561	880 800 0	43100			4920	Under Condtructio
1 1 1 1 1 1			0 0 0 0 0 0	NH1 NH1 NH1 NH1 NH1 NH1 NH1	RMB II RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.4	Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2	484 509 509 517 657	0 0 880 900 25	509 514 561 663	880 800 0 810	43100 6785	880 43100		4920	Under Condtructio
1 1 1 1 1 1 1 1			0 0 0 0 0 0 0	NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1	RMB II RMB II RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.5	Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 509 517 657 717	0 0 880 900 25 0	509 514 561 663 729	880 800 0 810 910	43100 6785 12910	880 43100 12910		4920	Under Condtructio Under Condtructio Under Condtructio
1 1 1 1 1 1 1 1 1		0	0 0 0 0 0 0 0 0	NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1	RMB II RMB II RMB II RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.5 SB 11.5	Left Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 509 517 657 717 740	0 880 900 25 0 640	509 514 561 663 729 791	880 800 0 810 910 500	43100 6785 12910 50860	880 43100 12910 50860		4920	Under Condtructio Under Condtructio Under Condtructio Under Condtructio
1 1 1 1 1 1 1 1 1 1 1			0 0 0 0 0 0 0 0 0 0 0 0 0 0	NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1	RMB II RMB II RMB II RMB II RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.4 SB 11.5 SB 11.5 SB 11.6	Left Left Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 509 517 657 717 740 791	0 0 880 900 25 0 640 500	509 514 561 663 729 791 819	880 800 0 810 910 500 850	43100 6785 12910	880 43100 12910		4920 6785	Under Condtructio Under Condtructio Under Condtructio Under Condtructio
		0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1 NH1	RMB II RMB II RMB II RMB II RMB II RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.4 SB 11.5 SB 11.5 SB 11.6 SB 11.6	Left Left Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 509 517 657 717 740 791 819	0 880 900 25 0 640 500 850	509 514 561 663 729 791 819 840	880 800 0 810 910 500 850 500	43100 6785 12910 50860	880 43100 12910 50860 28350		4920	Under Condtructio Under Condtructio Under Condtructio Under Condtructio Under Condtructio
		0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NH1	RMB II RMB II RMB II RMB II RMB II RMB II RMB II RMB II RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.4 SB 11.5 SB 11.6 SB 11.6 SB 11.6 SB 11.6	Left Left Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 509 517 657 717 740 791 819 840	0 880 900 25 0 640 500 850 500	509 514 561 663 729 791 819 840 867	880 800 0 810 910 500 850 500 743	43100 6785 12910 50860 76243	880 43100 12910 50860 28350 27243		4920 6785	Under Condtructio Under Condtructio Under Condtructio Under Condtructio Under Condtructio Under Condtructio
		0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NH1 NH1	RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.4 SB 11.5 SB 11.6 SB 11.6 SB 11.6 SB 11.6 SB 11.6 SB 11.6	Left Left Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 517 657 717 740 791 819 840 873	0 880 900 25 0 640 500 850 850 540	509 514 561 663 729 791 819 840 867 883	880 800 910 500 850 500 743 280	43100 6785 12910 50860 76243 10226	880 43100 12910 50860 28350 27243 10226		4920 6785	Under Condtructio Under Condtructio Under Condtructio Under Condtructio Under Condtructio
		0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NH1 NH1	RMB II RMB II	SB 11.3 SB 11.3 SB 11.3 SB 11.3 SB 11.4 SB 11.5 SB 11.6 SB 11.6 SB 11.6 SB 11.6	Left Left Left Left Left Left Left Left	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	484 509 509 517 657 717 740 791 819 840	0 880 900 25 0 640 500 850 500	509 514 561 663 729 791 819 840 867	880 800 0 810 910 500 850 500 743	43100 6785 12910 50860 76243	880 43100 12910 50860 28350 27243		4920 6785	Under Condtructio Under Condtructio Under Condtructio Under Condtructio Under Condtructio Under Condtructio

Table 2.3 Sample of Table-1

[Road Code]

Road Code is defined as 10 digit codes. Road code consists of road category, road number, road number supplement and branch number. Each road code is corresponding with route name.

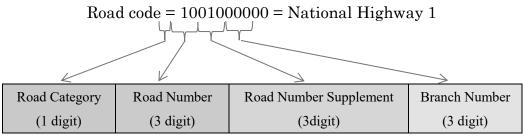


Figure 2.5 Road code

Road Category is the information used to identify the road category; whether the road national highway, expressway, provincial road, or others road.

Table 2.4 Road Calegory							
Classification	Code_Name	Code_ID					
National Highway	NH	1					
Expressway	Exp	2					
Provincial Road	PR	3					
Others Road	OR	4					

Table 2.4 Road Category

Road Number is the number assigned to each road. It consists of 3 digit numbers.

Road Number Supplement identifies the alphabet code on road name as a maximum 3 digit unique number. Road number supplement is defined beginning with 10 in alphabetical order from A. The code interval is basically set to 10 in order to correspond to the index number, such as NH4H1. The alphabet which is not used in Vietnam has no code definition, such as F, J W and Z.

Classification	Code_Name	Code_ID	Classification	Code_Name	Code_ID
А	А	010	М	М	110
В	В	020	Ν	Ν	120
С	С	030	0	0	130
D	D	040	Р	Р	140
Е	E	050	Q	Q	150
G	G	060	R	R	160
Н	Н	070	S	S	170
H1	H1	071	Т	Т	180
H2	H2	072	U	U	190
Ι	Ι	080	V	V	200
К	Κ	090	Х	Х	210
L	L	100	Y	Y	220

 Table 2.5 Road Number Supplement

Branch Number is a number given in order to manage road section when same chainage is used for multiple sections such as in the case of bypass or road split into branches/subsidiary road from the main route. It consists of 3 digits numbers.

[Calculation Method of Survey Length]

Survey route length is calculated by total of the planed survey length. Planed survey length defined by length of each section.

- Planed Survey length = Length
- Route survey length = Sum of "Planed survey length"

RMBs	SBs	Direction	Lane Position	From_KP	From_M	To_KP	To_M	Length	Excluded Length	Overlapping	Planned Survey Length	Note	
RMB II	SB II.1	Right	1	285	400	321	800	36400	36400			Under Cor	dtruction
RMB II	SB II.1	Right	1	321	800	330	0	8200			8200		1
RMB II	SB II.1	Right	1	330	0	368	400	38400	38400			Under Cor	dtruction
RMB II	SB 11.2	Right	1	383	0	423	600	40600	40600			Under Cor	dtruction
RMB II	SB 11.2	Right	1	423	600	425	875	2275			2275		
RMB II	SB 11.2	Right	1	425	875	449	300	23425	23425			Under Cor	dtruction
RMB II	SB 11.2	Right	1	449	300	451	0	1700			1700		
RMB II	SB 11.2	Right	1	451	0	458	0	7000	7000			Under Cor	dtruction
RMB II	SB 11.2	Right	1	458	0	467	0	9000			9000		
RMB II	SB II.1	Right	2	285	400	321	800	36400	36400			Under Cor	dtruction
RMB II	SB II.1	Right	2	321	800	330	0	8200			8200		
RMB II	SB II.1	Right	2	330	0	368	400	38400	38400			Under Cor	dtruction
RMB II	SB 11.2	Right	2	383	0	467	0	84000	84000			Under Cor	dtruction
RMB II	SB II.1	Left	1	285	400	321	800	36400	36400			Under Cor	dtruction
RMB II	SB II.1	Left	1	321	800	330	0	8200			8200		
RMB II	SB II.1	Left	1	330	0	368	400	38400	38400			Under Cor	struction
RMB II	SB 11.2	Left	1	383	0	423	600	40600	40600			Under Cor	dtruction
RMB II	SB 11.2	Left	1	423	600	425	900	2300			2300		
RMB II	SB 11.2	Left	1	425	900	449	300	23400	23400			Under Cor	dtruction
RMB II	SB 11.2	Left	1	449	300	451	0	1700			1700		
RMB II	SB 11.2	Left	1	451	0	458	0	7000	7000			Under Cor	dtruction
RMB II	SB 11.2	Left	1	458	0	467	0	9000			9000		
RMB II	SB II.1	Left	2	285	400	321	800	36400	36400			Under Cor	dtruction
RMB II	SB II.1	Left	2	321	800	330	0	8200			8200		
RMB II	SB II.1	Left	2	330	0	368	400	38400	38400			Under Cor	dtruction
RMB II	SB 11.2	Left	2	383	0	423	600	40600	40600			Under Cor	dtruction
RMB II	SB 11.2	Left	2	423	600	425	900	2300			2300		
RMB II	SB 11.2	Left	2	425	900	449	300	23400	23400			Under Cor	dtruction
RMB II	SB 11.2	Left	2	449	300	451	0	1700			1700		
RMB II	SB 11.2	Left	2	451	0	458	0	7000	7000			Under Cor	dtruction
RMB II	SB 11.2	Left	2	458	0	467	0	9000			9000		/
								668000	596225		(71775	775	
			ł					•	D .	Survey			

Route Survey Length

Sum the planed survey length, calculate the route survey length.

Figure 2.6 Calculation method of Route Survey Length

2) Estimation of schedule and cost

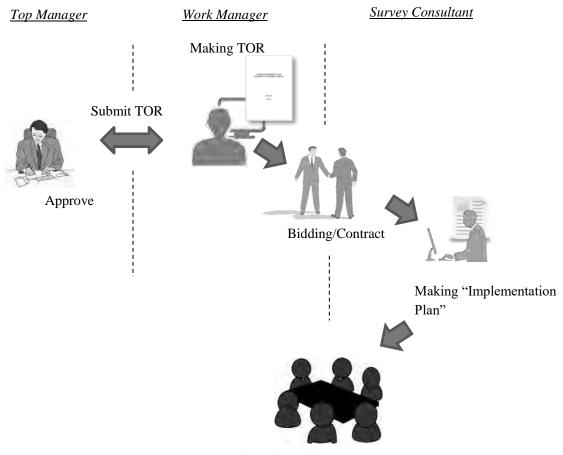
Work manager estimates the work period according to target survey length and work amount per day of work items. Work manager also estimates the cost of survey work based on total work amount.

The progress speed should be noted in the terms below:

- Survey Planning: 15 days (If the survey will be held in 4 RMBs)
- Calibration: 3 days/time
- Measurement: 70km/day
- Data Analysis: 10km/day (1 operator)
- Data Processing: 70km/day (1 operator)
- Final Report: 5 days

2.2. Assign Survey Consultant

Work manager makes the Terms of Reference (hereafter TOR) based on survey plan. And Work manager submits the TOR to top manager and gets the approval of top manager. As the result of bidding, Work manager contracts with the Survey consultant and Work manager order to the Survey consultant to make the "Implementation Plan". "Implementation Plan" shall be discussed detail between Work manager and Survey consultant before starting the survey.



Discussion before starting survey

Figure 2.7 Work flow of entrustment of PCS

1) Making the TOR

Work manager makes the TOR based on the Table-1 and schedule in the survey plan. Content list is shown in Table 2.6. When the TOR is updated using the format in Appendix 1, the items in Table 2.6 shall be updated.

After making the TOR, Work manager submits the TOR to Top manager and gets the approval of Top manager.

Contents	Description
Target area	Managed RMBs
Target route and length	Survey Section Table 1
Specification of Pavement condition survey	Regulation of Pavement condition Survey
work	
Implementation method	Detail of survey work item
Output Item	Item of delivered
Payment terms	Terms for payment to be made
Implementation Schedule	Describe the project implementation period
Survey vehicle and equipment	Describe the equipment specifications to use
	project

2) Entrustment of PCS

Work manager shall make an entrustment of Pavement Condition Survey Work with Survey Consultant according to the specified procedure.

3) Instruction to prepare Implementation Plan

Work Manager shall instruct Survey Consultant to prepare Implementation Plan. Survey Consultant shall update the following information in the TOR by using the format of Implementation Plan (Appendix-2). Survey Consultant shall submit the Implementation Plan to Work Manager promptly.

- Date of submission of Implementation Plan
- Signature of Survey Consultant
- Period of Calibration
- Period of Measurement
- <u>Target RMB and Sub-Bureau</u>
- Survey Length Table
- Period of Data Analysis
- Period of Data Processing
- The name, mobile number and email address of Team Leader
- The name, mobile number and email address of Survey team member

- The name, mobile number and email address of Data Analysis team member
- <u>Implementation schedule table</u>

Implementation structure in Survey Consultant is described in Figure 2.8. Survey Consultant has two partied, Survey team and Data Analysis team.

Survey Team has five (5) members, including one (1) driver three (3) operators and one (1) navigator. Work Manager shall dispatch a navigator who takes a responsibility of confirmation of road information, such as start/end point of road, direction, etc.

Data Analysis team has ten (10) members, who take responsibilities of data analysis and data processing work using collected data on site by Survey Team.

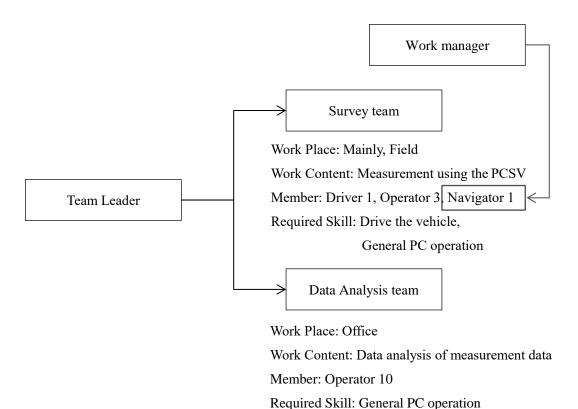


Figure 2.8 Formation of Survey Consultant

4) Discussion before survey

Discussion between Work Manager and Survey Consultant shall be held based on the Implementation Plan prepared by Survey Consultant. Work manager shall check all information in the Implementation Plan and confirm it.

- <u>Survey length (Route length, Planned survey length)</u>
- Excluded section, length
- <u>Implementation schedule</u>
- · <u>Report contents (particularly how to treat the traffic accident)</u>
- The place of calibration

2.3. The Importance to Conduct the Constantly Pavement Condition Survey

Since pavement condition survey should is not completed at once, it should be carried out continuously. Time-series database will be established by continuously conduction of pavement condition survey. Time-series database is utilized for management and evaluation for pavement maintenance work.

- Survey Plan

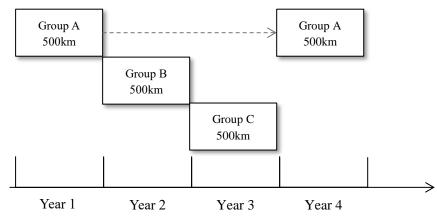
Long-term survey plan shall be prepared. In survey plan, the following points shall be considered.

- <u>Capacity of PCSV</u> Survey length that can be carried out in a year is decided according to the number of PCSV.
- <u>Secure human resource</u> Engineers for field survey work and data analysis work
- <u>Budget for survey</u> Secure enough budgets for PCS
- <u>Compatibility with progress of previous 5-year pavement maintenance plan</u>
 Decide next timing of survey based on the progress of 5-year pavement maintenance plan with previous PC data

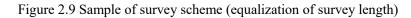
- Survey scheme

- <u>One time survey scheme</u> All road networks is surveyed in one time
- Equalization of survey length Survey length is equalized for each fiscal year

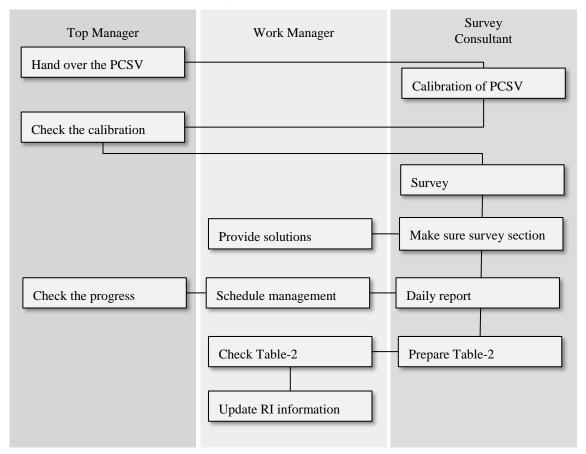
Figure 2.9 shows a survey scheme of equalization of survey length. In case that road network of 1500km is surveyed in 3 years, road network is divided into 3 groups (A, B, and C). In that case, survey length in one year is 500km. Road network in Group A is measured in the first year. Next survey in Group A is conducted in the 4th year after completion of all network survey.



In case that Length of road network: 1500km is surveyed in 3 years



3. Field Work Supervision



Work flow of field work is shown in Figure 3.1.

Figure 3.1 Work flow of field work

1) Field Work of Survey team

After complete the implementation contents at the first discussion, Survey team will start the measurement following the implementation schedule. Work manager supervises their activity in the office. Survey team will conduct the survey work as below items.

- <u>Calibration of the measurement devices (Before the measurement)</u>
- <u>Survey</u>
- <u>Report the problem (Traffic Accident/Broken)</u>
- <u>Confirmation of unclear point on survey</u>
- <u>Daily report</u>
- <u>Prepare "Surveyed Section Table (Table-2)"</u>

Table 3.1 is showing the items to be measured on site. Road damage data (Crack, Rut and IRI) are evaluated by using measured three items (Road image, cross-section profile and longitudinal profile). And front view image data with coordinates, which is one of the output data on PCS, is used to

Table 3.1 Measurement item in field survey							
Measurement item	Equipment	Analysis item					
Road image	CCD camera for road image	Crack					
Transverse profile	Laser scanner	Rut					
Longitudinal profile	Laser Displacement sensor & IMU	IRI					
Front image with according to	CCD compare for front image & CDS	(Finally the front image is					
Front image with coordinate	CCD camera for front image & GPS	registered to PMS server)					

identify pavement type or road surround information when data analysis.



Calibration



Measurement

Marking



Operation

Figure 3.2 Steps of field work

2) Matters to be Handled by Top manager

Top manager will respond to the following matters at the office.

- Before measurement (hand over the PCSV. Check the calibration result)
- Progress check
- 3) Matters to be Handled by Work manager

Work manager will respond to the following matters at the office as field work supervision.

- <u>Provide solutions to the report or question from the Survey team</u>
- <u>Schedule management</u>
- Check the Table-2

Furthermore, Work manager shall pay attention to the safety and data quality as a field supervisor. For example, Work manager instructs to Survey team the below contents.

• To Arrange the safety keeper when the marking at the starting and ending point

- To check the starting and ending point of the target survey route
- To check the brightness of the image (visible the crack in the image)
- <u>To check the position of measurement stop (possible to stop the measurement on the just KP position)</u>

3.1. Preparation the PCSV before Measurement

Survey team prepares the PCSV as shown in Figure 3.3.

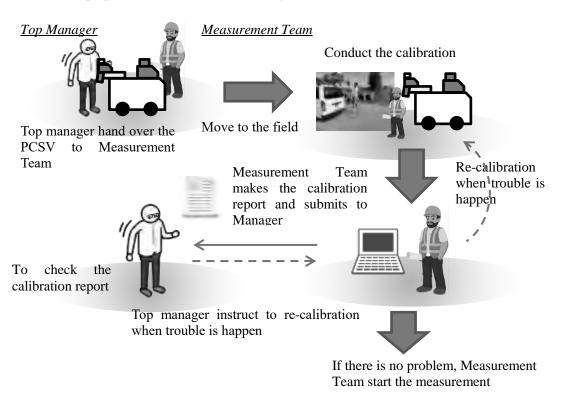


Figure 3.3 Work flow of survey preparation

1) Handover of PCSV

Top Manager shall handover the PCSV to Survey Consultant. Top Manager and Survey Consultant make sure survey method and operation procedure of the PCSV based on the manual of "Instruction Book of REAL Mini [PCS-Vol.4]" and "Management [PCS-Vol.2]". And Top Manager and Survey Consultant check basic operation of the PCSV and apparent condition of the vehicle, and make sure that there are no damages or failures in the PCSV. The results of above checks shall be recorded on a document with both signature between Top Manager and Survey Consultant.

2) Calibration of PCSV

Measurement device of the PCSV will have some change on setting location or device conditions by long-team use, and it might cause error of measurement data. To avoid measurement error, calibration of the PCSV shall be done to verify accuracy of measurement data and adjust device parameters.

Calibration work shall be done when the following timing;

Timing of calibration

- Before survey in case of survey over 350km in total during one survey term
- When measured length is over 5000km from the last calibration
- When over 6 months pass from the last calibration
- In case of changing tires or changing air pressure of tires

Table 3.2 is showing the items for calibration. For more detail about calibration work, refer to "Instruction Book of REAL Mini [PCS-Vol.4]" and "Calibration Report (Appendx-4)".

No.	Work Item	Check item	Tolerance
1	Inspection vehicle check	Condition of system	No Error
2	Camera check	Detection accuracy of crack width in image	2mm or more
3	Camera calibration	Measurement span	3.8m or more
4	Laser displacement sensor check	Accuracy of measurement	0.4mm
5	Laser scanner check	Accuracy of Rut depth measurement	6mm
6	Distance calibration	Accuracy of mileage measurement	Within range of -0.5% to 0.5%
7	Long test	Operating condition of inspection vehicle	No Error

Table 3.2 Cambration nem	Table	3.2	Calibration	item
--------------------------	-------	-----	-------------	------

3) Calibration Report

Survey Team of Survey Consultant shall prepare the Calibration Report using the format of the report and submit it to Top Manage. In case that there are some problems in the Calibration Report, Top manager shall instruct Survey Team to do calibration again.

3.2. Field survey

Survey team conducts the survey every day excluding rainy days. Survey team reports about progress to Work manager via email with an attached "Format of Measurement Report" (Appendix 6) every day. Work manager checks the progress from the report. If there is a big delay from the plan, Work manager confirms the reason for the delay. Work manager and Survey team discuss the countermeasure for the reason. Work manager submits the progress of field survey to Top manager. Top manager checks the progress based on the report from Work manager.

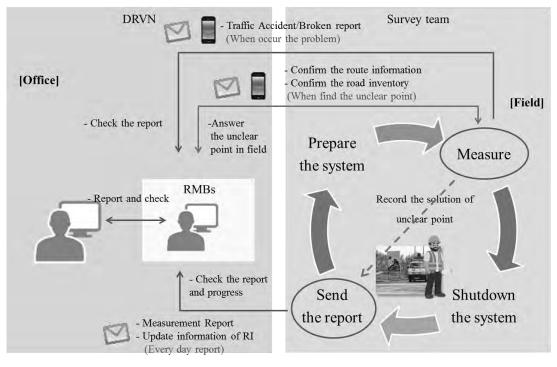


Figure 3.4 Work flow of field survey

In case the conducting the pavement condition survey in new route (new construction, expressway, PDOT management roads, etc.), the below contents should be confirmed carefully about each route situation in order to clear the problem point of survey in advance.

- Kilo post station is exist or not
- Pavement is exist or not
- Possibility of the starting and ending point (particularly expressway)
- Road code setting is appropriate or not
- 1) Schedule management

Survey team reports to Work manager via email with an attached "Format of Measurement Report" (Appendix 6) every day.

• Survey team:

Survey team reports to Manager via email about which route and how many km had been surveyed every day.

• Work Manager:

Work manager checks and manages the progress based on the report from the Survey team. If the progress is delayed from the plan, Manager finds out the reason and takes countermeasure for the reason.

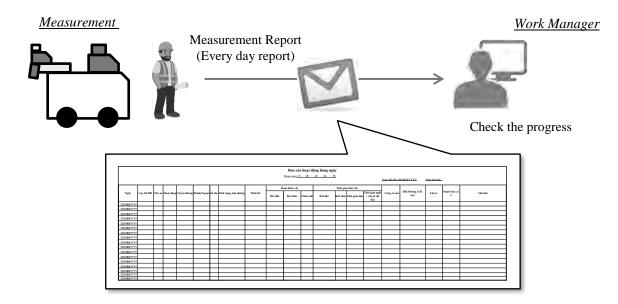


Figure 3.5 Format of measurement report

Dear XXXX,
I send today's daily report.
Please kindly refer the attachment for the detail.
Date: DD/MM/YYYY
Reporter: Name
Report at: Place
Survey length: Length
Survey route: Route name
DD
BR,
XXXX

Figure 3.6 Sample of mail format

2) Provide Solutions

Survey team reports any problem and question to Work manager if needed. Work manager instructs the solution to the Survey team.

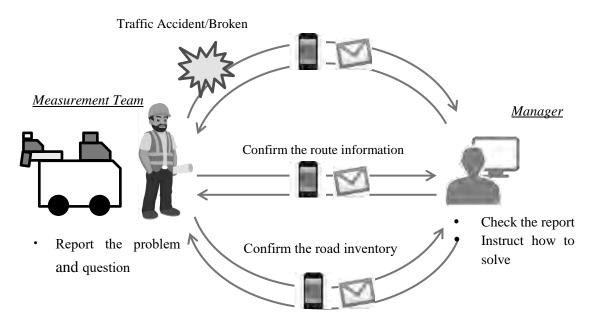


Figure 3.7 Flow of report and responding for the report

a) Safety Management

In case of traffic accident, Survey Team shall report to Work manager about situation of accident, including (1) Accident situation, (2) with or without injured persons and (3) Possibility to continue the survey, etc. In case of with injured persons, Survey Team requests an ambulance and reports to the police for highest priority of life rescue. If measurement device or vehicle has problems due to accident, Survey Team shall report to Top manager and Work manager about condition of the PCSV promptly.

If it is impossible to move the vehicle to a safe place, the PCSV is repaired there in case of minor damage. Or the PCSV is moved by tow-away and repaired.

In case that the vehicle has no damage but measurement device has failures, Survey Team shall go back to the garage of the PCSV and repair the device.

Finally, Survey Team shall make sure that the PCSV is operated properly by operation test.

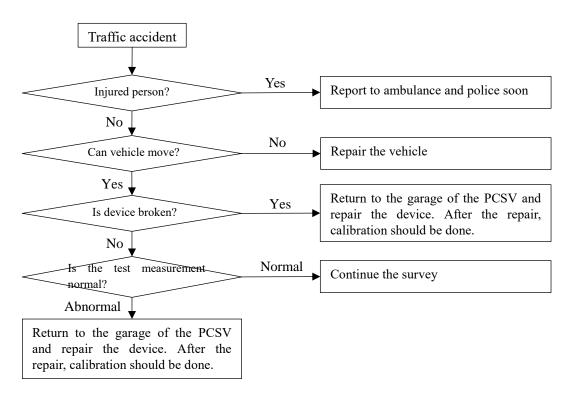


Figure 3.8 Flow in case of traffic accident

b) Confirmation of the Route Information

Survey team checks the differences between information on the Table-1 and information on site. Check item is below.

- Starting/ending point of the target route

Check the starting/ending point in the route

- Excluded section

Confirm the additional section of rehabilitation section and transferred section.

- Overlapping section

Check the starting/ending point of overlapping section in the route.

When hard to continue survey due to above issues, Survey Team shall ask navigator or Work Manager to provide solutions to correct information between planned information and on site situation. Navigator or Work Manager shall confirm the situation and direct solutions to Survey Team.

[Example of the difference]

Route Change

When new opened route is found on site within the targeted route, Survey Team shall make sure the jurisdiction and road inventory (road code, branch code, etc.) of both routes (new route and old route) by asking to Work Manager. Work Manager shall provide necessary information to Survey Team.

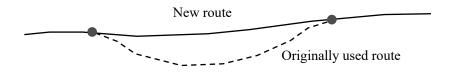


Figure 3.9 Route change

Jurisdiction change

When targeted sections are transferred to other road administration agencies, including BOT construction sections, these sections shall be excluded from survey. The start and end point of excluding sections shall be marked up on pavement, and these sections shall be measured at that time. The excluding section will be confirmed when data analysis.



Figure 3.10 Transferred section

c) Confirm the Road Inventory Information

Survey team reports to navigator or Work Manager if there is different inventory information (ex: road width, change position of number of lane, etc.) between Table-1 and information on site. The navigator or Work Manager checks the report and instruct proper solutions to Survey team.

3.3. After Field Survey Completed (Check Table-2)

Survey Team shall prepare the "Surveyed Section Table (Table-2)" using measured information (route name, KP and surveyed length) after field survey completion as the following steps;

- Insert a row in the 8 columns next to "Planned survey length (km)" in Table-1
 KP (From and To), Surveyed length (surveyed length, excluding sections length and overlapping length), Note
- KP information and surveyed length are inputted into the targeted columns based on measured information
- Information on additional excluding sections and additional survey sections are inputted into added column

("Added excluding section" or "Additional survey sections" are written in Note)

• "Surveyed Section Table (Table-2)" is completed after all information are inputted.

Survey Team shall submit the Table-2 to Work Manager. Work Manager shall check it and verify KP information and section length of additional excluding sections and additional survey sections.

- Select sections which has "Added excluding section" and "Additional survey sections" in Note in Table-2
- KP (From and To) information and section length of corresponding records shall be confirmed.

Work Manager shall instruct Survey Team to update the Table-2 if needed. In the case of misstatement of KP or survey length, Survey Team corrects the relevant part and resubmits it.

When a section different from the actual section is set as excluding section or additional survey section, Survey Consultant shall survey that section again and update the Table-2.

Table-2 and survey length is fixed by Work Manager.

When there is a big difference between "Planned survey length (km)" and "Survey length (km)", Work Manager shall discuss with Survey Consultant to change contract contents.

For example;

"Planned survey length (km)" > "Survey length (km)"

Add survey routes

"Planned survey length (km)" < "Survey length (km)"

Update the contract amount

Table 3.3	Sample	of Table-2
-----------	--------	------------

Road No. Supplement	Branch No.	Road Name	RMBs	SBs	Direction	Lane Position	From_ KP	From M	To_KP	To_M	Length	100000		Planned Survey Length		From_KP	From_M	To_KP		200200	Overlapping Length	10000	Note
	0 1	NHI	RM8 II	58 (1.)	Right	1	1 521	800	330	0		1		8200		321	800	330	0			8540	
	0 1	NH1	RM8 11				423	600		87			1	2275		423	800	425	875			2095	
	0	NH1	RMB TI				1 449	300						1700		449	300	451	0			1665	
	0	NH1	RMB II				458	0	457	1 0				9000		458	0	467	.0			9600	
	0 1	NH1	RMB TI			1	1 468	0	484					16000	1	468	0	484	0			16000	
	0 1	NH1	RMB TI	\$8 11.3	Right		1 504	400	518	1 1				13600		504	400	517	1080			13650	
	0 1	NH1	RMB TI	58 11.3	Right		1 561	0	587	1 5			1.1	26000		561	0	587	0			26000	
	0 1	NH1	RMB II	\$8 11.3	Right		1 591	600	595	1				3400		591	600	595	- 4			3405	
	0	NH1	RMB 1	\$8 11.4	Right		1 595	0	597	590	259	0		2590	1	595		597	590			2385	
	0 1	NH1	RMB II	58 11.4	Right		1 625	125	625	880	75	5		755		625		625	880	k	0	755	
	0 1	NH1	RMB 12	58 11,4	Right		1 657	- 25	663	815	5 579	2		6790		657	25	663	815			6545	
	0 1	NH1	RMB II	\$8 11.4	Right		1 671	230	672	305	5			1075		671	230	672	305			1075	
	0	NH1	RMB 1/	58 11.6	Right.		1 819	850	840	500	0			20650		819		840	500		· · · · ·	20300	
	0	NH1	RMB II	\$8 11.6	Right	1	1 868	100	873	600				4500		868	300		600			4330	
	0	NH1	RMB 12	58 11,6	Right		1 883	700	\$85	500	2			2800		883		886	500			2510	
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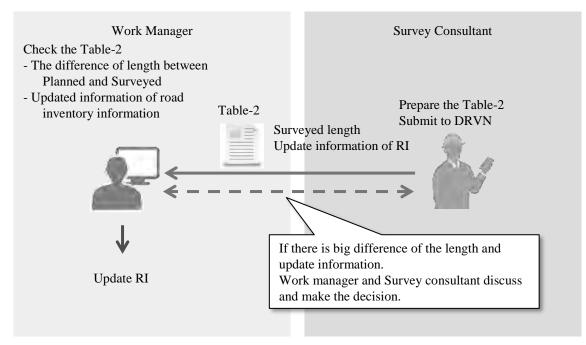
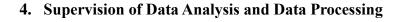
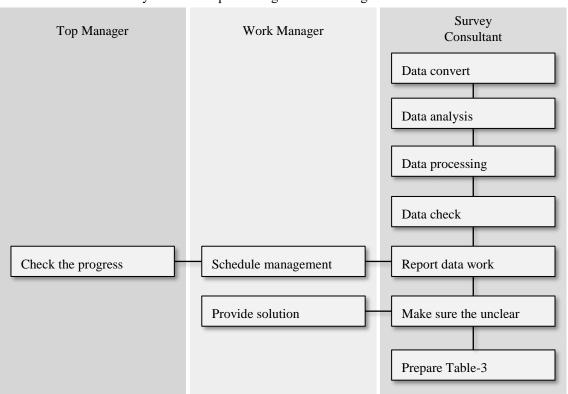


Figure 3.11 Work flow of preparing Table-2





Work flow of data analysis and data processing is shown in Figure 4.1.

Figure 4.1 Work flow in data analysis and data processing

1) Data Analysis and Data Processing by Data Analysis team

The measurement data will be stored into the external HDD. Survey team hands over the external HDD to Data Analysis team. Data Analysis team conducts the data analysis and data processing to prepare the PC data. Data Analysis team uses the application of data analysis and data processing on PC. The work items are as below,

- Data Conversion
- Data Analysis
 - The starting and ending position setting
 - Road width setting
 - Interpretation of crack
 - Road surface type classification
 - KP and structure setting
- Data processing
 - Data processing for 100m
 - Data coupling
 - Output the data

- Data check
- <u>Weekly report</u>
- Confirmation of unclear point on analysis
- <u>Prepare "Analyzed Section Table (Table-3)"</u>

Top manager provides licenses of Data Analysis application and Data Processing Applications to Data Analysis team. After completion of survey project, Data Analysis team shall delete the installed applications from PCs.

In case of analysis work for new routes, such as new constructed routes, Expressway or routes managed by other road administration agencies, Analysis operators in Data Analysis team shall add new road code information and route name to the configuration file of Location Setting Application. For more detail procedure to update the configuration file, refer to the chapter 10 of manual of "Instruction Book of REAL Mini [PCS-Vol.4]".



Figure 4.2 Data Analysis and Data Processing work in Office

- The Matters should be treated by Top Manager Top manager will respond to the following matter
 - Progress check of analysis and processing work
- 3) The Matters should be treated by Work manager

Work manager supervises the below matters during the data analysis and data processing.

- <u>Schedule management</u>
- · Responding for the Report and Question of data analysis and data processing
- Check the length of data analysis (Table-3)

4.1. Schedule Management

Data Analysis team conducts the data analysis and data processing work in the office every day. The leader of Data Analysis team records the progress every day for "Data Analysis Weekly Report"

(Appendix 7). The Data Analysis team leader sends the "Weekly Report" with attachment to Work manager via email like a Figure 4.3.

Furthermore the sample of "Weekly Report" would be indicated in Figure 4.4. It is possible to check the analysis length of section length of the data. Work manager checks the progress to confirm the sum of analysis length and "Table-2". If the progress is delayed significantly, Work manager finds out the reason and instructs to push up the progress.

Work manager submits the progress of analysis work and processing work to Top manager. Top manager checks the progress based on the report from Work manager.

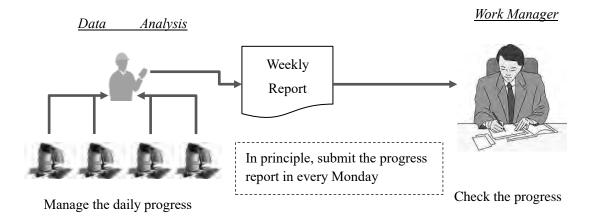


Figure 4.3 Flow of data analysis progress report

Dear XXXX, I send weekly report. Please kindly refer the attachment for the detail.

Date: DD/MM/YYYY Reporter: Name Analysis length in week: Length Total analysis length: Length

BR, XXXX

Figure 4.4 Sample of email of data analysis report

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Figure 4.5 Format of data analysis Weekly Report

- A. Analysis Period (From To)
- B. Analysis Number (sequential number)
- C. Route Name
- D. Right Left
- E. Number of Lane
- F. Survey Section (Starting position; KP number)
- G. Survey Section (Ending position; KP number)
- H. Survey Section (Length (km))
- I. File Number (Folder number of Measurement)
- J. Progress of Interpretation (X; Complete, Blank; Not complete)
- K. Progress of Data Check (X; Complete, Blank; Not complete)
- L. Progress of Data Processing (X; Complete, Blank; Not complete)
- M. Note (Memo, Message)

4.2. Provide Solutions

Data Analysis team reports to Work manager about the unclear matter in the data analysis and data

processing at every time. Work manager confirms the report or question and instructs to the matter.

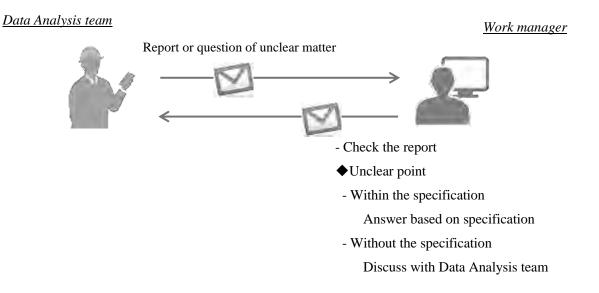


Figure 4.6 In case of report or question of unclear matter

[Example of Report and Instruction]

<Case 1: Setting of Pavement Surface Type>

How to set the pavement type where two pavement types exist in the same position?

(Ex. AC and BST exist in the same position)

→ Set the wider pavement type at the place

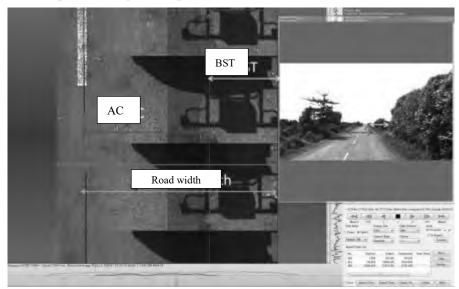
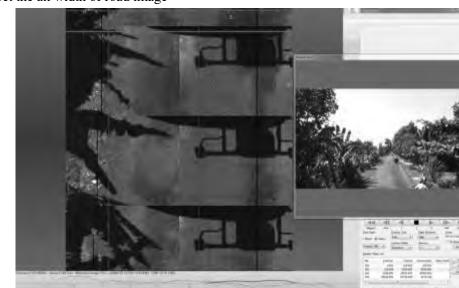


Figure 4.7 Example of pavement type setting

<Case 2: Setting of road Width>

How to set the road width where there is no center line as narrow section?



→ Set the all width of road image

Figure 4.8 Example of road width setting at narrow section

<Case 3: Setting of Patching>

Whether the repaired part is patching or not?

 \rightarrow The part is patching at the interpretation (in the red square)

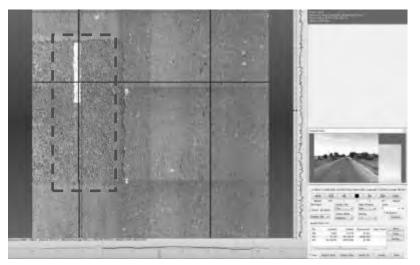


Figure 4.9 Example of patching setting

<Case 4: Visible only Forward View Image>

Visible the crack in the forward view image but invisible in the road image because the image is dark.

 \rightarrow Set the crack compare between forward view image and road image

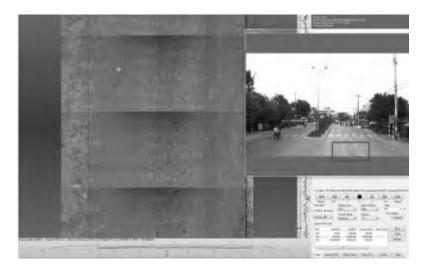


Figure 4.10 Example of visible the crack only forward view image

<Case 5: Setting of peculiar condition>

Which peculiar condition is correct?

→ Work manager check the road image and decide the category of peculiar condition

Items	Description	Image
1.Broken	Once paved sections, but there is serious damage which cannot be evaluated.	
2.Unpaved or unidentified Pav. Type	Unpaved: never paved. Unidentified Pavement type: besides, AC, CC and BST.	A state of the sta
3.Wet Condition	The lane is covered with water or wet.	
4.Other damage	Other type damages that cannot be judged as cracking. (Ex. Raveling, Scratch, etc.)	

Table 4.1 Definition of peculiar condition

	Surface cannot be seen due to	
5.Invisible	coverage of pavement surface by	
5.111/181010	other objects, such as sand, soil,	and the second second
	construction material, etc.	
6.Under construction	Ongoing construction work on the survey lane.	

4.3. Prepare Analyzed Section Table (Table-3)

Data Analysis team shall prepares the "Analyzed Section Table (Table-3)" after completed the data analysis and data processing. Contents of Table-3 are the following items.

Road Inventory Data

(Road Category, Road No., Road No., Supplement, RMBs, SBs, Direction, Lane Position)

- ·КР
- Analysis length

Data Analysis team leader inputs the all information. After complete to input all of column, save as the file name "Analyzed Section Table". Data Analysis team sends the Table-3 to Work manager. Work manager checks the Table-3 about the road inventory information and the difference between the "Analyzed Length" and "survey Length". Work manager asks Data Analysis team when Work manager has any questions on the Table-3. The length of pavement condition survey in Table-3" shall become the fixed number.

	Road No.	Road No. Suppleme nt	Branch No.	Road Name	RMBs	SBs	Direction	Lane Position	From_K P	From_ M	То_КР	To_M	Analysis Length
1	1	0	0	NH1	RMB II	SB II.2	R	1	321	800	330	0	8535
1	1	0	0	NH1	RMB II	SB II.2	R	1	423	600	425	875	2095
1	1	0	0	NH1	RMB II	SB II.2	R	1	449	300	451	0	1665
1	1	0	0	NH1	RMB II	SB II.3	R	1	458	0	467	0	9590
1	1	0	0	NH1	RMB II	SB II.3	R	1	468	0	484	0	15710
1	1	0	0	NH1	RMB II	SB II.3	R	1	504	400	517	1075	13630
1	1	0	0	NH1	RMB II	SB II.3	R	1	561	0	587	0	26095
1	1	0	0	NH1	RMB II	SB II.3	R	1	591	600	595	5	3595
1	1	0	0	NH1	RMB II	SB II.4	R	1	595	5	597	590	2330
1	1	0	0	NH1	RMB II	SB II.4	R	1	625	125	625	880	755
1	1	0	0	NH1	RMB II	SB II.4	R	1	657	25	663	815	6645
1	1	0	0	NH1	RMB II	SB II.4	R	1	671	230	672	305	1075
1	1	0	0	NH1	RMB II	SB II.6	R	1	819	850	840	475	20290
1	1	0	0	NH1	RMB II	SB II.6	R	1	868	100	872	570	4330
1	1	0	0	NH1	RMB II	SB II.6	R	1	883	700	886	460	2510
1	1	0	0	NH1	RMB II	SB II.2	R	2	321	800	330	0	8535
1	1	0	0	NH1	RMB II	SB II.2	R	2	423	600	425	875	2095

5. Data Check and Data Install

Data Analysis team submits the PC data to Work manager after complete the data analysis and data processing. Work manager checks the quality of the data. If the quality of the data has no problem, Work manager can accept the data. If the quality of the data has some problems, Data Analysis team updates the problem points.

Finally, Work manager submits the PC data to Top manager. Top manager receives the PC data and approves the completion of the pavement condition survey. Top manager (IT center) installs the PC data to PMS database.

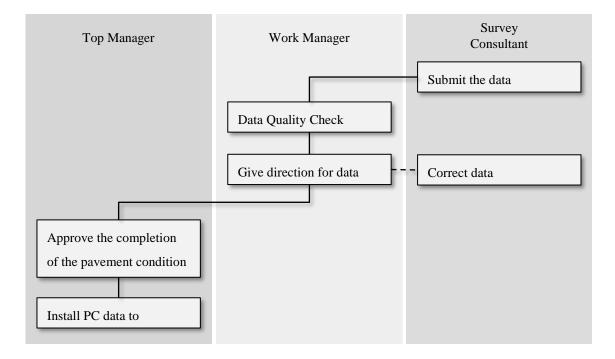


Figure 5.1 Work flow of Data Check and Data Install

5.1. Data Quality Check

Data Analysis team submits the Pavement Condition Data after complete the data analysis and data processing. Work manager check the quality of submitted data within 5 days. The quality check should be done as follow,

1) Quantity and Road inventory information

Work manager check the quantity and road inventory information by compare the Table-2 and Table-3. Items to be checked are as below;

- Surveyed and analyzed length
- Route code of surveyed routes

- Jurisdiction information
- The different of chainage
- 2) Check output of PC data and folder structure

Work manager check the number of output file and data structure.

- Output file

Pavement Condition File (formatted as .csv)

Image data with coordination File (formatted as .csv)

Forward view image (formatted as . JPG)

- Folder structure

Work manager check the folder structure. Folder structure is shown in Table 5.1.

							a straetare	
		Fo	older St	tructu	re			File
Root								
F	PCfile							PCfile_RMB I_2017.csv
F	ImageFile							ImageFile_RMB I_2017.csv
L	2017	— R	MB I	\top	NH1	\neg	Left_laen1	00000001.jpg
								00000002.jpg
								:
						F	Left_lane2	00000001.jpg
								00000002.jpg
								:
						⊢	Left_lane1	
						L	Left_lane2	
							—	
					NH2	T	Left_lane1	
						L	_ Right_lane1	

3) Quantity of images

Work manager checks whether there is no difference in the number of forward image file with the number calculated from length of the Pavement Condition Data.

4) Abnormal value

Work manager checks the abnormal value based on definition value.

- Crack ratio: Over 70%

- Rutting Depth (max): Over 50mm
- Rutting Depth (average): Over 30mm
- IRI: Over 15mm/m
- MCI: Equal 0

When Work manager finds errors on data, Work Manager shall instruct Data Analysis team to update the output data.

5.2. Project Completion and Submission

After Work Manager confirms that there are no errors on the output data, Work Manager receives the final output data from Survey Consultant. Survey Consultant saves these data on external HDD and submits the HDD to Work Manager. Work Manager submits the PC data in the HDD to Top Manager. Finally Top Manager accepts the completion of the Pavement Condition Survey Project.

5.3. PC Data Registration

The data confirmed by Top manager is registered in the PMS server by IT center. The registration procedure is the following five steps.

- 1) Connect to HDD to PMS server
- 2) Copy the PC data file to PMS server
- 3) Copy the Image file to PMS server
- 4) Copy the FV image file to PMS server
- 5) Commit to import PC data to using web system

Copy each data to the following directory. Copy FV image file whole folder into the following directory.

- PC data file : [PMS] [public] [pcimport] [pcfile]
- Image file : [PMS] [public] [pcimport] [imagefile]
- FV image file : [PMS] [public] [Pavementconditionimage]

After copying the data to the server, use PMS to register the data.

Select Pavement Condition Data Package	
Pavement Condition Dataset	
PCfile_RMBIII_new_form	*
Image Data	
ImageFile_RMBIII_new_form	~

Figure 5.2 Pavement Condition Data Registration Function Display

The PC data registered in the PMS database can be displayed on the web-display system.

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Figure 5.3 Image of Web-display system for Pavement Condition

6. Maintenance and inspection of Pavement Condition Survey System

It is quite important to maintain the pavement condition survey system (PCSS), including vehicle, device and PC systems, in order to utilize the PCSS continuously and keep accuracy of the output data from the system. Since the PCSS is composed of advanced technologies, the user (Top manager of Pavement Condition Survey) must receive support from a special manufacturer constantly. The Maintenance agreement shall be signed between Top manager and the manufacture for manufacturer's any support. Without the maintenance agreement, system user cannot receive any assistance from the manufacture.

The contents of general maintenance agreement are as follows. However Top Manager shall carefully discuss about the contents of agreement with the manufacture.

Coverage of the Maintenance Agreement

- Call center (consultation service)
- Simple work in emergency
- Periodical inspection of the PCSS by professional engineers (inspection and calibration)
- Service in case of failure on the PCSS (whether with or without consideration of payment)
- Preferential price of replacement parts or labor work

By signing of the agreement, the manufacture shall be responsible for the following items.

Manufacture's scope of responsibility

- Keep information about the PCSS for timely support
- Manage history information on inspection and repair of the PCSS
- Secure professional engineers who can support the PCSS
- Grasp information about the possibility of inventory of system devices, replacement parts etc.
- Procurement of replacement parts or alternative way in case of system replacement (whether with or without consideration of payment)

7. Point to note of Pavement Condition Survey

This chapter describes points to be aware of when expanding of Pavement Condition Survey System.

a) Responsibility Assignment

In case that new target route, such as Expressway or routes managed by PDOTs, will be surveyed, the responsible agency shall determine the person in charge of all the tasks on PCS.

- Top Manager

Top Manager shall supervise and approve the project as the following tasks;

- Accept implementation plan
- Manage PCSS
- > Check work progress report reported by Work Manager
- Accept completion of the project
- PC data install (by IT Center)

- Work Manager

Work Manager shall make a survey plan and supervise Survey Consultant as the following tasks;

- Prepare survey plan
- Submit survey plan to Top Manager
- Dispatch Survey Consultant
- Supervise field survey work (progress and problems)
- Report progress to Top Manager
- Supervise Data Analysis work(progress and problems)
- Data verification
- Submit the PC data to Top Manager
- Survey Consultant

Survey Consultant shall take responsibilities of whole survey work and preparation of PC data as the following tasks;

- > Prepare the Implementation Plan
- ➢ Field survey
- Data analysis
- Data processing
- Data check

b) Survey plan

When the inventory information of the database for preparing the survey plan is insufficient (new

construction routes, Expressway or route managed by other road administration agencies, etc.), it is necessary to securely obtain the information on the routes to be surveyed for preparing Table-1.

c) Survey for Expressway or routes managed by PDOTs

In case of expanding the PCSS to other routes, the following road conditions shall be checked in advance for each route.

- With or without Kilo-post station
- Paved or not
- Possibility to confirm star and end point on site (especially on Expressway for safety issue)
- Sufficiency of road code information

In case of hard to conduct survey due to above issues, Top Manager shall consult to manufacture of PCSS in advance.

d) Running speed on Expressway

The maximum speed of the PCSV is 70 km/h. When the speed of the vehicle exceeds 70 km/h, PCSS will stop. The driver shall keep the vehicle speed at 70 km/h or less.

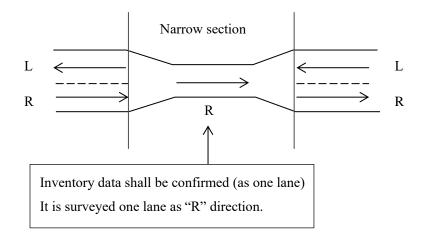
e) Confirmation of lane structure in narrow section

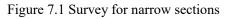
When survey for narrow sections, Survey Team shall pay attention to the difference between inventory information and actual situation on site.

e.g.

Despite being a narrow width, the inventory has two directions (right and left).

Survey of narrow sections by both directions may cause duplication of survey data.





f) Safety Management

Especially when survey for Expressway, if confirmation work on the road is necessary, regulations on Expressway shall be applied for strict safety management.

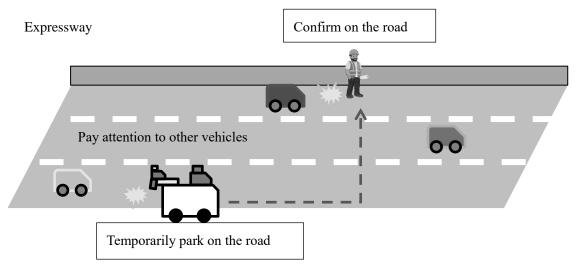


Figure 7.2 Safety management on Expressway

g) Data analysis application to apply new routes

When analysis work using analysis application as target (new constructed routes, Expressway and routes managed by other road administration agencies) without road code data, the configuration file shall be updated. For more detail procedure to update the configuration file, refer to the manual of "Instruction Book of REAL Mini [PCS-Vol.4]".

h) Referential document

The description in the reference manual shall be updated if needed.

i) Other

If unexpected events occur, consult to manufacture of PCSS.

Appendix 1: Format of TOR

TERMS OF REFERENCE ON PAVEMENT CONDITION SURVEY

MAY 2017

DRVN

1. OBJECTIVE

- To provide pavement condition data to the development of PMS and the formulation of road pavement long-term budget plans and 3-Year repair work plans.
- To conduct pavement condition survey on national roads managed by RMB *.

2. MEASUREMENT

The Contractor shall conduct Pavement Condition Survey on each lane of the target road sections and analyze surveyed data accordingly. Total length of the target road sections of the survey is estimated at XXXX lane-km, upon road administration data provided by each RMBs. In case, actual survey length is different from estimated length (longer or shorter), the Contractor shall report to the Client for discussion.

RMBs	Route Name	Lane Length (lane-km)
	NH *	XXX.X
*	NH *	XXX.X
	Total	X,XXX.X

Table.1 Target Survey Length of RMB *

Note) detailed target sections are shown in Appendix 4

3. DATA ITEMS

Table 5 shows data items require to be collected. The data gathered in the survey are also recorded in the pavement condition database in every 100 meters.

Table.2 Data item and interval

No.	Data Item	Unit	Recording Interval
1	Cracking Ratio (AC, BST)	% or	100 m
2	Cracking Index (CC)	cm / m^2	100 m
3	Rutting depth (Max, Average)	mm	100 m
4	IRI	mm / m	100 m
5	GPS	М	5 m
6	Front view image	М	5 m

4. IMPLEMENTATION METHOD

Pavement condition survey consists of two tasks; (1) field survey and (2) data analysis / processing. Pavement condition survey shall be implemented based on the "Road Condition Survey System Basic Operation Manual, March 2014."

4.1 Implementation Plan

The Contractor shall make and update the implementation plan to conduct the pavement condition survey. The implementation plan shall include such as the purpose of the survey, scheduled work volume, methodology, accuracy management, schedule, formation and contact number of each person. The Contractor shall submit this implementation plan after contract immediately. When the content of the implementation plan would be changed, the Contractor shall modify and submit to Client each time.

4.2 Field Survey

The pavement condition survey vehicle will be provided by DRVN. The Contractor is requested to submit a survey plan to complete the survey by due date. The Contractor is also requested to assign a team leader, two (2) surveyors and a driver for field survey team. For smooth survey, DRVN will assign navigators to work at the field with survey team. Navigators will assist field survey to identify target sections. The operation expenses for field survey, such as vehicle fuel cost, charges for toll roads, parking fee, insurance, storage device, all necessary and reasonable cost for field survey will be borne by the Client.

4.3 Calibration

As a preparation work for survey, the Contractor shall implement the calibration of the pavement condition survey vehicle in collaboration with DRVN engineer in the field by following the "Road Condition Survey System Basic Operation Manual, March 2014."

4.4 Data analysis / processing

The Contractor is requested to assign a team leader and eight (8) surveyors for data analysis / processing. They shall be trained for software of pavement condition data analysis. DRVN will allow to use ten (10) PCs installed the software during the analysis / processing. This task is assumed to be done in Hanoi.

4.5 Survey monitoring

The Client assigns an expert to monitor progress and quality of survey data both at the field and at the data processing periodically.

The composition of survey team shows in table.6.

	Γ	DRVN			
Agency		RMB / Sub		Contractor	
		Bureaus			
Category	Supervisor	Navigator	Survey leader	Surveyor	Driver
Assignment method	Periodic / Part time	Full Time	Full time	Full time	Full Time
(1) Field survey	1	1	1	2	1
(2) Data analysis / processing	_	_	1	8	_

Table. 3 Staff Assignment for Survey and Analysis (Person)

(NOTE)"" TE annalysis / processing" includes the task of data registration into pavement condition database

(NOTE)"" TE annalysis / processing" includes the

(NOTE)"" TE annalysis / processing" includes the task of data registration into pavement condition database the daother reason of each target route.

5. FOR SUBMISSION

The output items for submission from the pavement condition survey are shown Table. 7. The sample of the output items are shown in Appendix 1 and Appendix 2.

No.	Output Item	Quantity	Unit	Format Type
1	Survey Implementation Plan (English and Vietnamese)	2	Set	Hardcopy and Softcopy
2	Pavement Condition Data	1	Set	MS Excel, CSV
3	Geographic Coordinate Data Table	1	Set	MS Excel, CSV
4	Forward View Image	1	Set	JPG
5	Final Report of Pavement Condition Survey (EN and VN)	2	Set	Hardcopy and Softcopy

Table. 4 Output Items for submission

After completion of data analysis and processing of each RMB, data and report shall be provided to the Client. The Client will check the data and report quality and request Contractor to correct is data are not as per the format/quality as specified in the operation manual.

6. PAYMENT TERMS

As far as the gap between the survey length and the estimated survey length, X,XXX km-lane, is within 5%, the payment shall be made upon contract amount.

7. IMPLEMENTATION SCHEDULE

The survey and data processing shall be completed by DD/MM/YYYY. Final schedule will be set after the consultation with DRVN and contracted firm.

				mpr	mema		10 0 0 1 0					
RMBx	Item	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10^{th}	11^{th}
	Preparation											
	Calibration											
	Field survey											
RMBx	Data processing											
	Data checking											
	Data preparation											
	Report											

Table. 5Implementation Schedule

8. SURVEY VEHICLE AND EQUIPMENT

"Pavement condition survey vehicle" and "Data analysis and processing PC" which provided by JICA to DRVN in 2014 will be provided to the survey firm. Survey firm shall prepare the HDD for pavement condition survey.

Content	Image
Pavement condition survey vehicle	
Data analysis and processing PC	
HDD	

Table.6 Equipment

APPENDIX 1 Pavement Condition Data

							Kirom	eter Po	ost							Num	ber of	Survey						С	Condition	(Distress)				
ID	Geographical Area Jurisdiction	M aintenance Company		Branch	Route Name	E	rom		То		Section Length	Analysi Area	Structure	Intersecti	Overlapp	L	ine	Lane	Surf ce	1	Date				ngRatio/ ex(%∕cm/	m²)		utting th(mm)	IRI	Note
		Company	Numbe	ivunder			n,m)		(km,m)		(m)	(m2)		01	ing	U	D	U/D Pat Lar			yy/mm)	Crack	ing F	Patching	Pothole	Total	Max	Ave	(mm/	1
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	17	5	11	200	25	82	2			3	3	D	1 AC	2	012 1	0	0	0) (D	0 1	7	10 6	5.22 *11k+175(11k+135)
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	20)	11	300	100	33	2			3	3	D	1 AC	2	012 1	0	0	0) (D	0 1	3	8 4	4.05
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	30)	11	400	100	33	1			3	3	D	1 AC	2	012 1	0	0	0) (D	0 1	5	8 2	3.17
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	40)	11	500	100	33	4			3	3	D	1 AC	1	012 1	0	0	0) (D	0 1	5	8 2	2.21
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	50	D	11	600	100	33	1			3	3	D	1 AC	2	012 1	0	0	0) (D	0 1	7	9 2	2.47
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	60)	11	700	100	33	4			3	3	D	1 AC	1	012 1	0	0	0) (o	0 1	5	10 2	2.75
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	70)	11	800	100	33	2			3	3	D	1 AC	1	012 1	0	0	0) (b	0 1	7	10 2	2.43
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	80)	11	900	100	33	D			3	3	D	1 AC	1	012 1	0	0	0) (b	0 1	7	9 2	2.24
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	11	90	D	12	0	100	33	2			3	3	D	1 AC	1	012 1	0	0	0) (o	0 1	6	9 2	2.11
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	12)	12	100	100	33	2			3	3	D	1 AC	1	012 1	0	0	0) (o	0 2	6	10 2	2.76
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	12	10)	12	200	100	33	1			3	3	D	1 AC	1	012 1	0	0	0) (0	0 1	9	12 :	3.24
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	12	20)	12	300	100	33	0			3	3	D	1 AC	1	012 1	0	0	0) (D	0 1	7	12 7	2.37
	NORTHERN AREA RRMU2	RRMC240		5 0	NATIONAL HIGHWAY 5	12	30)	12	400	100	33	3	I		3	3	D	1 AC	1	012 1	0	0	0) (b	0 1	8	11	3 U/N

Table.7Sample of Pavement Condition Data

APPENDIX 2 Geographic Coordinate Data Table

ID	ID2	Latitude	Longitude	Hight	Image Path
		106.71155	21.973593	293.704	00100\DOWN\0000k00010-0051k00000\PIC0000002.jpg
		106.71154	21.973549	293.445	00100\DOWN\0000k00010-0051k00000\PIC0000003.jpg
		106.71153	21.973506	293.31	00100\DOWN\0000k00010-0051k00000\PIC00000004.jpg
		106.71152	21.973463	293.184	00100\DOWN\0000k00010-0051k00000\PIC00000005.jpg
		106.71151	21.973418	293.013	00100\DOWN\0000k00010-0051k00000\PIC0000006.jpg
		106.7115	21.973373	292.784	00100\DOWN\0000k00010-0051k00000\PIC00000007.jpg
		106.71149	21.973329	292.59	00100\DOWN\0000k00010-0051k00000\PIC0000008.jpg
		106.71148	21.973285	292.308	00100\DOWN\0000k00010-0051k00000\PIC0000009.jpg
		106.71147	21.973242	292.125	00100\DOWN\0000k00010-0051k00000\PIC00000010.jpg

Table.8Sample of Geographic Coordinate Data Table

APPENDIX 3 Folder Structure

			Folder	r Structu	ıre			File
Root								
F	PCfile							PCfile_RMB I_2017.csv
F	ImageFile							ImageFile_RMB I_2017.csv
L	2017	—	RMB I	\top	NH1	\top	Left_laen1	00000001.jpg
								00000002.jpg
								:
						\vdash	Left_lane2	00000001.jpg
								00000002.jpg
								:
						\vdash	Left_lane1	
						L	Left_lane2	
				\vdash	NH2	\top	Left_lane1	
						L	Right_lane1	

		Road No.						Lane						Excluded		Planned	
Road Category	Road No.	Supplement	Branch No.	Road Name	RMBs	SBs	Direction	Position	From_KP	From_M	To_KP	To_M	Length	Length	Overlapping	Survey Length	Note
1	1	0	0	NH1	RMB II	SB II.1	Right	1	285	400	321	800	83000	36400			Under Condtruction
1	1	0	0	NH1	RMB II	SB II.1	Right	1	321	800	330	0				8200	
1	1	0	0	NH1	RMB II	SB II.1	Right	1	330	0	368	400		38400			Under Condtruction
1	1	0	0	NH1	RMB II	SB II.2	Right	1	383	0	423	600	84000	40600			Under Condtruction
1	1	0	0	NH1	RMB II	SB II.2	Right	1	423	600	425	875				2275	
1	1	0	0	NH1	RMB II	SB II.2	Right	1	425	875	449	300		23425			Under Condtruction
1	1	0	0	NH1	RMB II	SB II.2	Right	1	449	300	451	0				1700	
1	1	0	C	NH1	RMB II	SB II.2	Right	1	451	0	458	0		7000			Under Condtruction
1	1	0	C	NH1	RMB II	SB II.2	Right	1	458	0	467	0				9000	
1	1	0	C	NH1	RMB II	SB 11.3	Right	1	467	0	468	0	128000	1000			Under Condtruction
1	1	0	C	NH1	RMB II	SB 11.3	Right	1	468	0	484	0				16000	
1	1	0	0	NH1	RMB II	SB II.3	Right	1	484	0	504	400		20400			Under Condtruction
1	1	0	C	NH1	RMB II	SB II.3	Right	1	504	400	518	0				13600	
1	1	0	C	NH1	RMB II	SB 11.3	Right	1	518	0	561	0		43000			Under Condtruction
1	1	0	C	NH1	RMB II	SB 11.3	Right	1	561	0	587	0				26000	
1	1	0	C	NH1	RMB II	SB 11.3	Right	1	587	0	591	600		4600			Under Condtruction
1	1	0	C	NH1	RMB II	SB 11.3	Right	1	591	600	595	0				3400	
1	1	0	0	NH1	RMB II	SB II.4	Right	1	595	0	597	590	2590			2590	
1	1	0	0	NH1	RMB II	SB II.4	Right	1	625	125	625	880	755			755	
1	1	0	0	NH1	RMB II	SB II.4	Right	1	657	25	663	815	6790			6790	
1	1	0	0	NH1	RMB II	SB II.4	Right	1	663	900	671	230	53100	7330			Under Condtruction
1	1	0	0	NH1	RMB II	SB II.4	Right	1	671	230	672	305				1075	
1	1	0	0	NH1	RMB II	SB II.4	Right	1	672	305	717	0		44695			Under Condtruction
1	1	0	0	NH1	RMB II	SB 11.5	Right	1	717	0	791	500	74500	74500			Under Condtruction
1	1	0	0	NH1	RMB II	SB 11.6	Right	1	791	500	819	850	113300	28350			Under Condtruction
1	1	0	0	NH1	RMB II	SB 11.6	Right	1	819	850	840	500				20650	
1	1	0	C	NH1	RMB II	SB 11.6	-	1	840	500	868	100		27600			Under Condtruction

APPENDIX 4 Target Road Sections (Survey Plan Section Table)

Appendix 2: Format of implementation Plan

IMPLEMENTATION PLAN ON PAVEMENT CONDITION SURVEY

May 2017

Survey Consultant Name

I. Calibration and Survey Plan

1. Calibration Plan:

<u>Survey Consultant</u> plans to calibrate the equipment of REAL-Mini in Hanoi together with DRVN before surveying.

Implementation duration: From **<u>DD/MM/YYYY</u>** to **<u>DD/MM/YYYY</u>**

2. Survey Plan:

The pavement condition survey will be done based on the TOR of pavement condition survey. <u>Survey Consultant</u> plan the below contents before conduct the survey,

- Responsibility assignment on pavement condition survey (filed survey, data analysis and data preparation)
- External HDD to store the measurement data and analysis data.
- Route confirmation such as the start point, end point, eliminated start point, eliminated end point, overlap start point and overlap end point.
- Operation check of survey vehicle, data analysis program and data processing program.

Implementation duration: on **DD/MM/YYYY**

II. Survey Implementation Plan

National Highway	From	То	Number of Lanes	Total Length (km)
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	<u>LLL.LL</u>
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	$\underline{KM xxx + xxx}$	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
Total				LLLL.LL

1. Target Routes (RMB \underline{X}):

2. Implementation Duration:

The field survey implementation in RMB \underline{X} will be done as below schedule:

+ From **<u>DD/MM/YYYY</u>** to **<u>DD/MM/YYYY</u>**

3. Report of field survey

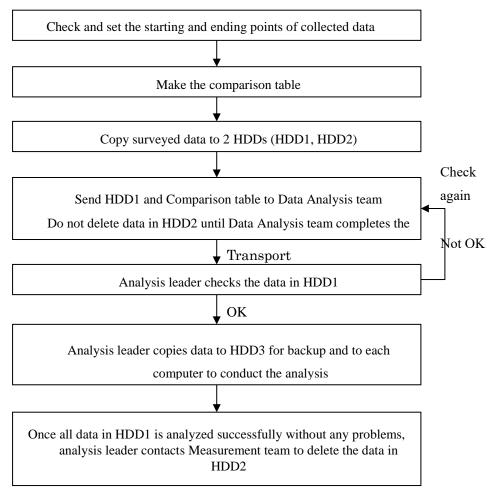
+ **Daily report**: Survey team leader reports implementation quantity/progress to DRVN at the end of day on the daily basis via email.

Report format:

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						1.1				leye bhie sti			Thời gi	na liter vier					1	
7947	C# QLBB	Chirp	Hun ding	Tayin Barng	Thuện/Sgreye	Sè là	Tink trong sais during	They stee	Rirdie	Kas that	Chiris dat	linkie	Kés that	Thiri gian lam	Thit gian ophi • check dë liço	Cing to not	Dân During (Chi rạc)	Liin	Nguêl han chê	tili na
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DAMINN	_																			
DOAMANY	_																			
DOMMININ																				
DOM MOTOR	_																			
COMMITTY																				
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III. Data management and delivery:

- Survey team shall make a copy and send the surveyed data to Data Analysis team at home to conduct the analysis work (about every 500km)
- HDDs storing surveyed data should be sent to Data Analysis team via transportation company
- Data HDD transfer flow:



IV. Data Analysis Plan

- 1. Implementation method
 - Data Analysis team has 8 members, including 6 data analysts and 2 data quality manager;
 - After convert the surveyed data, analysis leader copies converted data to the other members to conduct the analysis. Once data is analyzed, the analyzed data is sent to data quality manager to check.
 - After completing the analysis, the analysis leader informs Survey team to delete the data stored in HDDs on site.
- 2. Data analysis progress for RMB X
 - Data analysis duration: from **<u>DD/MM/YYYY</u>** to **<u>DD/MM/YYYY</u>**
- 3. Report schedule for data analysis

+ Weekly report: Data Analysis team leader reports Total implementation quantity/progress during the week and implementation plan for the next week to DRVN on the weekly basis via email.

Α	В	С	D	E	F	G	Н		J	К	L
Week	y Report										
rom	DD/MM/Y	YYY	То	DD/MN	M/YYYY						
				Sur	vey sect	tions		Activi	ties perf	ormed	
No	Route name	Right /Left	Lane Num ber	From	То	Length (Km)	File name	Analysis	Data	Data Process ing	Note
1										1	
2											
3											
4											
5											
6											
7											
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10						1					
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Weekly report format:

V. Data Processing Plan and Report

- After completion of all analysis work, an analist conducts the data processing and reports the results of Pavement condition data in RMBX to DRVN.
- Duration: from **DD/MM/YYYY** to **DD/MM/YYYY**.

VI. Report Order in Emergency Cases

As unexpected events happen during the survey (broken vehicle, traffic accident ...) or during the data analysis and processing, implementing members shall contact directly to management agency (RMB, SB). If the management agency is not able to solve the problem, it should contact DRVN to find out the solutions.

VII. Members (tentative):

Team Leader Name -- Phone: xxxx.xxx

Email: <u>xxxxxxxx@gmail.com</u>

1. Survey team:

No.	Name	Title	Email	Phone		
1	**** *** ****	Leader	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>		
2	**** *** ****	Operator	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>		
3	**** *** ****	Operator	<u>******@gmail.com</u>	<u>XXXX.XXX.XXX</u>		
4	**** *** ****	Driver	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>		

2. Data Analysis team:

No.	Name	Title	Email	Phone
1	**** *** ****	Leader	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
2	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>XXXX.XXX.XXX</u>
3	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
4	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
5	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
6	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>XXXX.XXX.XXX</u>
7	**** *** ****	Analyst	<u>*****@gmail.com</u>	<u>xxxx.xxx.xxx</u>

8	Analyst	<u>******@gmail.com</u>	<u>XXXX.XXX.XXX</u>
---	---------	-------------------------	---------------------

VIII. Implementation Schedule

The implementation schedule of pavement condition survey followed below the schedule table.

Work Item	1^{st}	2^{nd}	3 rd	4 th	5 th	6 th	7^{th}	8 th	9 th	10^{th}	11^{th}
Survey Plan and Preparation											
Field Survey											
Data Analysis											
Data Preparation											
Data Check											
Submission Data and report											

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Vietnam Ph
Phase II

SBs	Direction	Lane Position	From_KP	From_M	To_KP	To_M	Length	Excluded Length	Overlapping Length	Planned Survey Length	Note
						-					
		1					1				
			1								

Appendix 3: Format of Survey Plan Section Table

Road

Category

Road

No.

Road No.

Supplement

Branch

No.

Road

Name

RMBs

Appendix 4 Format of Calibration Report

Project Name

Report on

Calibration of the Survey Vehicle

MMM YYYY

Survey Consultant Name

1. Objective

Pavement Condition Survey will be done in RMBX. In order to secure the measurement accuracy, calibration and checking of equipment is implemented once in each RMB before the starting survey.

- 2. Contents of Calibration and Check
 - Inspection vehicle check (power, system, equipment)
 - Distance calibration
 - Camera check
 - Laser displacement sensor check
 - Laser scanner check
 - Camera calibration
 - Long test

3. Place

1) Filed 1 (Place name)

- Inspection vehicle check (power, system, equipment)
- Distance calibration
- Camera check
- Laser displacement sensor check
- Laser scanner check
- Camera calibration

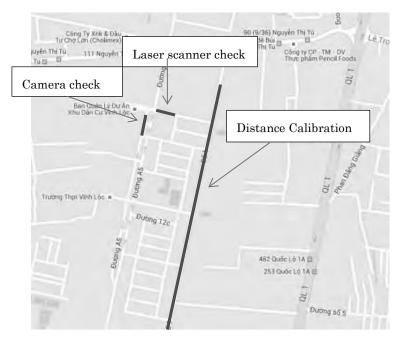


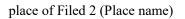
Figure 1: place of Filed 1 (Place name)

2) Field 2 (Place name)

- Long test



Figure 2:



3. Schedule

Date	Place/ Route	Km-Post	Member	Activity
MM/DD (Mon)				Inspection vehicle check (power, system, equipment) Distance calibration
MM/DD (Thu)				Camera check Laser displacement sensor check Laser scanner check
MM/DD (Wed)				Laser scanner check Camera calibration
MM/DD (Thur)				Camera calibration Long test

Table 1: Timetable of calibration and checking

4. Result

- 1) Condition of system
- Vehicle
 - Tire inflation pressure: OK

Table 2: Result of inflation pressure

Tire position	Before	After	Condition
Front Right	kg/cm ²	kg/cm ²	OK
Front Left	kg/cm ²	kg/cm ²	ОК
Rear Right	kg/cm ²	kg/cm ²	OK
Rear Left	kg/cm ²	kg/cm ²	OK

- Direction indicators: OK
- Light: OK
- Engine oil: OK
- Fan belt: OK

- System

- Scratch and condition of system: OK
- Wiring of Equipment: OK
- Voltage of battery: OK
 - 12.5V
- Screw: OK

2) Accuracy of equipment

• the focus of Lens (FV, RC): OK

The device is capable of properly recognizing cracking as small as 2mm in depth on the test chart.

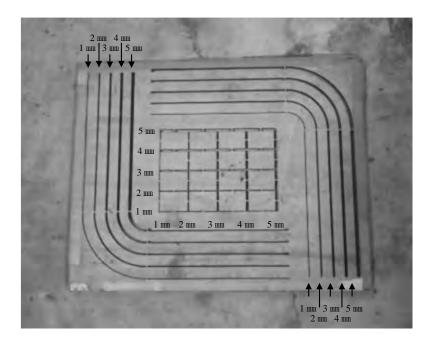


Figure 3: Test chart

- FV



Figure 4: Result of Forward view camera image

- RC (Sunshine)

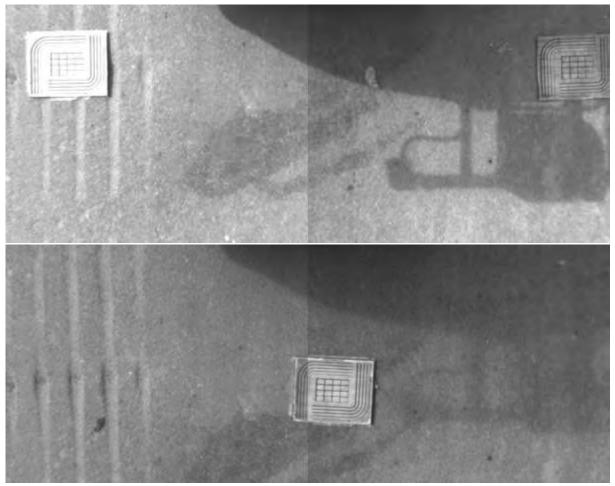
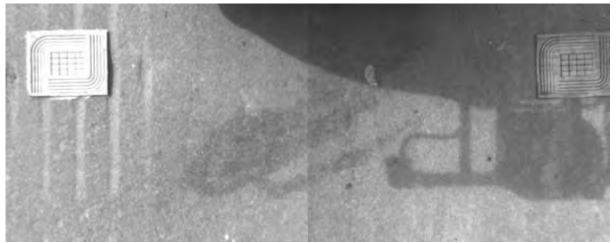


Figure 5: Result of Road camera image (sunshine)

- RC (Shadow)



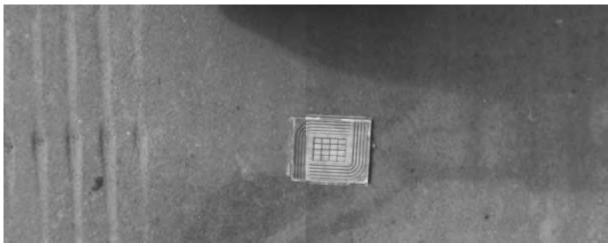


Figure 6: Result of Road camera image (shadow)

• Angle of view (CR): OK

Calibration boards are installed at 3.8 meters apart. The device captures images covering a span of 3.8 meters or more.

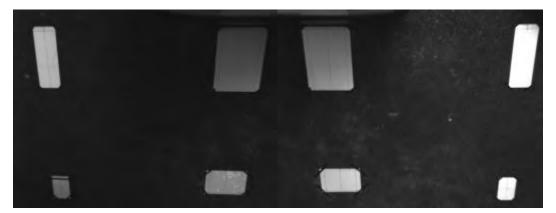


Figure 7: Result of angle of view (Road camera)

• Installation dimension of calibration boards

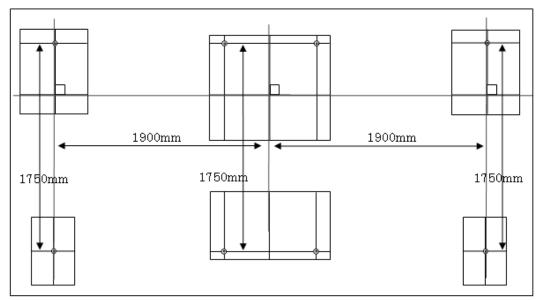


Figure 8: Installation dimension of calibration boards for road camera

• The accuracy of laser displacement sensor: OK

Heights from ten measurements were collected by inserting a wood block at each measurement. The thickness of the wood block was calculated from the differences between collected heights, and the measurement accuracy was verified by comparing the results against the actual thickness of the wood block. Results showed that the average deviation was *.**mm.

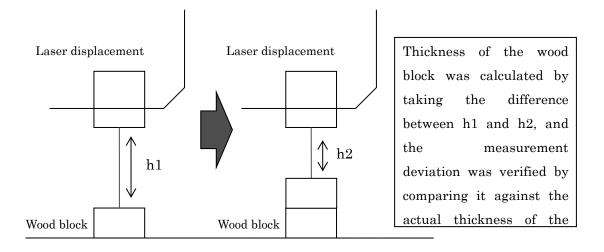


Figure 9: method of checking the accuracy of laser displacement sensor

		Laser di	splacement r	neter (mm)		Actual measurement (mm)		ation nm)
	1st	2nd	3rd	Median	Thickness of block	Thickness of block	Integer	Absolute
0					_	_	_	_
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
						Ave		* **

Table 3: Result of laser displacement sensor

• The shape of laser scanner data: OK

Comparisons between profiles collected through the dipstick and those collected through the automated measurement device showed that same profiles were being detected in general.

- No.1

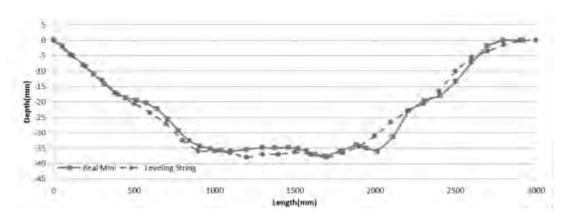


Figure 10: Result of rut shape (No.1)

- No.2

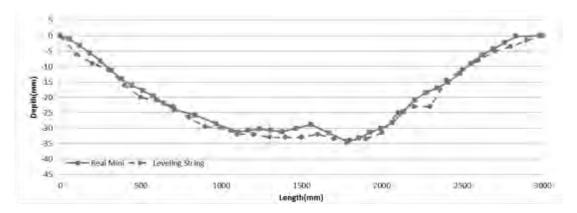


Figure 11: Result of rut shape (No.2)

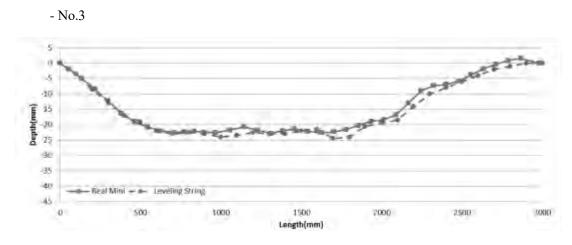


Figure 12: Result of rut shape (No.3)

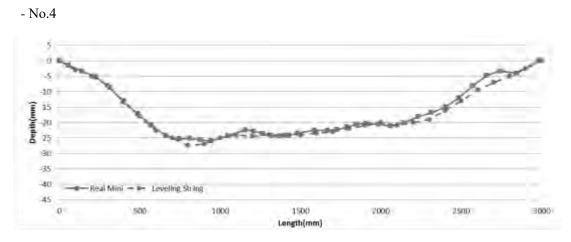


Figure 13: Result of rut shape (No.4)

- No.5

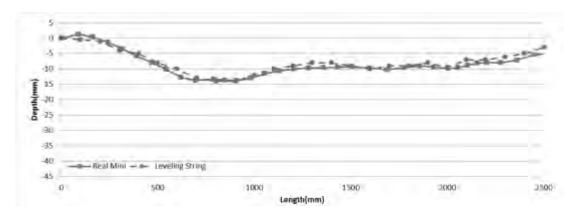


Figure 14: Result of rut shape (No.5)

• Comparison of rut depth: OK

As the difference stands at 1.5 mm at the maximum and at 0.8 mm at an average, it was verified that the device is within the deviation range of -6mm to +6mm, which satisfies the requirement.

		1	
No.	Leveling	REAL	Deference
	String	Mini	Deference
1			
2			
3			
4			
5			
		MAX	
		MIN	
		AVERAGE	

Table 4: Result of Rut depth

• Distance: OK

A distance of 1000 meters was traveled four times, and the average vehicle pulse signal from the four runs was 2540.

Measurement count	Measured value	Average value
Previous Value	_	
1		
2		
3		
4		

Table 5: Result of vehicle pulse

A coefficient was configured based on this value, and as a result of measuring a distance of 1000 meters, the deviation rate was -0.01%. The device showed an accuracy that is within the range of -0.5% to +0.5% of the actual length, and thus it was verified that the instrument meets the required specifications.

Table 6: Result of measurement distance test

Section length (m)	Measured value (m)	Deviation (m)	Deviation rate (%)	Test result (Deviation rate <±0.5%)
1000			%	Pass

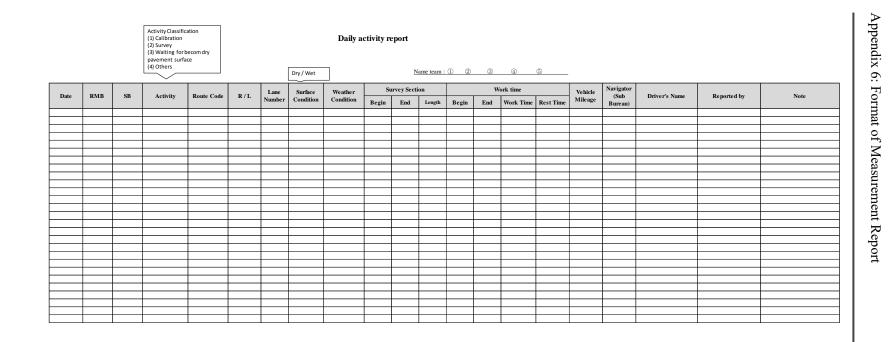
• Test survey: OK

Table 7: Result of test survey

Number of Times	Measurement Length (km)	Condition
1 st		No Error

	Appendix 5:
	Format
•	of Surveyed
	Section
	Table

Road Category	Road No.	Road No. Supplement		RMBs	SBs	Direction	Lane Position From_KP	From_M	To_KP	To_M	Length	Excluded Length	Overlapping Length	Planned Survey Length	Note	From_M	To_KP	To_M	Length	Excluded Length	Overlapping Length	Survey Length	Note
				I																			
				1																			
			 									_	-							-			
				I																			
				1																			



Pavement Condition Survey

The Project for Capacity Enhancement in Road Maintenance in Vietnam Phase II

Appendix 7: Format of Data Analysis Report

Weekly Report

```
From DD/MM/YYYY To DD/MM/YYYY
```

				Sur	vey secti	ons		Activi	ties perfo	ormed	
No	Route name	Right /Left	Lane Num ber	From	То	Length (Km)		Data	Data Process ing	Note	
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14				****		*****		****		****	
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25				****	*****	*****		*****		****	
26											
27											
28											
29											
30	†										
31											
51											

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Road Category	Road No.	Road No. Supplement	Branch No.	Road Name	RMBs	SBs	Direction	Lane Position	From_KP	From_M	To_KP	To_M	Analysis Length	Note

Appendix 8: Format of Analyzed Section Table



JAPAN INTERNATIONAL COOPERATION AGENCY DIRECTORATE FOR ROADS OF VIETNAM MINISTRY OF TRANSPORT (MOT) THE SOCIALIST REPUBLIC OF VIETNAM



THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE PHASE II

PAVEMENT CONDITION SURVEY MANUAL

Volume 2.1.3: Operation (Field Survey & Data Analysis)

MARCH 2017

JICA PROJECT TEAM

Record of updates

Rev.	Date	Contents change
1.00	2017.12.19	First edition

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<u>Glossary</u>

Administration Database	Database of PMS data storing administrative information.
Analyzed section Table (Table-3)	The final section table prepared by PC data.
Calibration	Adjustment of devices for true value
Camera for front image	The device for measuring the front image
Camera for road image	The device for measuring the road image
Crack	Damage index based on the pavement surface crack.
End point	The end position of the target route.
Excluded section	The out of scope section. For example, the section that is under construction or being transferred to the management of another agency are in this excluded section.
IRI (International Roughness Index)	Damage index based on the longitudinal shape on the pavement surface.
KP (Kilometer post)	Positon of route. It is consist of Kilo-post station number and distance from the Kilo-post station number.
Kilo-post station	A road sign on the side of the road to indicate distances from major cities.
Kilo-post station number	The number indicated on the kilo-post stations in the side of the road.

Laser displacement sensor	The device for measuring the longitudinal profile
Laser scanner	The device for measuring the transverse profile
Main control unit	The Unit for control the measurement device
Marking	Marking of the start point and end point for easier recognition.
Overlapping section	A section in which two routes overlap in terms of management.
Patching	The repaired part of partially damage area (Pothole, crack, and so on).
Pavement condition	The condition of pavement surface. The pavement condition is evaluated for cracks, ruts and IRI.
Pavement condition survey vehicle	Vehicle assembled with measurement devices.
PDCA cycle	Management cycle acronym for PLAN, DO, CHECK and ACT.
PMS	Pavement Management System.
PMS Database	Database stored for PMS dataset.
Power control unit	The Unit for supply and control the electric power to the measurement device
REAL Mini	Name of the pavement condition survey vehicle made by PASCO Corporation.
Rut	Damage index based on the transverse shape on the pavement surface.
Start point	The start position of the target route.
Survey plan section Table (Table-1)	Table of planned survey length
Surveyed route table	Table of summary surveyed route for each surveyed day
Surveyed section Table (Table-2)	Table-1 with extensions added

<u>Acronyms</u>

AC	Asphalt Concrete
BOT	Build-Operate-Transfer
BST	Bituminous surface treatment
CC	Cement Concrete
DPI	Department of Planning and Investment
DRVN	Directorate for Roads of Vietnam
HDD	Hard Disk Drive
IWP	In wheel path
КР	Kilometer post
MMD	Management and Maintenance Department
OWP	Out wheel path
PC data	Pavement condition data
PCS	Pavement Condition Survey

PCSV	Pavement Condition Survey Vehicle
PDOT	Provincial Department of Transport
PPC	Provincial People's Committee
QC	Quarter-Car
RMBs	Road Management Bureaus
SB	Sub Bureaus
STEICD	Science, Technology, Environment, International
	Cooperation Department
TOR	Terms of Reference

1. Introduction

1.1. About This Manual

Operation (Field Survey & Data Analysis) (PCS-Vol.3) is one of six manuals comprising the suite of the documentation for pavement condition survey. Figure 1.1 shows the component of pavement condition survey manual is divided into three parts, Overview, Operation manual and Technical manual. Documents to be referenced depend on the responsibility and work steps of stakeholders involved in pavement condition survey. Overview describes the basic items of survey that all stakeholders should refer to. Operation manual shows important matters to be referred to mainly when survey work managing. Technical manual indicates technical matters such as system and device operation methods, data definition and data preparation. Figure 1.2 shows the description of contents of each document.

This manual explains the survey and analysis work of Survey consultant on pavement condition survey. It contains the survey and analysis rule. It is to be used by surveyor and analysis operator who to carry out the pavement condition survey. If there is any lack of information, addition and updates would be recommended.

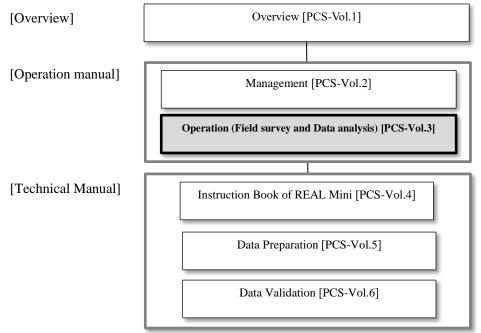


Figure 1.1 Pavement condition survey manual

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Overview (PCS-Vol.1]

→ Describe the overview and measuring methods of pavement condition survey. It is a general purpose document which provides in an understanding of pavement condition survey.

[Operation manual]

Management [PCS-Vol.2]

➔ Describe the management work of road administrator on pavement condition survey. It contains all management works such as the planning, supervising, and data checking on pavement condition survey describing. It is to be used by administrator who to carry out the management of pavement condition survey.

Operation (Field survey and Data analysis) [PCS-Vol.3]

➔ Describe the survey and analysis work of survey consultant on pavement condition survey. It contains the survey and analysis rule. It is to be used by surveyor and analysis operator who to carry out the pavement condition survey.

[Technical manual]

Instruction Book of REAL Mini [PCS-Vol.4]

→ Describe the operation procedure of REAL Mini system. It contains the operation procedure of inspection vehicle and analysis system, calibration and maintenance of the inspection vehicle and so on. It is to be used by surveyor and analysis operator whose task is to carry out the deep study for operation procedure of REAL Mini system.

Data Preparation [PCS-Vol.5]

→ Describe the contents of pavement condition data (PC data). It contains the code definition, explanation of each item of PC data and so on.

Data Validation [PCS-Vol.6]

→ Describe the data check procedure when creating the PC data. It is to be used by person whose task is to carry out the data check in pavement condition survey.

Figure **1.2** Contents of Pavement condition survey manual

1.2. Summary of Pavement Condition Survey and Work Allocation

1) Pavement Condition Survey

Pavement condition survey (PCS) measures pavement damages such as cracks, ruts and IRI using the pavement condition survey vehicle (hereafter PCSV) on moving and make the pavement condition data files. The pavement damage expresses surface (crack), transverse (rut) and longitude (IRI) (Figure 1.3). The PCSV assembled some devices such as laser scanner and cameras for the pavement damages measurement (Figure 1.4).

Pavement condition survey measures not only pavement condition but also road inventory information, forward view image and position information at the same time.

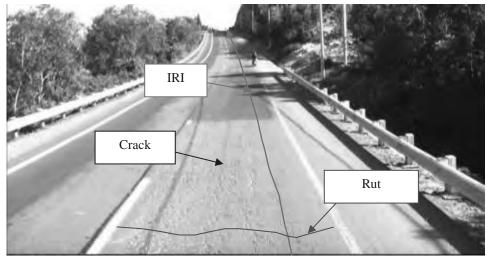


Figure 1.3 Pavement damage to be evaluated by PCS

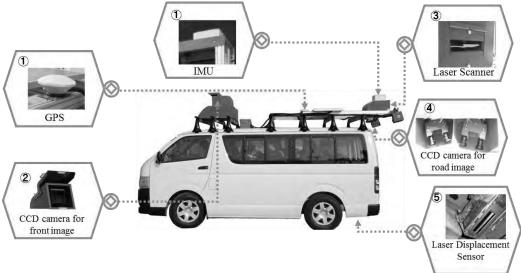


Figure 1.4 PCSV (REAL Mini)

2) Pavement Condition Data

PC Data file is result of road surface damage status by pavement condition survey. Damage of road surface is evaluated by crack rate, rut depth, IRI and MCI. These evaluated data are prepared for every 100 m unit section. Description of evaluation item of road surface damage is shown in Table 1.1. For more detail information, refer to the manual of "Overview [PCS-vol.1]".

Item	Content	Description	Note
Crack	Crack ratio [%]	Crack ratio is calculated by	For AC, BST
	Patching [%]	damaged area per total area	
	Pothole [%]	grids.	
	Crack index [cm/m2]	Crack index is calculated by crack length of damaged per total area	For CC
Rut	Rut depth	Average rutting depth	
	(Average,)[mm]	within unit section (100m)	
	Rut depth (Max) [mm]	Maximum rutting depth	
		within unit section (100m)	
IRI	IRI [mm/m]	Total Axial displacement of	
		QC model in unit section	
		(100m)	
MCI	Integrated condition	automatic calculated by 3	
	index using above 3	damaged values	
	damage items		

|--|

3) Work Allocation of Survey consultant on Pavement Condition Survey

Pavement condition survey can be divided into four steps, 1) Survey Plan, 2) Measurement, 3) Data Analysis and Data Processing, and 4) Data Check and Data Install. List of work item and assignment on Pavement Condition Survey is shown in Table 1.2. Work Allocation of Pavement Condition Survey is as below.

- Survey consultant

- Survey consultant conducts the below contents.
 - Preparation of implementation plan
 - Measurement
 - Data analysis
 - Data processing

- DRVN (DPI, MMD, STECID and, IT Center)

DRVN has a responsibility of Top manager of pavement condition survey (hereinafter, this is called "Top manager"). In the future, RMBs or PDOT can become Top manager of the pavement condition survey. Role of Top manager are as follows;

- Approve the survey plan
- · Check the progress of the pavement condition survey based on RMBs report
- Manage the PCSV
- Approve the completion of the pavement condition survey
- Install the PC data to PMS server (IT Center)

- RMB (DPI, MM, SB)

RMBs manages all work in pavement condition survey (hereinafter, this is called "Work manager"). Role of Work manager are as follows;

- Prepare the survey plan
- Supervise the work of the Survey consultant
- Submit the plan, progress report and complete PC data to Top manager

Responsible division of DRVN in pavement condition survey is shown in Figure 1.5.

No.	Work Item	DRVN (Top manager)	RMMBs (Work manager)	Survey consultant
1	Survey plan	• Approve the survey plan	 Preparation of survey plan Submit the survey plan to DRVN Assign Survey consultant 	• Preparation of Implementation plan
2	Field survey	 Management of PCSV Check the progress report form RMBs 	 Supervise field work (Progress, Problem) Report the progress to DRVN 	• Field survey
3	Data analysis Data Processing	 Check the progress report form RMBs 	 Supervise data work (Progress, Problem) 	Data analysisData processing
4	Data check Data install	 Approve the completion of the pavement condition survey Install PC data (IT center) 	 Data check Submit PC data to DRVN 	• Correct data

Table 1.2 Work item and Assignment on Pavement Condition Survey

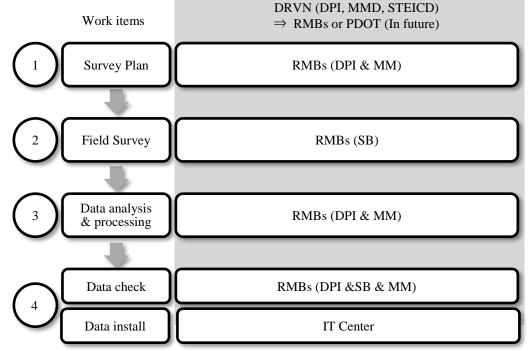


Figure 1.5 Responsible division of Pavement Condition Survey Referential Document of This Operation Manual

This operation manual refers to the below manual and standard document as detail specification or procedure. Refer to the below manuals or documents in detail.

1) Survey Plan

1.3.

- Format of implementation Plan (Appendix 1)
- Format of Survey Plan Section Table(Appendix 2)

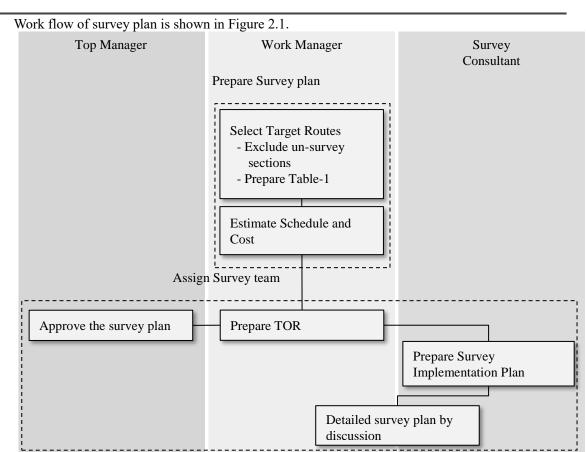
2) Field Work

- Format of Calibration Report (Appendix 3)
- Format of Surveyed Route Table(Appendix 4)
- Format of Measurement Report (Appendix5)

- Format of Surveyed Section Table(Appendix 6)
- Instruction book of REAL Mini [PCS-Vol.4]

3) Data Analysis and Data Processing

- Format of Data Analysis Report (Appendix 7)
- Format of Analyzed Section Table(Appendix 8)
- Instruction book of REAL Mini [PCS-Vol.4]
- Data Preparation [PCS-Vol.5]



2. Survey Plan

Figure 2.1 Work flow of survey plan

Based on the "Survey Plan Section Table (Table-1)" and the TOP prepared by Work Manager, Survey Consultant shall prepare "Implementation Plan" and submit it to Work manager.

Discussion between Work manager and Survey Consultant shall be held based on the Implementation Plan and confirm about contents of work items.

[Section Table]

Three (3) section tables are prepared in PCS. The section tables are summary of section length of survey targeted routs. These section tables are used to calculate section length for each work step (plan, survey and data analysis). Definition of section tables are shown in Table 2.1.

Section Table	Information	Prepared by	Timing	Note
Survey plan section table (Table-1)	Survey Planned Section	Work manager	When preparing of Survey Plan	Information of Target section for PCS
Surveyed section table (Table-2)	Surveyed Section	Survey consultant	After field survey	Section information of after field work
Analyzed section table (Table-3)	Analyzed Section	Survey consultant	After Data Analysis	Section information of after analysis work (Section of PC data)

Table 2.1	Contents	of section	table
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1) Prepare Implementation Plan

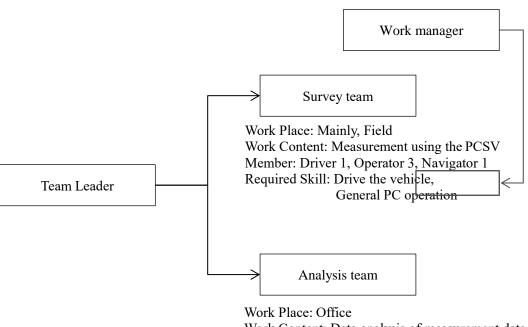
Based on the TOR, Survey Consultant shall prepare the "Implementation Plan". When preparation of the "Implementation Plan", the format of the Implementation Plan (Appendix-1) is used and the following information items updated. Survey Consultant shall submit the Implementation Plan to Work manager as soon as it is prepared.

- Date of submission of Implementation Plan
- <u>Signature of Survey consultant</u>
- <u>Period of Calibration</u>
- Target route information (route name, KP, number of lane, length)
- <u>Period of Measurement</u>
- Period of Data Analysis
- <u>Period of Data Processing</u>
- The name, mobile number and email address of Team Leader
- The name, mobile number and email address of Survey team member
- The name, mobile number and email address of Data Analysis team member

Implementation structure in Survey Consultant is described in Figure 2.2. Survey Consultant has two partied, Survey team and Data Analysis team.

Survey Team has five (5) members, including one (1) driver three (3) operators and one (1) navigator. Work Manager shall dispatch a navigator who takes a responsibility of confirmation of road information, such as start/end point of road, direction, etc.

Data Analysis team has ten (10) members, who take responsibilities of data analysis and data processing work using collected data on site by Survey Team.



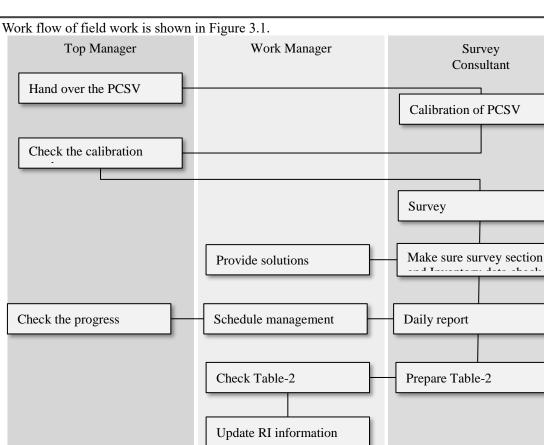
Work Content: Data analysis of measurement data Member: Operator 10 Required Skill: General PC operation

Figure 2.2 Formation of Survey consultant

2) Discussion before Survey

Discussion between Work Manager and Survey Consultant shall be held based on the Implementation Plan prepared by Survey Consultant. Work manager shall check all information in the Implementation Plan and confirm it.

- <u>Survey length (Route length, Planned survey length)</u> <u>Excluded section, length</u> •
- •
- Implementation schedule
- Report contents (particularly how to treat the traffic accident)
- The place of calibration



3. Field Work

Figure 3.1 Work flow of field work

After complete the implementation contents at the first discussion, Survey team will start the measurement following the implementation schedule. Work manager supervises their activity in the office. Survey team will conduct the survey work as below items.

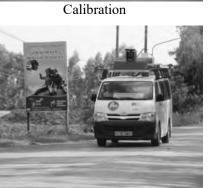
- · <u>Calibration of the measurement devices (Before the measurement)</u>
- <u>Survey</u>
- <u>Report the problem (Traffic Accident/Broken)</u>
- <u>Confirmation of unclear point on survey</u>
- <u>Daily report</u>
- <u>Prepare "Surveyed Section Table (Table-2)"</u>

Table 3.1 is showing the items to be measured on site. Road damage data (Crack, Rut and IRI) are evaluated by using measured three items (Road image, cross-section profile and longitudinal profile). And front view image data with coordinates, which is one of the output data on PCS, is used to identify pavement type or road surround information when data analysis.

Measurement item	Measurement item Equipment	
Road image	CCD camera for road image	Crack
Transverse profile	Laser scanner	Rut
Longitudinal profile	Laser Displacement sensor & IMU	IRI
Front image with coordinate	CCD camera for front image & GPS	(Finally the front image is registered to PMS server)

Table 3.1 Measurement item i	in fiel	d survey
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Measurement

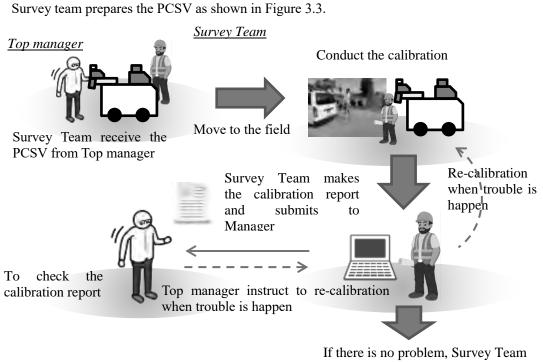


Marking



Operation Figure 3.2 Steps of field work

3.1. Preparation the PCSV before Measurement



start the measurement

Figure 3.3 Work flow of survey preparation

1) Hanover of PCSV

Top Manager shall handover the PCSV to Survey Consultant. Top Manager and Survey Consultant make sure survey method and operation procedure of the PCSV based on the manual of "Instruction Book of REAL Mini [PCS-Vol.4]" and "Management [PCS-Vol.2]". And Top Manager and Survey

Consultant check basic operation of the PCSV and apparent condition of the vehicle, and make sure that there are no damages or failures in the PCSV. The results of above checks shall be recorded on a document with both signature between Top Manager and Survey Consultant.

2) Calibration of PCSV

Measurement device of the PCSV will have some change on setting location or device conditions by long-team use, and it might cause error of measurement data. To avoid measurement error, calibration of the PCSV shall be done to verify accuracy of measurement data and adjust device parameters. Calibration work shall be done when the following timing;

Timing of calibration

- Before survey in case of survey over 350km in total during one survey term
- When measured length is over 5000km from the last calibration
- When over 6 months pass from the last calibration
- In case of changing tires or changing air pressure of tires

Table 3.2 is showing the items for calibration. For more detail about calibration work, refer to "Instruction Book of REAL Mini [PCS-Vol.4]" and "Calibration Report (Appendx-4)".

No.	Work Item	Check item	Tolerance
1	Inspection vehicle check	Condition of system	No Error
2	Camera check	Detection accuracy of crack width in image 2mm or more	
3	Camera calibration	Measurement span	3.8m or more
4	Laser displacement sensor check	Accuracy of measurement	0.4mm
5	Laser scanner check	Accuracy of Rut depth measurement	6mm
6	Distance calibration	Accuracy of mileage measurement	Within range of -0.5% to 0.5%
7	Long test	Operating condition of inspection vehicle	No Error

3) Report Calibration Result

Survey Team of Survey Consultant shall prepare the Calibration Report using the format of the report and submit it to Top Manage. In case that there are some problems in the Calibration Report, Top manager shall instruct Survey Team to do calibration again.

3.2. Field Survey

Survey team conducts the survey every day excluding rainy days. Survey team reports about progress to Work manager via email with an attached "Format of Measurement Report" (Appendix 5) every day. Field survey work in a day is below items.

- Arrangement of PCSV
- Measurement by PCSV
- Finalize of survey and PCSV
- Send the daily report

Work manager checks the progress from the report. If there is a big delay from the plan, Work manager confirms the reason for the delay. Work manager and Survey team discuss the countermeasure for the reason.

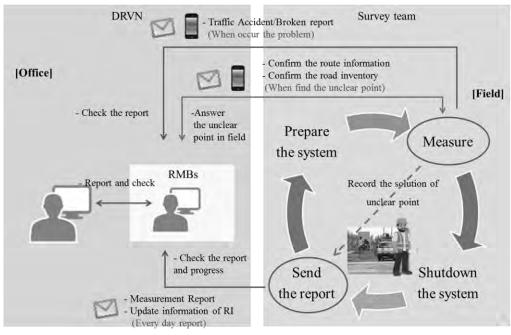


Figure 3.4 Work flow of field survey

In case the conducting the pavement condition survey in new route (new construction, expressway, PDOT management roads, etc.), the below contents should be confirmed carefully about each route situation in order to clear the problem point of survey in advance.

- Kilo post station is exist or not
- Pavement is exist or not
- Possibility of the starting and ending point (particularly expressway)
- Road code setting is appropriate or not

3.2.1. Arrangement of PCSV

Survey Team shall arrange the PCSV before start field survey. The procedure of arrangement of PCSV is as follows. For more detail information, refer to chapter 6 of the manual of "Instruction Book of REAL Mini [PCS-Vol.4]"

- Open the covers (CCD cameras for road image and for front image, laser scanner and laser displacement sensor)
- Connect the HDD to both PCs (PC1 and PC2)
- Turn on the system (power control unit, main control unit, PC1 and PC2)

Measurement application starts automatically when PC power is on. After start of measurement application, Survey Operator selects the measurement function and input measurement data (Road category, Road number, Road number supplement, brunch number, lane, direction). When completion of data input, the window changes to measurement window.

When the color of "status" is not green, all systems (PC1, PC2, main control unit and power control unit) are turned off power and connection of devices and HDD are checked. And all systems are turned on again and "status" is checked.

If the situation is not improved, Survey Team shall reports to Work Manager.

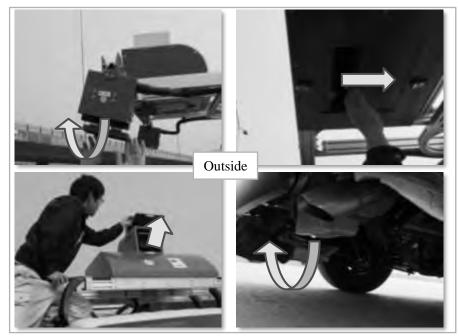


Figure 3.5 Open the covers (outside of PCSV)

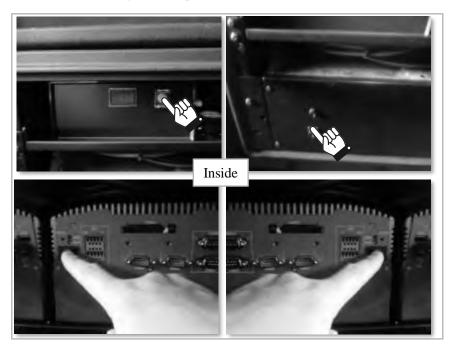


Figure 3.6 Turn on the system (inside of PCSV)

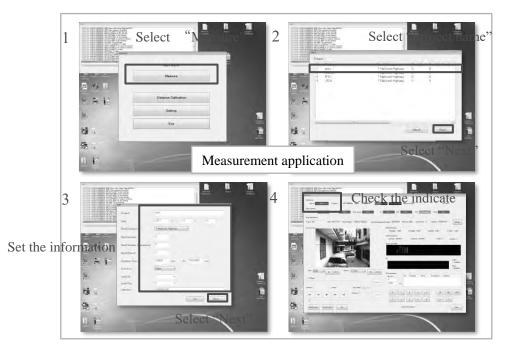


Figure 3.7 Preparation of measurement application

3.2.2. Measurement by PCSV

After arrangement of PCSV, Survey team move to start point of target route and start the measurement by PCSV.

1) Measurement Method

Work flow of measurement is shown in Figure 3.8. Refer the chapter 6 in "Instruction Book of REAL Mini" about detail operation procedure of REAL Mini.

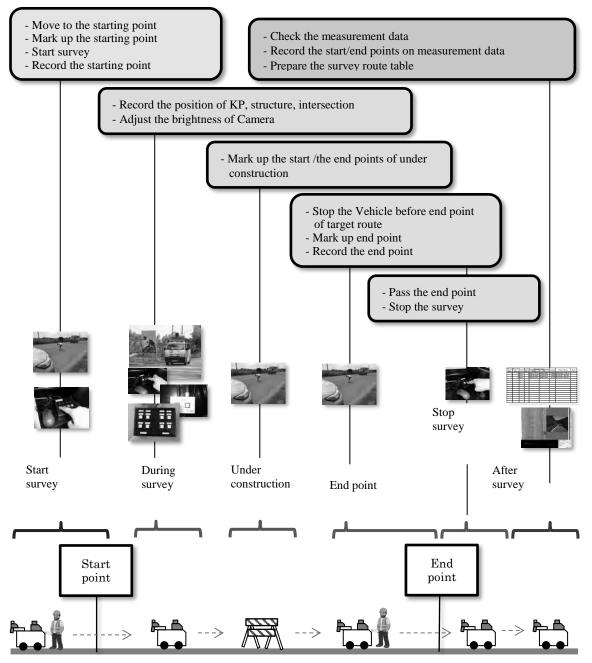


Figure 3.8 Work flow of measurement

a) Work on starting point

Survey team moves to the starting point of the targeted survey route with the PCSV and stop there. The Operator leaves the vehicle, and confirms the starting point position, and marks up the starting point on pavement.

Marking on pavement is used to identify the starting point of analysis data on the Analysis Application.

Survey Team starts survey with PCSV after finish of marking. Figure 3.9 shows the work steps on starting point.

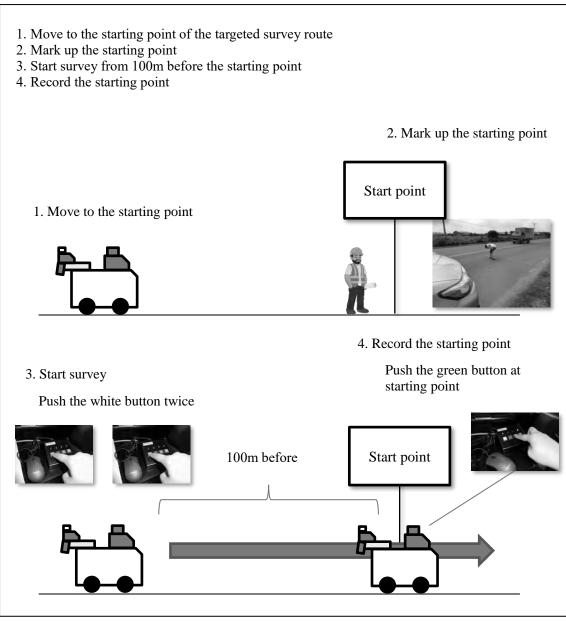


Figure 3.9 Work steps on starting point

b) Work during survey

During survey with PCSV, the operator shall record the position of Kilo-post stations, structure and intersection on measurement data.

Also to keep the brightness of the image constant, the brightness of the camera shall be adjusted. Figure 3.10 shows the work items during survey.

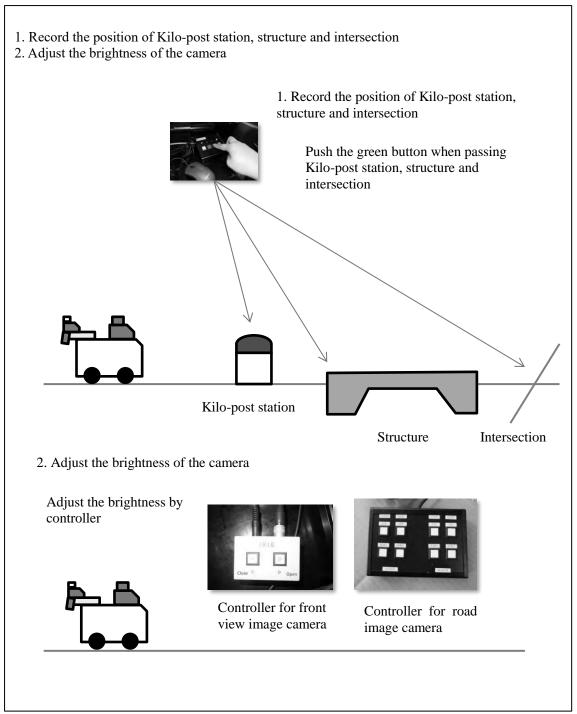


Figure 3.10 Work items during survey

c) The work on under construction section

Under construction sections are excluded from survey. However in the view point of efficiency of field survey, survey is not stopped in under construction sections between survey sections, and survey is conducted continuously. In order to exclude under construction sections from data analysis targets, information specifying under construction sections on the Data Analysis application must be recorded in the measurement data. When there is a under construction section, Survey Team marks up at the end point of under construction section.

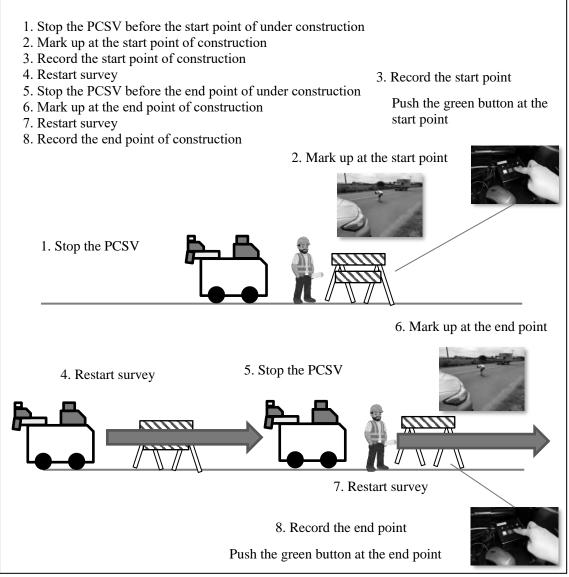


Figure 3.11 Work on under construction section

d) Work on end point or when survey stops

Survey Team stops the PCSV at the end point approaches. And the operator marks up at the end point on pavement. After marking up, Survey Team restart survey. Finally, after 100 meters from the end point, survey is stopped and the PCSV is moved to a safe place. Figure 3.12 is showing the procedure of these works.

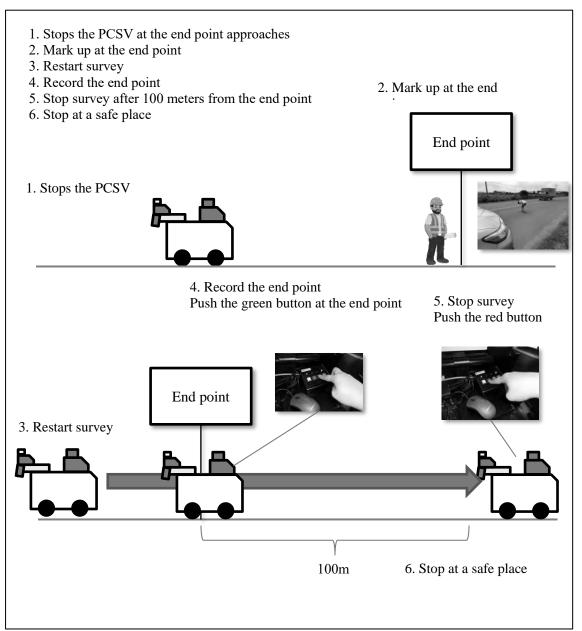
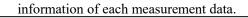


Figure 3.12 Work on end point or when survey stops

e) The work of finishing the measurement

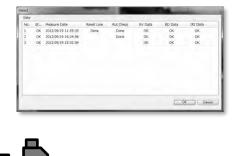
After field survey, Survey Team checks the measured data and records the start/end points through the Start/End points setting application. Data number to be collected shall be checked. When data number is insufficient, that section shall be surveyed again. Without any problems on measured data, the start/end points are recorded. For more detail procedures, refer to chapter 7 of the manual of "Instruction Book of REAL Mini [PCS-Vol.4]".

Next, in order for the Data Analysis team to determine the information on the route and section of the measurement data, the Surveyed Route Table of route information (road code, measurement direction, lane information, KP) and measurement data (folder name) is prepared. At the time of analysis, Data Analysis team refers to the Surveyed Route Table and specifies the route



- 1. Checks the measured data
- 2. Records the start/end points
- 3. Prepare the surveyed route table
 - 1. Checks the measured data

2. Records the start/end points





3. Prepare the surveyed route table

			Road		Road	Branch		Survey					Note	
Survey date	Folder	Road Name	Category	Road No.	No.	Code	Fr	om		0	Left/Right	Lane	Note	
			cutegory		Supp lement	coue	Km	m	Km	m				
2015/11/6	20151106_102010	QL N2	1	482	0	2	5	18	59	0	R	1		
2015/11/7	20151107_072418	QL N2	1	482	0	2	59	0	101	920	R	1		
2015/11/7	20151107_092731	QL N2	1	482	0	2	101	920	48	0	R	1		
2015/11/7	20151107_143211	QL N2	1	482	0	2	48	0	5	18	L	1		
2015/11/8	20151108_095022	QL 30	1	30	0	0	34	320	93	0	R	1		
2015/11/8	20151108_133737	QL 30	1	30	0	0	93	0	118	0	R	1		
2015/11/8	20151108_150020	QL 30	1	30	0	0	118	0	119	418	R	1		
2015/11/8	20151108_151004	QL 30	1	30	0	0	119	418	108	0	L	1		
2015/11/9	20151109_081113	QL 30	1	30	0	0	110	0	34	320	L	1	CO DOAN DANG THI CONG	
2015/11/9	20151109_135512	QL 30	1	30	0	0	0	0	1	200	R	1		
2015/11/9	20151109_140259	QL 30	1	30	0	0	1	200	0	0	L	1		
2015/11/10	20151110_083505	QL 80	1	80	0	0	0	0	50	875	R	1		
2015/11/10	20151110_105859	QL 80	1	80	0	0	50	875	0	0	L	1		
2015/11/11	20151111_102406	QL 91B	1	91	0	2	0	0	15	793	R	1		
2015/11/11	20151111_114323	QL91	1	91	0	0	39	0	45	118	R	1		
2015/11/11	20151111_120245	QL91	1	91	0	0	45	118	39	0	L	1		
2015/11/11	20151111_134638	QL91	1	91	0	0	51	140	70	233	R	1		
2015/11/11	20151111_143220	QL91	1	91	0	0	70	233	51	140	N	1		

[Surveyed Route Table]

Figure 3.13 Work after field survey

The Surveyed Route Table which is a summary of surveyed route for each surveyed day is prepared in order to identify surveyed data in the HDD.

The Surveyed Route Table is used to identify the information of surveyed route in the HDD by Data Analysis team when start data analysis work. Data Analysis team can find the data of targeted route for analysis in the HDD using surveyed date information (Date, hour, minute and second) as an identification key. (A sample format of the Surveyed Route Table is available in Appendix-4).

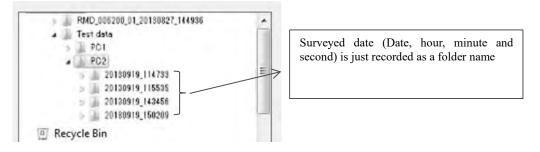


Figure 3.14 Saved window of surveyed data

Preparation steps of the Surveyed Route Table;

- Enter a surveyed date into "Survey Date" column
- Enter a folder name which has surveyed data into "Folder" column
- Enter a road name into "Road Name" column
- Enter a code of road category into "Road Category" column
- Enter a Road Number into "Road No." column
- Enter a Road No. Supplement into "Road No. Supplement" column
- Enter a Branch Code into "Branch Code" column
- Enter a KP(Km, m) at survey start point into "From" and enter a KP(Km, m) at survey end point into "To" column
- Enter a surveyed direction into "Left/Right" column
- Enter a surveyed lane number into "Lane" column
- Enter memos or message into "Note" column if needed(e.g. Excluding section, etc.)

			Road		Road	Branch	Survey Section				Note		
Survey date	Folder	Road Name	Category	Road No.	No.	Code	Fr	om		ò	Left/Right	Lane	Note
			category		Supplement	code	Km	m	Km	m			
2015/11/6	20151106_102010	QL N2	1	482	0	2	5	18	59	0	R	1	
2015/11/7	20151107_072418	QL N2	1	482	0	2	59	0	101	920	R	1	
2015/11/7	20151107_092731	QL N2	1	482	0	2	101	920	48	0	R	1	
2015/11/7	20151107_143211	QL N2	1	482	0	2	48	0	5	18	L	1	
2015/11/8	20151108_095022	QL 30	1	30	0	0	34	320	93	0	R	1	
2015/11/8	20151108_133737	QL 30	1	30	0	0	93	0	118	0	R	1	
2015/11/8	20151108_150020	QL 30	1	30	0	0	118	0	119	418	R	1	
2015/11/8	20151108_151004	QL 30	1	30	0	0	119	418	108	0	L	1	
2015/11/9	20151109_081113	QL 30	1	30	0	0	110	0	34	320	L	1	CO DOAN DANG THI CONO
2015/11/9	20151109_135512	QL 30	1	30	0	0	0	0	1	200	R	1	
2015/11/9	20151109_140259	QL 30	1	30	0	0	1	200	0	0	L	1	
2015/11/10	20151110_083505	QL 80	1	80	0	0	0	0	50	875	R	1	
2015/11/10	20151110_105859	QL 80	1	80	0	0	50	875	0	0	L	1	
2015/11/11	20151111_102406	QL 91B	1	91	0	2	0	0	15	793	R	1	
2015/11/11	20151111_114323	QL91	1	91	0	0	39	0	45	118	R	1	
2015/11/11	20151111_120245	QL91	1	91	0	0	45	118	39	0	L	1	
2015/11/11	20151111_134638	QL91	1	91	0	0	51	140	70	233	R	1	
2015/11/11	20151111_143220	QL91	1	91	0	0	70	233	51	140	N	1	

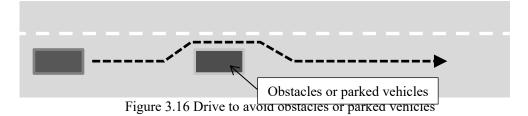
Figure 3.15 Sample of Surveyed Route Table

- 2) Notes for Field Survey
- a) Rules for field survey

The driver not only drives safely, but also pays attention to the driving situation of other vehicles.

• In case that there are obstacles or parked vehicles on the shoulder

In case that there are street parking vehicles on the shoulder, there is a possibility that a person may come down from the parked vehicles, so the driver shall drive avoiding the parked vehicle while paying attention to the movement of a person from inside the vehicle. Also, there is a possibility that a person may come out from behind the parked vehicle, the driver shall pay attention to jumping out from the blind spot.



• Drive Speed

The PCSV strictly adheres to the legal speed of each route. Also, in case of bad weather condition, such as sudden rain or thick fog, driver shall pay attention to keep a safe speed. The maximum speed of the PCSV is 70km/h when survey, and it runs at 70km/h or less when survey to avoid stopping the system.

• <u>Safety drive</u>

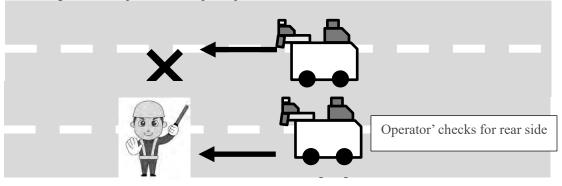
In order to maintain not only the safety of the vehicle but also the quality of measured data constant, the driver shall not drive dangerous, such as sudden start, abrupt stop, sudden acceleration, rapid deceleration and sudden steering wheel, etc. When low-speed vehicles are running in front of the PCSV, the driver shall not overtake them, and keep inter-vehicle distance enough. Since the

equipment is attached on the ceiling of the vehicle, the driver shall pay attention to height limitation (allowable height is 2.7m or less).

Note that the distance between the preceding vehicle and the preceding vehicle to travel safely is the same distance as the speed per hour. For example, in case of 40 km/h, that is 40 m.

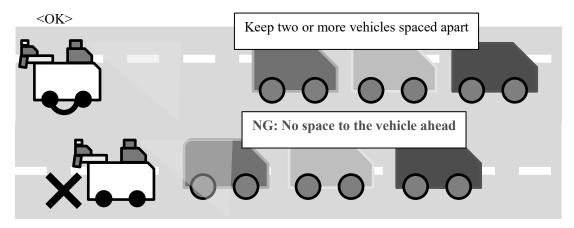
• <u>Going in reverse prohibited</u> The rear side of the vehicle tends to be a blind spot. Therefore, for the purpose of preventing accidents in principle going in reverse is prohibited. However, in case it is unavoidable such as when parking, the operator shall surely go out once to check the safety of the rear side.

< Going in reverse prohibited in principle>



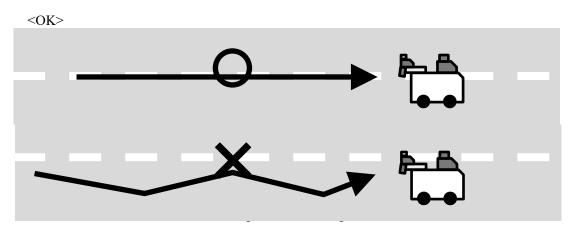
• <u>Drive in traffic congestion</u>

If the distance between the PCSV and the vehicle ahead is short, the road surface does not appear on the front image. Therefore, in case of traffic congestion when survey, the PCSV shall go through with two or more vehicles spaced apart from the preceding vehicle.



Drive Straight

The driver shall drive straight to avoid incorrect survey length due to zigzag drive.



b) Judgement to stop survey

When it rains, laser scanners and laser displacement sensor are irregularly reflected due to wet condition of road surface. Also since water drops are reflected on the image, the quality of the image deteriorates. Therefore, the survey shall be stopped in case of rain.

- In case of suddenly rain during survey
- In the case of weak rain that raindrops do not appear on the camera If possible, survey shall be continued until the end point and the weather conditions shall be monitored.

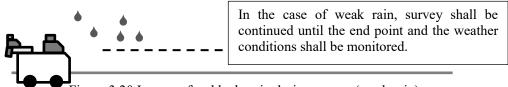
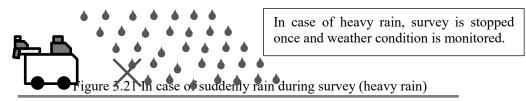


Figure 3.20 In case of suddenly rain during survey (weak rain)

In the case of heavy rain that raindrops appear on the camera and water stay on pavement Survey is stopped and the driver stops the PCSV at a place where the vehicle can be parked safely on the shoulder. In case the weather condition is not recovered, the survey is ended. When the weather condition is expected to recover, and when the condition of the road surface is in a dry, survey is restarted from the position of the previous Kilo- post station.



• <u>Pavement condition after stop rain</u> After stop rain, survey can be restarted if road surface is dry. How to judge to restart survey is explained as bellows;

Examples of road conditions where survey CANNOT be restarted (NG) Water still stay on a part of the road surface



Figure 3.22 Road conditions where survey cannot be restarted (sample-1)



Water stay on whole part of the road surface

Figure 3.23 Road conditions where survey cannot be restarted (sample-2)

Examples of road conditions where survey CAN be restarted (OK) Dry on the road surface (no water on the road surface)

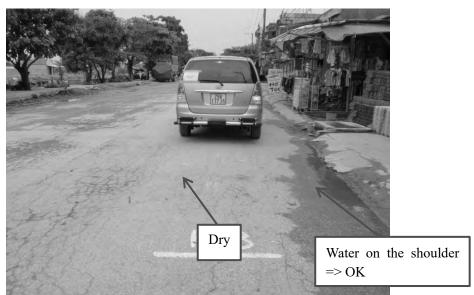


Figure 3.24 Road conditions where survey can be restarted (sample-1)

Dry on the road surface (totally recovered)



Figure 3.25 Road conditions where survey can be restarted (sample-2)

3) Make Sure the Unclear Point

Survey team reports any problem and questions to Work manager if needed. Work manager instructs the solution to the Survey team.

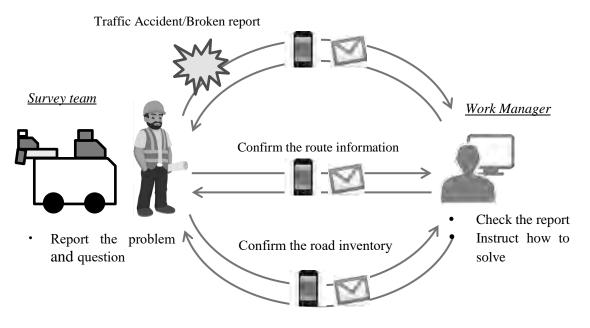


Figure 3.26 Flow of report and responding for the report

a) Safety management

In case of traffic accident, Survey Team shall report to Work manager about situation of accident, including (1) Accident situation, (2) with or without injured persons and (3) Possibility to continue the survey, etc. In case of with injured persons, Survey Team requests an ambulance and reports to the police for highest priority of life rescue. If measurement device or vehicle has problems due to accident, Survey Team shall report to Top manager and Work manager about condition of the PCSV promptly.

If it is impossible to move the vehicle to a safe place, the PCSV is repaired there in case of minor damage. Or the PCSV is moved by tow-away and repaired.

In case that the vehicle has no damage but measurement device has failures, Survey Team shall go back to the garage of the PCSV and repair the device.

Finally, Survey Team shall make sure that the PCSV is operated properly by operation test.

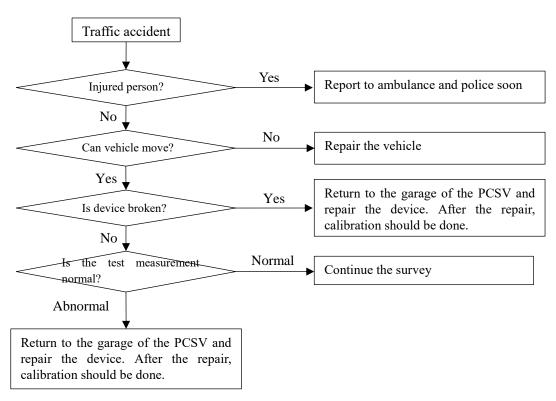


Figure 3.27 Flow in case of traffic accident

b) Confirmation of the route information

Survey team checks the differences between information on the Table-1 and information on site. Check item is below.

- Starting/ending point of the target route
- Check the starting/ending point in the route
- Excluded section

Confirm the additional section of rehabilitation section and transferred section.

- Overlapping section

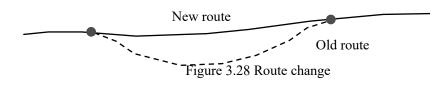
Check the starting/ending point of overlapping section in the route.

When hard to continue survey due to above issues, Survey Team shall ask navigator or Work Manager to provide solutions to correct information between planned information and on site situation. Navigator or Work Manager shall confirm the situation and direct solutions to Survey Team.

[Example of the difference]

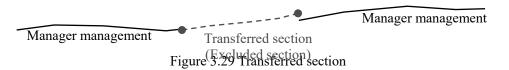
Route change

When new opened route is found on site within the targeted route, Survey Team shall make sure the jurisdiction and road inventory (road code, branch code, etc.) of both routes (new route and old route) by asking to Work Manager. Work Manager shall provide necessary information to Survey Team.



Jurisdiction change

When targeted sections are transferred to other road administration agencies, including BOT construction sections, these sections shall be excluded from survey. The start and end point of excluding sections shall be marked up on pavement, and these sections shall be measured at that time. The excluding section will be confirmed when data analysis.



c) Confirm the road inventory information

Survey team reports to navigator or Work Manager if there is different inventory information (ex: road width, change position of number of lane, etc.) between Table-1 and information on site. The navigator or Work Manager checks the report and instruct proper solutions to Survey team.

3.2.3. Finalize of Survey and PCSV

After the day's work is over, the PCSV shall be closed as the following ways. For more detail information, refer to chapter 6 of the manual of "Instruction Book of REAL Mini [PCS-Vol.4]".

- Shut down the systems (PC1, PC2, power control unit and main control unit)
- Remove the HDD which is connected with PC1 and PC2
- Cover device (CCD cameras for road image and for front image, laser scanner and laser displacement sensor)

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Figure 3.30 Shut down the systems (Inside of PCSV)

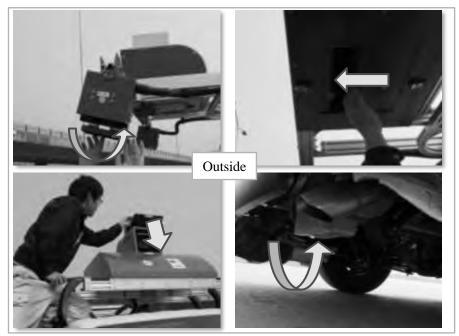


Figure 3.31 Cover device (Outside of PCSV)

3.2.4. Send the Daily Report

Survey team reports to Work manager via email about which route and how many km was surveyed every day. Refer the format of measurement report in Appendix 5.

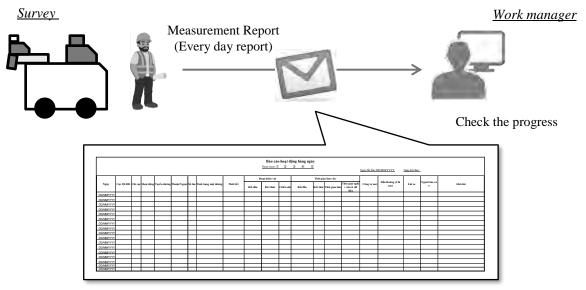


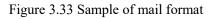
Figure 3.32 Format of measurement report

Dear XXXX,

I send today's daily report. Please kindly refer the attachment for the detail.

Date: DD/MM/YYYY Reporter: Name Report at: Place Survey length: Length Survey route: Route name

BR, XXXX



3.3. Work after Field Survey (Table-2 preparation)

Survey Team shall prepare the "Surveyed Section Table (Table-2)" using measured information (route name, KP and surveyed length) after field survey completion as the following steps;

- Insert a row in the 8 columns next to "Planned survey length (km)" in Table-1 KP (From and To), Surveyed length (surveyed length, excluding sections length and overlapping length), Note
- KP information and surveyed length are inputted into the targeted columns based on measured information
- Information on additional excluding sections and additional survey sections are inputted into added column
 - ("Added excluding section" or "Additional survey sections" are written in Note)
- "Surveyed Section Table (Table-2)" is completed after all information are inputted.

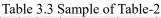
Survey Team shall submit the Table-2 to Work Manager. Work Manager shall check it and verify KP information and section length of additional excluding sections and additional survey sections.

- Select sections which has "Added excluding section" and "Additional survey sections" in Note in Table-2
- KP (From and To) information and section length of corresponding records shall be confirmed.

Survey Team shall update the Table-2 if needed according to the instruction of Work Manager. In the case of misstatement of KP or survey length, Survey Team shall correct the relevant part and resubmits it.

When a section different from the actual section is set as excluding section or additional survey section, Survey Consultant shall survey that section again and update the Table-2. Table-2 and survey length is fixed by Work Manager.

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- 1	0	0 NH1	RMB II				1 561	0	587	1			· · · · · · ·	26000		561	0	587	0			26000	
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		0 NH1	RMB 18				1 595	0	597	590	259	2		2590		595		597	590			2385	
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		0 NH1	RMB 12				657	25	_				-	6790		657		663	815			6643	
	0	0 NH1	RMB II				671	230	672	305				1075		671	230	672	305			1075	
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		0 NH1	RMB II			1	868	100					1	4500		868		872	600			4330	
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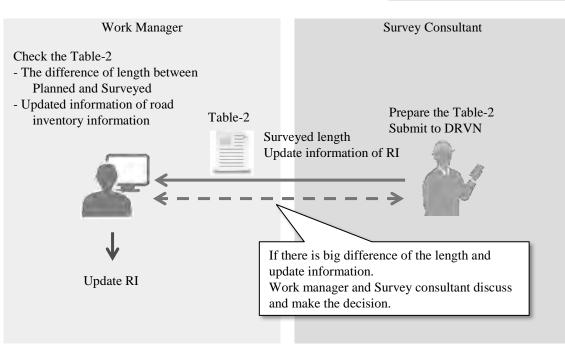
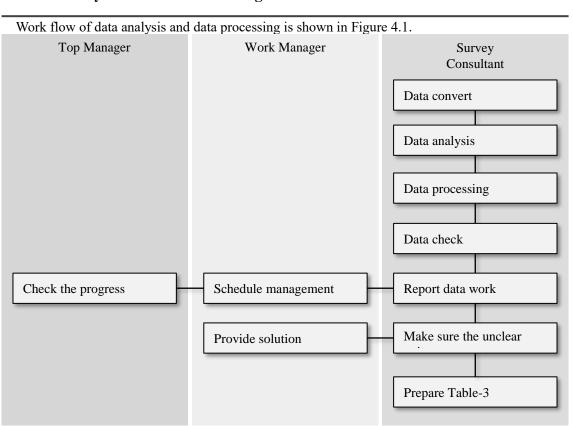


Figure 3.34 Work flow of preparing Table-2



4. Data Analysis and Data Processing

Figure 4.1 Work flow in data analysis and data processing

The measurement data will be stored into the external HDD. Survey team hands over the external HDD to Data Analysis team. Data Analysis team conducts the data analysis and data processing to prepare the PC data. Data Analysis team uses the application of data analysis and data processing on PC. The work items are as below,

- Data Conversion
- Data Analysis
 - The start and end position setting
 - Road width setting
 - Interpretation of crack
 - Road surface type classification
 - KP and structure setting
- Location setting
- Data processing
 - Data processing for 100m
 - Data coupling
 - Output the data
- Data check
- Weekly report
- <u>Confirmation of unclear point on analysis</u>
- <u>Prepare "Analyzed Section Table (Table-3)"</u>

Top manager provides licenses of Data Analysis application and Data Processing Applications to Data Analysis team. After completion of survey project, Data Analysis team shall delete the installed applications from PCs.

In case of analysis work for new routes, such as new constructed routes, Expressway or routes managed

by other road administration agencies, Analysis operators in Data Analysis team shall add new road code information and route name to the configuration file of Location Setting Application. For more detail procedure to update the configuration file, refer to the chapter 10 of manual of "Instruction Book of REAL Mini [PCS-Vol.4]".



Figure 4.2 Data Analysis and Data Processing work in Office

4.1. Analysis and Processing of Measurement Data

1) Analysis and Processing Work

Data Analysis team conducts the data analysis and data processing work in the office every day. Work flow of analysis and processing is shown in Figure 4.3. If you would like to know about detail operation procedure of each application, refer the chapter 8 to 11 in "Instruction Book of REAL Mini [PCS-Vol.4]".

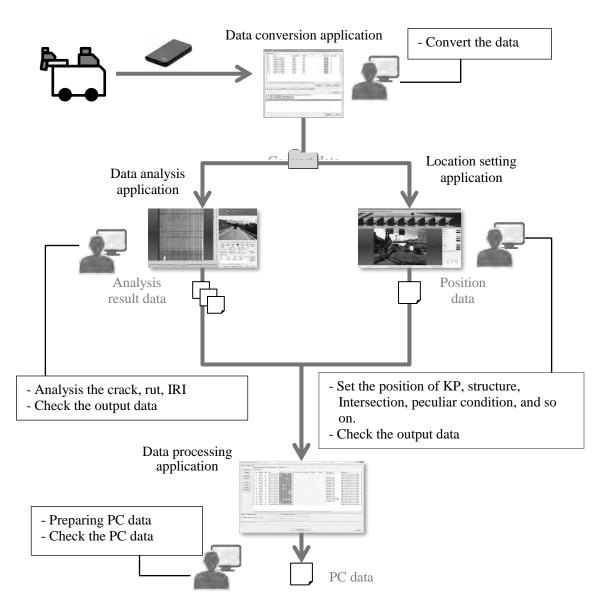


Figure 4.3 Walk flow of preparing PC data

a) Data conversion

Convert data measured with REAL Mini to a format readable by the Data Analysis application.

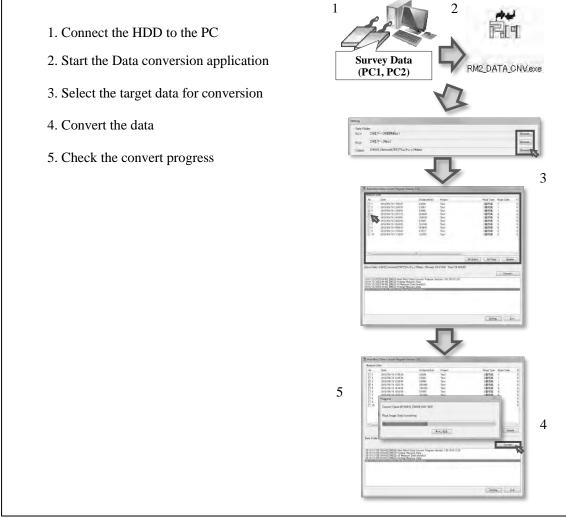


Figure 4.4 Procedure of data conversion

b) Data Analysis

Using the converted survey data, cracks, rut, IRI and coordinate data are prepared on the Data Analysis application.

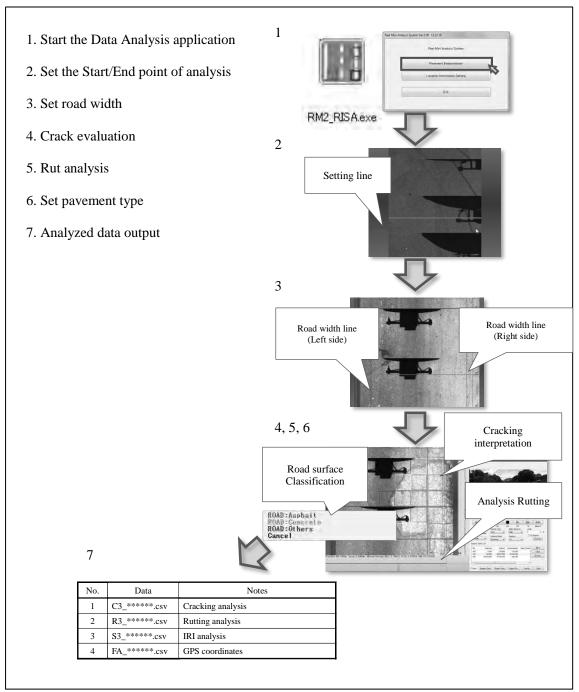


Figure 4.5 Procedure of data analysis

c) Prepare location data

Using the Position Setting application, location data of bridges, intersections and chainage of change of lane structure, etc. is prepared by checking the road image data of front view image data.

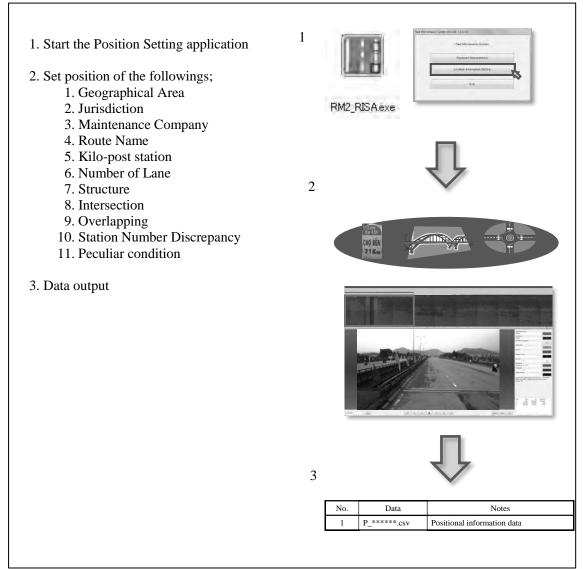


Figure 4.6 Procedure of location setting

d) Data Processing

Using the Data Processing application, PC data is prepared from output files of the Data Analysis application and the Position Setting application.

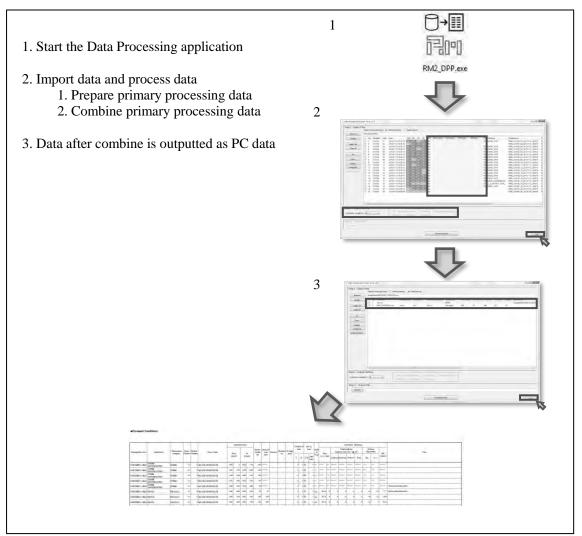


Figure 4.7 Procedure of data processing

2) Data Quality Check

During and after completion of the work of data analysis and data processing, Data Analysis team shall check the data quality for all the data in the following manner;

a) Quality of image

If there is an ambiguous image (too bright or too dark) when the analysis operator evaluates pavement damage based on the image data, the analysis operator reports to the team leader about this situation. When this situation goes over a long section (100m or more), the team leader consults with Work Manager about the necessity of resurvey.



Figure 4.8 Image samples (left: too bright, right: too dark)



Figure 4.9 Image sample (sunlight reflected)

b) Quality of damage evaluation result

During data analysis work, one or two persons are assigned as responsible for data check, and they check the analyzed data. If there are errors in evaluated data, data analysis operator shall be instructed to analyze data again.

Incomplete analysis

An example that Damage point is not correctly read

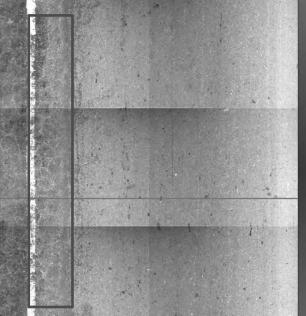


Figure 4.10 Sample of incomplete analysis-1

- An example of reading as a crack without damage

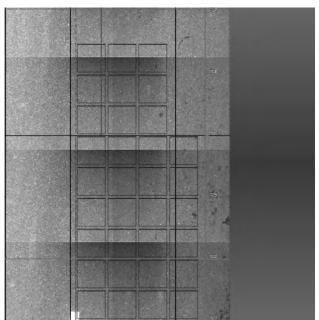


Figure 4.11 Sample of incomplete analysis-1

c) Abnormal value

The Data Analysis application has a function of judging a value exceeding a certain range at the timing of data output as an abnormal value and outputting a list of abnormal data records. The operator shall check whether the data judged to be an abnormal value is due to a mistake in analysis work as the following way;

- Open the file of abnormal value list (ERROR.txt) and find the location information
- · Check the road condition on the Data Analysis application
- In case of a mistake in analysis, it shall be analyzed again

Table 4.1 shows the criteria for judging abnormal values, and Table 4.2 shows possible reasons of analysis errors for each item.

When rutting or IRI value is 0, data convert shall be done again. If the data still cannot be corrected, Survey Consultant shall inform Work Manager about a possibility of equipment failure. Work Manager shall contact the manufacturer of PCSS and ask the detail investigation for it. As a result of the investigation, if the equipment is broken, the equipment shall be repaired. And Survey Consultant shall survey again that section where the abnormal value was happened.

Table 4.1 Criteria for judging abnormal values								
Items	Criteria							
Crack ratio	Over 70%							
Rutting depth (max)	0mm or over 50mm							
Rutting depth (average)	0mm or over 30mm							
IRI	0mm/m or over 15mm/m							

Table 4.2	Possible r	easons of	analysis	errors

Items	Criteria	Possible reasons								
Crack ratio	Over 70%	Incomplete analysis read								
Rutting depth (max)	Over 50mm	Incomplete width setting								
Rutting depth (average)	Over 30mm	Incomplete position of rut evaluation point								
Rutting depth (max) Rutting depth (average) IRI	0 mm 0 mm 0mm/m	Data conversion error Data fault due to equipment error								

d) Missing or inconsistent KP

Missing KP information and difference in both directions entered by the Position Setting Application are checked.

First, continuity of KP from the KP list file outputted from the Position Setting Application is checked. If there are missing KPs, KPs are checked again on the Position Setting Application. If KPs are found, the numbers of KPs are set.

Next, consistency of KP in both directions on the same route is checked. By comparing of the KP files in directions, KP numbers and number of KPs are checked. If there is KP only on single side, KP is set on the Position Setting Application by referring to the position information in the direction of KP.

e) Position of structure

Consistency of the structure in both directions on the same route is checked. Using the structure list file outputted by the Position Setting Application, the type and the number of structures in both directions on the same route are compared.

If there is a structure only in one direction, the analysis operator sets up the structure again for the data in the insufficient direction. Even if the total number of settings of structures is the same, different types of structure setting is not acceptable.

f) Position of intersection

Consistency of intersections in both directions on the same route is checked. Using the intersection list file outputted by the Position Setting Application, the number and positions of intersections in both directions on the same route are compared. If the number of intersection is short in one direction, the intersection to be added to the data on the missing direction is set.

g) Structure of PC data

Structure of PC data shall be checked as the following points;

- 1. Route code : from small number to large number
- 2. Direction : from Right to Left
- 3. Lane number : from small number to large number

3) Send the Progress Report

Data Analysis team conducts the data analysis and data processing work in the office every day. The leader of Data Analysis team records the progress every day for "Data Analysis Weekly Report" (Appendix 7). The Data Analysis team leader sends the "Weekly Report" with attachment to Work manager via email like a Figure 4.13.

Furthermore the sample of "Weekly Report" would be indicated in Figure 4.14. It is possible to check the analysis length of section length of the data. Work manager checks the progress to confirm the sum of analysis length and "Table-2". If the progress is delayed significantly, Work manager finds out the reason and instructs to push up the progress.

Work manager submits the progress of analysis work and processing work to Top manager. Top manager checks the progress based on the report from Work manager.

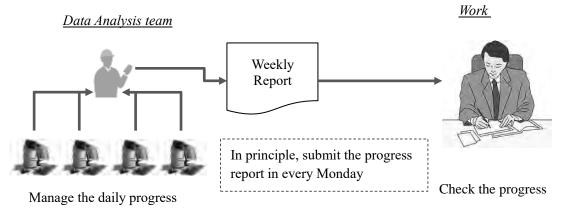


Figure 4.12 Flow of data analysis progress report

Dear XXXX,

I send weekly report. Please kindly refer the attachment for the detail.

Date: DD/MM/YYYY Reporter: Name Analysis length in week: Length Total analysis length: Length

BR, XXXX

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	-				_	_					
_	-	_									

Figure 4.13 Sample of email of data analysis report

Figure 4.14 Format of data analysis Weekly Report

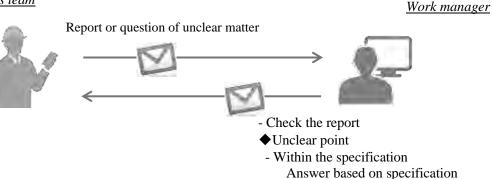
- A. Analysis Period (From To)
- B. Analysis Number (sequential number)
- C. Route Name
- D. Right Left
- E. Number of Lane
- F. Survey Section (Start position; KP number)
- G. Survey Section (End position; KP number)
- H. Survey Section (Length (km))

- I. File Number (Folder number of Measurement)
- J. Progress of Interpretation (X; Complete, Blank; Not complete)
- K. Progress of Data Check (X; Complete, Blank; Not complete)
- L. Progress of Data Processing (X; Complete, Blank; Not complete)
- M. Note (Memo, Message)
- 4) Make Sure the Unclear Point

Data Analysis team reports to Work manager about the unclear matter in the data analysis and data processing at every time. Work manager confirms the report or question and instructs to the matter.

Figure 4.15 In case of report or question of unclear matter

Data Analysis team



- Without the specification

Discuss with Analysis team

[Example of Report and Instruction]

<Case 1: Setting of pavement surface type>

How to set the pavement type where two pavement types exist in the same position? (Ex. AC and BST exist in the same position)

Set the wider pavement type at the place



Figure 4.16 Example of pavement type setting

<Case 2: Setting of road width>

How to set the road width where there is no center line as narrow section?

→ Set the all width of road image



Figure 4.17 Example of road width setting at narrow section

<Case 3: Setting of patching>

- Whether the repaired part is patching or not?
- → The part is patching at the interpretation (in the red square)

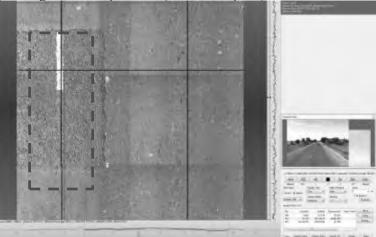


Figure 4.18 Example of patching setting

<Case 4: Visible only forward view image>

Visible the crack in the forward view image but invisible in the road image because the image is dark.

→ Set the crack compare between forward view image and road image



Figure 4.19 Example of visible the crack only forward view image

<Case 5: Setting of peculiar condition>

- Which peculiar condition is correct?
- → Work manager check the road image and decide the category of peculiar condition

Table 4.3	Definition	of peculiar	condition
10010 110	Derminon	or pee anar	Contantion

Items	Description	Image
1.Broken	Once paved sections, but there is serious damage which cannot be evaluated.	
2.Unpaved or unidentified Pav. Type	Unpaved: never paved. Unidentified Pavement type: besides, AC, CC and BST.	
3.Wet Condition	The lane is covered with water or wet.	
4.Other damage	Other type damages that cannot be judged as cracking. (Ex. Raveling, Scratch, etc.)	
5.Invisible	Surface cannot be seen due to coverage of pavement surface by other objects, such as sand, soil, construction material, etc.	
6.Under construction	Ongoing construction work on the survey lane.	

4.2. Prepare Analyzed Section Table (Table-3)

Data Analysis team shall prepare the Analyzed section table (Table-3) based on the final PC data after completion of data analysis and data processing work. The content of the Table-3 is shown as below.

- Road Inventory Information
- (Road Category, Road No., Road No. Supplement, Branch No., Road Name, RMBs, SBs, Direction and Lane Position)
- KP information
- Section Length information (Analyzed length)

Table 4.4 Sample of Table-3

							. 1						
	Road No.	Road No. Suppleme nt	Branch No.	Road Name	RMBs	SBs	Direction	Lane Position	From_K P	From_ M	То_КР	To_M	Analysis Length
1	1	0	0	NH1	RMB II	SB II.2	R	1	321	800	330	0	8535
1	1	0	0	NH1	RMB II	SB II.2	R	1	423	600	425	875	2095
1	1	0	0	NH1	RMB II	SB II.2	R	1	449	300	451	0	1665
1	1	0	0	NH1	RMB II	SB II.3	R	1	458	0	467	0	9590
1	1	0	0	NH1	RMB II	SB II.3	R	1	468	0	484	0	15710
1	1	0	0	NH1	RMB II	SB II.3	R	1	504	400	517	1075	13630
1	1	0	0	NH1	RMB II	SB II.3	R	1	561	0	587	0	26095
1	1	0	0	NH1	RMB II	SB II.3	R	1	591	600	595	5	3595
1	1	0	0	NH1	RMB II	SB II.4	R	1	595	5	597	590	2330
1	1	0	0	NH1	RMB II	SB II.4	R	1	625	125	625	880	755
1	1	0	0	NH1	RMB II	SB II.4	R	1	657	25	663	815	6645
1	1	0	0	NH1	RMB II	SB II.4	R	1	671	230	672	305	1075
1	1	0	0	NH1	RMB II	SB II.6	R	1	819	850	840	475	20290
1	1	0	0	NH1	RMB II	SB II.6	R	1	868	100	872	570	4330
1	1	0	0	NH1	RMB II	SB II.6	R	1	883	700	886	460	2510
1	1	0	0	NH1	RMB II	SB II.2	R	2	321	800	330	0	8535
1	1	0	0	NH1	RMB II	SB II.2	R	2	423	600	425	875	2095

Table 4.5 is showing the reference in PC data for Table-3.

Table 4.5 Reference in PC data

	Reference in P	C data	
Table-3	Column in Excel file	Column in CSV file	Note
Road Category	Е	5	
Road No.	F	6	
Road No. Supplement	G	7	
Branch No.	Н	8	
Road Name	Ι	9	
RMBs	С	3	
SBs	D	4	
Direction	U	21	
Lane Position	V	22	
From_KP	J	10	
From_M	K	11	
To_KP	L	12	
To_M	М	13	
Analysis Length	Ν	14	Total of targeted section

The procedure of preparation of Table-3 is as the following steps;

- i. Open the PC data
- ii. Enter road inventory information of the first line of PC data
- iii. Enter "From_KP" and "From_To" of the first line of PC data
- iv. Find data break position in PC data
 - Discontinuous point of KP
 - Chang point of jurisdiction (SBs)

- v. Enter "To KP" and "To M" of the break position of PC data
- vi. Enter the summed value of section length from the first line of PC data to the line of break position into "Analysis Length" in Table-3.

The line next to the break position is set as the first line, and from ii to vi is repeated to complete Table-3.

∠	U	UNATIONAL	01	300	01	400	100	JUU.I		
2	0	0 NATIONAL	51	400	51	500	100	378.9		
2	0	0 NATIONAL	51	500	51	600	100	353.5		
2	0	0 NATIONAL	51	600	51	700	100	368.7		
Break	0	0 NATIONAL	51	700	51	800	100	363.8		
	0	0 NATIONAL	51	800	51	820	20	76		_
	0	0 NATIONAL	53	330	53	400	70	235.6		
2	- 0	0 NATIONAL	53	400						
2	0	0 NATIONAL	53	500	Posi	tion of	f diffe	rent	number	between
2	0	0 NATIONAL 0 NATIONAL	53 53	500 600					number	between
2 2 2	0 0 0					tion of to nex			number	between
2 2 2 2	0 0 0	0 NATIONAL	53	600					number	between
2 2 2 2 2 2	0 0 0 0	0 NATIONAL 0 NATIONAL	53 53	600 700					number	between
2 2 2 2 2 2 2 2	0 0 0 0 0	0 NATIONAL 0 NATIONAL 0 NATIONAL	53 53 53	600 700 800	"To"		t "Fron	n "	number	between
2	0 0 0 0 0 0 0	0 NATIONAL 0 NATIONAL 0 NATIONAL 0 NATIONAL	53 53 53 53	600 700 800	"To"	' to nex	t "Fron	n "		between

Figure 4.20 Sample of break point in PC data KP (Discontinuous KP)

After enter all data into all columns, the Table-3 is saved as "Table-3", and Data Analysis team sends Table-3 to Work Manager. Work Manager checks the difference between "Surveyed section length" and "Analyzed section length" in Table 3. Work manager asks Data Analysis team when there is an uncertain point in Table 3.

Length in Table-3 is fixed as the final number in PCS.

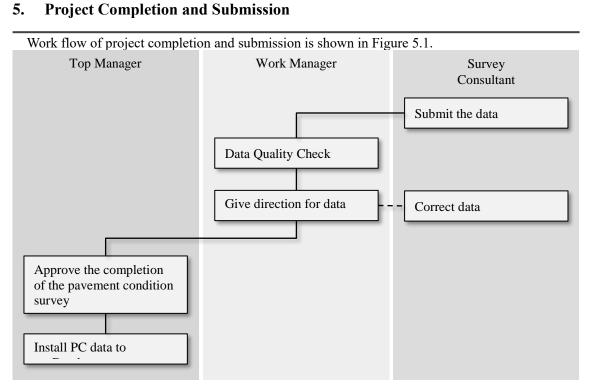


Figure 5.1 Work flow of project completion and submission

Data Analysis team submits the PC data to Work manager after complete the data analysis and data processing. Work manager checks the quality of the data. If the quality of the data has no problem, Work manager can accept the data. If the quality of the data has some problems, Data Analysis team updates the problem points.

The submission data is the following file. Table 5.1 shows the folder structure.

Pavement Condition File (formatted as .csv) Image data with coordination File (formatted as .csv) Forward view image (formatted as JPG)

	Folder Structure		File
Root ⊢ PCfile ⊢ ImageFile ∟ 2017		⊢ Left_lane2 - Left_lane1 - Left_lane2	PCfile_RMB I_2017.csv ImageFile_RMB I_2017.csv 00000001.jpg 00000002.jpg : 00000001.jpg 00000002.jpg :

Table 5.1 Data structure

Appendix 1: Format of implementation Plan

IMPLEMENTATION PLAN ON PAVEMENT CONDITION SURVEY

May 2017

Survey Consultant Name

I. Calibration and Survey Plan

1. Calibration Plan:

<u>Survey Consultant</u> plans to calibrate the equipment of REAL-Mini in Hanoi together with DRVN before surveying.

Implementation duration: From **<u>DD/MM/YYYY</u>** to **<u>DD/MM/YYYY</u>**

2. Survey Plan:

The pavement condition survey will be done based on the TOR of pavement condition survey. <u>Survey Consultant</u> plan the below contents before conduct the survey,

- Responsibility assignment on pavement condition survey (filed survey, data analysis and data preparation)
- External HDD to store the measurement data and analysis data.
- Route confirmation such as the start point, end point, eliminated start point, eliminated end point, overlap start point and overlap end point.
- Operation check of survey vehicle, data analysis program and data processing program.

Implementation duration: on **DD/MM/YYYY**

II. Survey Implementation Plan

1. Target Routes (RMB X):

National Highway	From	То	Number of Lanes	Total Length (km)
NH. <u>X</u>	KM xxx + xxx	<u>KM yyy + yyy</u>	<u>X</u>	LLL.LL
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	<u>LLL.LL</u>
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	<u>LLL.LL</u>
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	<u>LLL.LL</u>
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	LLL.LL
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	LLL.LL
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	LLL.LL
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	LLL.LL
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	LLL.LL
NH. <u>X</u>	KM xxx + xxx	KM yyy + yyy	<u>X</u>	<u>LLL.LL</u>
Total				LLLL.LL

2. Implementation Duration:

The field survey implementation in RMB \underline{X} will be done as below schedule:

+ From <u>DD/MM/YYYY</u> to <u>DD/MM/YYYY</u>

3. Report of field survey

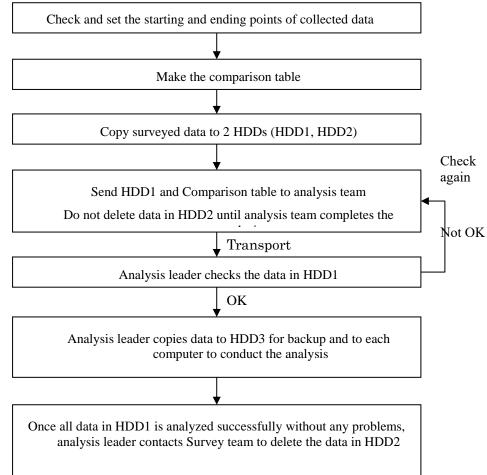
+ **Daily report**: Survey team leader reports implementation quantity/progress to DRVN at the end of day on the daily basis via email.

Report format:

	_	_									0 0	0 0				Sipey him date 10	TITLAKS	Tage kai mus		
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III. Data management and delivery:

- Survey team shall make a copy and send the surveyed data to Data Analysis team at home to conduct the analysis work (about every 500km)
- HDDs storing surveyed data should be sent to Data Analysis team via transportation company
- Data HDD transfer flow:



IV. Data Analysis Plan

1. Implementation method

- Data Analysis team has 8 members, including 6 data analysts and 2 data quality manager;
- After convert the surveyed data, analysis leader copies converted data to the other members to conduct the analysis. Once data is analyzed, the analyzed data is sent to data quality manager to check.
- After completing the analysis, the analysis leader informs Survey team to delete the data stored in HDDs on site.
- 2. Data analysis progress for RMB X
 - Data analysis duration: from <u>DD/MM/YYYY</u> to <u>DD/MM/YYYY</u>
- 3. Report schedule for data analysis
 - + Weekly report: Data Analysis team leader reports Total implementation quantity/progress during the week and implementation plan for the next week to DRVN on the weekly basis via email.

Α	B	C	D	E	F	G	Н	1	J	К	L
	. .										
Neek	y Report										
rom	DD/MM/Y	YYY	То	DD/MI	M/YYYY						
			Lane	Sui	vey sect	ions		Activi	ties perf	ormed	
No	Route name	Right /Left	Num ber	From	То	Length (Km)	File name	Analysis	Data Check	Data Process ing	Note
1										ing	
2								-+			+
3											
4											
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22			<u> </u>			+		-+			<u> </u>

Weekly report format:

V. Data Processing Plan and Report

- After completion of all analysis work, an analist conducts the data processing and reports the results of Pavement condition data in RMBX to DRVN.
- Duration: from **<u>DD/MM/YYYY</u>** to **<u>DD/MM/YYYY</u>**.

VI. Report Order in Emergency Cases

As unexpected events happen during the survey (broken vehicle, traffic accident ...) or

during the data analysis and processing, implementing members shall contact directly to management agency (RMB, SB). If the management agency is not able to solve the problem, it should contact DRVN to find out the solutions.

VII. Members (tentative):

<u>Team Leader Name</u> -- Phone: <u>xxxx.xxx</u> Email: <u>xxxxxxxxx@gmail.com</u>

1. Survey team:

No.	Name	Title	Email	Phone
1	**** *** ****	Leader	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
2	**** *** ****	Operator	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
3	**** *** ****	Operator	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
4	**** *** ****	Driver	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>

2. Data Analysis team:

No.	Name	Title	Email	Phone
1	**** *** ****	Leader	<u>*******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
2	**** *** ****	Analyst	<u>*******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
3	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
4	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
5	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
6	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
7	**** *** ****	Analyst	<u>*******@gmail.com</u>	<u>xxxx.xxx.xxx</u>
8	**** *** ****	Analyst	<u>******@gmail.com</u>	<u>xxxx.xxx.xxx</u>

VIII. Implementation Schedule

The implementation schedule of pavement condition survey followed below the schedule table.

Work Item	1 st	2^{nd}	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th	11 th
Survey Plan and Preparation											
Field Survey											
Data Analysis											
Data Preparation											
Data Check											
Submission Data and report											

Pavement Condition Survey

Road Category	Road No.	Road No. Supplement	Branch No.	Road Name	RMBs	SBs	Direction	Lane Position	From_KP	From_M	To_KP	To_M	Length	Excluded Length	Overlapping Length	Planned Survey Length	Note
	1				1												
-																	

Appendix 2: Format of Survey Plan Section

Pavement Condition Survey

Project Name

Report on Calibration of the Survey Vehicle

MMM YYYY

Survey Consultant Name

1. Objective

Pavement Condition Survey will be done in RMBX. In order to secure the measurement accuracy, calibration and checking of equipment is implemented once in each RMB before the starting survey.

2. Contents of Calibration and Check

- Inspection vehicle check (power, system, equipment)
- Distance calibration
- Camera check
- Laser displacement sensor check
- Laser scanner check
- Camera calibration
- Long test

3. Place

- 1) Filed 1 (Place name)
 - Inspection vehicle check (power, system, equipment)
 - Distance calibration
 - Camera check
 - Laser displacement sensor check
 - Laser scanner check
 - Camera calibration

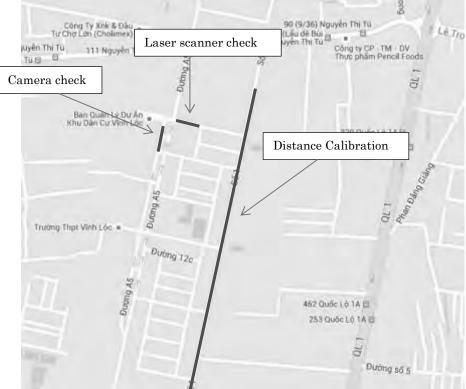


Figure 1: place of Filed 1 (Place name)

2) Field 2 (Place name)





place of Filed 2 (Place name)

3. Schedule

	Table 1: T	imetable of o	calibration a	nd checking
Date	Place/ Route	Km-Post	Member	Activity
MM/DD (Mon)				Inspection vehicle check (power, system, equipment) Distance calibration
MM/DD (Thu)				Camera check Laser displacement sensor check Laser scanner check
MM/DD (Wed)				Laser scanner check Camera calibration
MM/DD				Camera calibration

Long test

4. Result

1) Condition of system

(Thur)

- Vehicle
 - Tire inflation pressure: OK •

Table 2: Result of inflation pressure

	14010 211000010 01		
Tire position	Before	After	Condition
Front Right	kg/cm ²	kg/cm ²	OK
Front Left	kg/cm ²	kg/cm ²	OK
Rear Right	kg/cm ²	kg/cm ²	OK
Rear Left	kg/cm ²	kg/cm ²	OK

- Direction indicators: OK
- Light: OK
- Engine oil: OK
- Fan belt: OK

- System

- Scratch and condition of system: OK
- Wiring of Equipment: OK

- Voltage of battery: OK 12.5V
- Screw: OK
- 2) Accuracy of equipment
 - the focus of Lens (FV, RC): OK
 - The device is capable of properly recognizing cracking as small as 2mm in depth on the test chart.

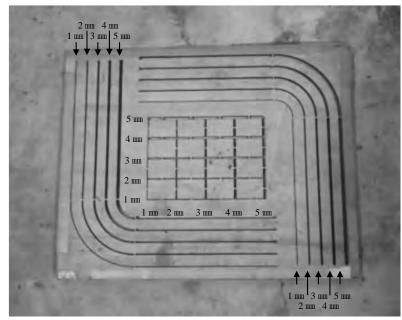


Figure 3: Test chart

- FV





Figure 4: Result of Forward view camera image

- RC (Sunshine)

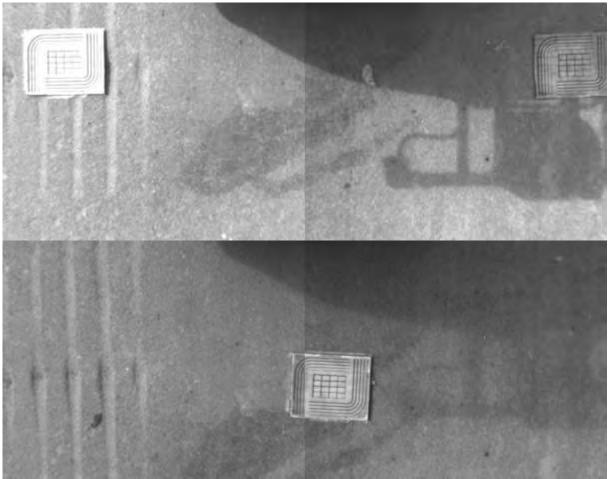
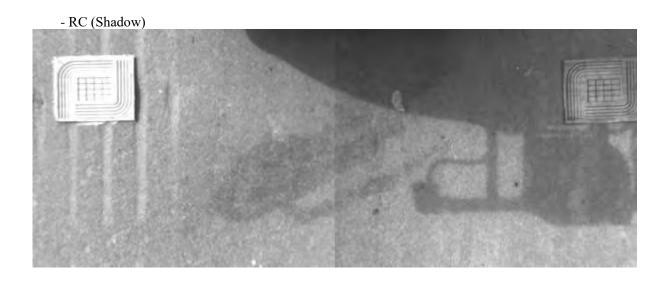


Figure 5: Result of Road camera image (sunshine)



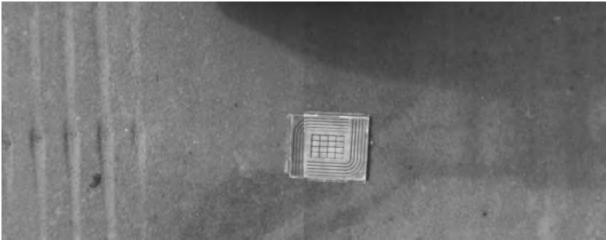


Figure 6: Result of Road camera image (shadow)

• Angle of view (CR): OK

Calibration boards are installed at 3.8 meters apart. The device captures images covering a span of 3.8 meters or more.



Figure 7: Result of angle of view (Road camera)

• Installation dimension of calibration boards

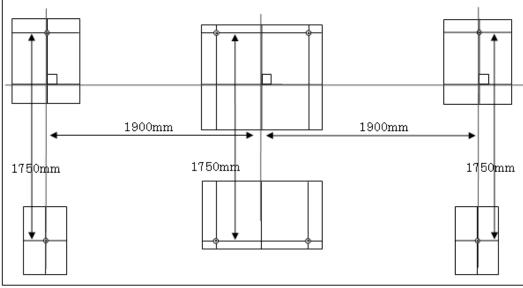


Figure 8: Installation dimension of calibration boards for road camera

• The accuracy of laser displacement sensor: OK

Heights from ten measurements were collected by inserting a wood block at each measurement. The thickness of the wood block was calculated from the differences between collected heights, and the measurement accuracy was verified by comparing the results against the actual thickness of the wood block. Results showed that the average deviation was *.**mm.

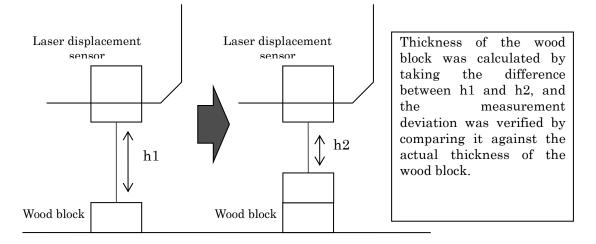


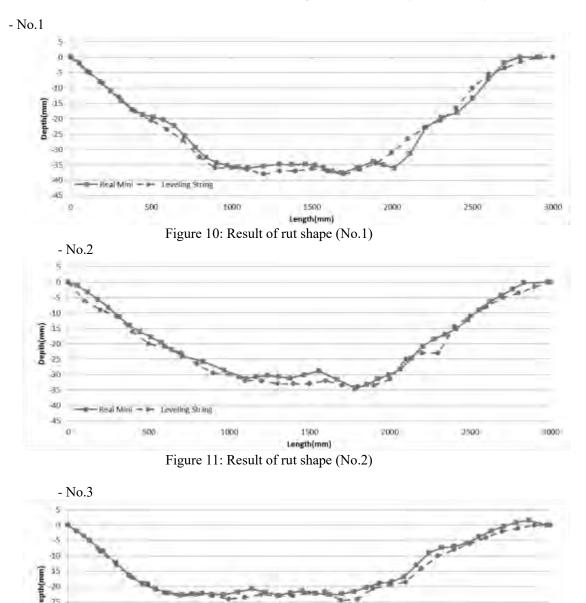
Figure 9: method of checking the accuracy of laser displacement sensor

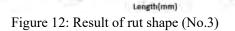
		Laser di	splacement r	neter (mm)		Actual measurement (mm)		ation nm)
	1st	2nd	3rd	Median	Thickness of block	Thickness of block	Integer	Absolute
0					_	—	—	—
1								
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Table 3: Result of laser displacement sense	or
---	----

The shape of laser scanner data: OK

Comparisons between profiles collected through the dipstick and those collected through the automated measurement device showed that same profiles were being detected in general.





1000

1500

2000

2500

UNK

-5 -10 35 Depth/mm) 20 15 90 -35 40

43

0

Real Mini - - Leveling String

500

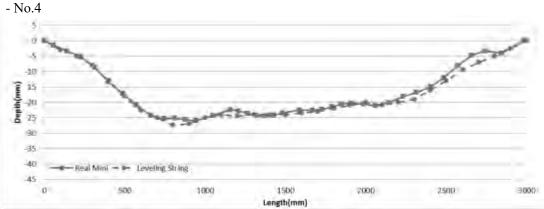


Figure 13: Result of rut shape (No.4)

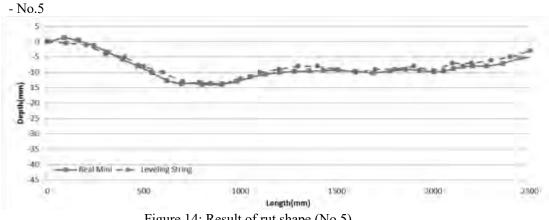


Figure 14: Result of rut shape (No.5)

Comparison of rut depth: OK

As the difference stands at 1.5 mm at the maximum and at 0.8 mm at an average, it was verified that the device is within the deviation range of -6mm to +6mm, which satisfies the requirement.

No.	Leveling String	REAL Mini	Deference
1			
2			
3			
4			
5			
		MAX	
		MIN	
		AVERAGE	

Table 4: Result of Rut depth

Distance: OK

A distance of 1000 meters was traveled four times, and the average vehicle pulse signal from the four runs was 2540.

Measurement count	Measured value	Average value
Previous Value	_	
1		

Table 5. Pecult of vabials pulse

2	
3	
4	

A coefficient was configured based on this value, and as a result of measuring a distance of 1000 meters, the deviation rate was -0.01%. The device showed an accuracy that is within the range of -0.5% to +0.5% of the actual length, and thus it was verified that the instrument meets the required specifications.

Section length (m)	Measured value (m)	Deviation (m)	Deviation rate (%)	Test result (Deviation rate <±0.5%)
1000			%	Pass

• Test survey: OK

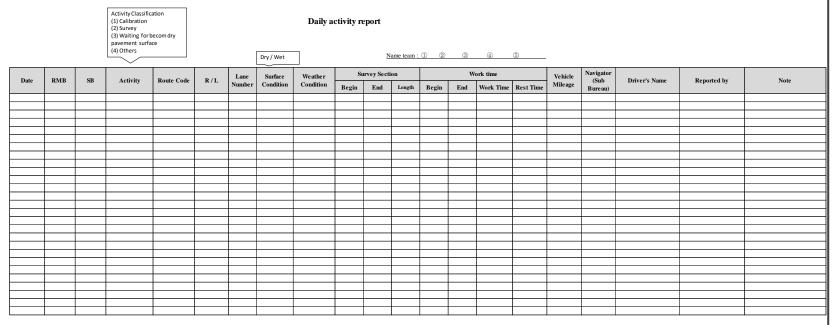
Table 7: Result of test survey

Number of Times	Measurement Length (km)	Condition
1 st		No Error

The Project for Capacity Enhancement in Road Maintenance in Vietnam Phase II	1
roject for Capacity Enhancement in Road Maintenance in Vietnam Phase	The
roject for Capacity Enhancement in Road Maintenance in Vietnam Phase	Ιŝ
acity Enhancement in Road Maintenance in Vietnam Phase	rc
acity Enhancement in Road Maintenance in Vietnam Phase	уjе
acity Enhancement in Road Maintenance in Vietnam Phase	ct
acity Enhancement in Road Maintenance in Vietnam Phase	fo
acity Enhancement in Road Maintenance in Vietnam Phase	r
acity Enhancement in Road Maintenance in Vietnam Phase	Ca
city Enhancement in Road Maintenance in Vietnam Phase.	pq
cement in Road Maintenance in Vietnam Phase .	2
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m Phase II	1a)
Phase II	m
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	6

a 1.			Road	D IN	Road	Branch		Survey	Section		I COL	Ţ	
Survey date	Folder	Road Name	Category	Road No.	No. Supplement	Code	Fr	om	1	ò	Left/Right	Lane	Note
					Supplement		Km	m	Km	m			

Appendix 4: Format of Surveyed Route Table



Pavement Condition Survey

Appendix 5: Format of Measurement Report

The Project for Capacity Enhancement in Road Maintenance in Vietnam Phase II

Appendix 6: Format of Surveyed Section Table

Road Category	Road No.	Road No. Supplement		RMBs	SBs	Direction	Lane Position	From_KP	From_M	To_KP	To_M	Length	Excluded Length	Overlapping Length	Planned Survey Length	Note	From_M	To_KP	To_M	Length	Excluded Length	Overlapping Length	Survey Length	Note
																				-				
																				-				
				+																+				
																				<u> </u>				
				1																1				
				1																				

Appendix 7: Format of Data Analysis Report

Weekly Report

From DD/MM/YYYY To DD/MM/YYYY

			1	Sur	vey secti	ons		Activi	ties perfe	ormed	
No	Route name	Right /Left	Lane Num ber	From	То	Length (Km)	File name			Data Process ing	Note
1											
2											
3											
4											
5											
6				*****	*****			*****	*****	*****	
6 7				*****	*****		***************************************	******	*****	*****	***************************************
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											***************************************
18											
19											
20											
21											
22											
23			******		*****	*****				****	
24		*****			*****	*****	*****	*****	*****	****	
25				*****	*****	*****			*****		
26	+										
20	+										
28	+										
29											
30											
31											
51											

Road Category	Road No.	Road No. Supplement	Branch No.	Road Name	RMBs	SBs	Direction	Lane Position	From_KP	From_M	To_KP	To_M	Analysis Length	Note

Appendix 8: Format of Analyzed Section Table



JAPAN INTERNATIONAL COOPERATION AGENCY

DIRECTORATE FOR ROADS OF VIETNAM

MINISTRY OF TRANSPORT (MOT)



THE SOCIALIST REPUBLIC OF VIETNAM

THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE PHASE II

PAVEMENT CONDITION SURVEY MANUAL

Volume 2.1.4: Instruction Book of REAL Mini

MARCH 2018

JICA PROJECT TEAM

Record of updates

Rev.	Date	Contents change
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1. About This Instruction Book

Instruction Book of REAL Mini (PCS-Vol.4) is one of six manuals comprising the suite of the documentation for pavement condition survey. Figure 1.1 shows the component of pavement condition survey manual is divided into three parts, Overview, Operation manual and Technical manual. Documents to be referenced depend on the responsibility and work steps of stakeholders involved in pavement condition survey. Overview describes the basic items of survey that all stakeholders should refer to. Operation manual shows important matters to be referred to mainly when survey work managing. Technical manual indicates technical matters such as system and device operation methods, data definition and data preparation. Figure 1.2 shows the description of contents of each document.

This instruction book explains the REAL Mini system on pavement condition survey. It contains the operation procedure of inspection vehicle and analysis system, calibration and maintenance of the inspection vehicle and so on. It is to be used by surveyor and analysis operator whose task is to carry out the deep study for operation procedure of REAL Mini system.

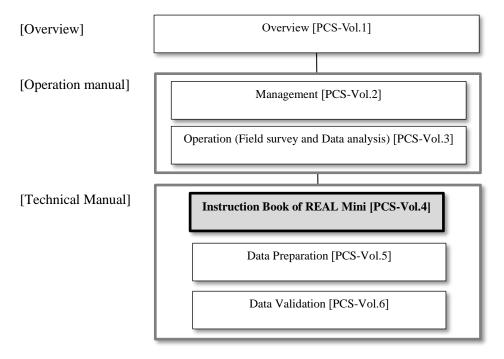


Figure 1.1 Pavement condition survey manual

[Overview]

Overview (PCS-Vol.1]

→ Describe the overview and measuring methods of pavement condition survey. It is a general purpose document which provides in an understanding of pavement condition survey.

[Operation manual]

Management [PCS-Vol.2]

➔ Describe the management work of road administrator on pavement condition survey. It contains all management works such as the planning, supervising, and data checking on pavement condition survey describing. It is to be used by administrator who to carry out the management of pavement condition survey.

Operation (Field survey and Data analysis) [PCS-Vol.3]

→ Describe the survey and analysis work of survey consultant on pavement condition survey. It contains the survey and analysis rule. It is to be used by surveyor and analysis operator who to carry out the pavement condition survey.

[Technical manual]

Instruction Book of REAL Mini [PCS-Vol.4]

→ Describe the operation procedure of REAL Mini system. It contains the operation procedure of inspection vehicle and analysis system, calibration and maintenance of the inspection vehicle and so on. It is to be used by surveyor and analysis operator whose task is to carry out the deep study for operation procedure of REAL Mini system.

Data Preparation [PCS-Vol.5]

→ Describe the contents of pavement condition data (PC data). It contains the code definition, explanation of each item of PC data and so on.

Data Validation [PCS-Vol.6]

→ Describe the data check procedure when creating the PC data. It is to be used by person whose task is to carry out the data check in pavement condition survey.

Figure 1.2 Contents of Pavement condition survey manual

1.1 Composition of this Manual

This Manual consists of the chapters listed in Table 1.1.

Table 1.1 Composition of this Manual		
Chapter	Title	Description
1	About This Instruction Book	Purpose and composition of this Manual
2	Introduction	Purpose, workflow, definition of equipment to be used, terminology, management of pavement condition survey
3	Output data of the system	Output file and Definitions of items on data
4	General rulu in survey	Impassable case, safety control, and storage and management of data
5	Instruction Manual of Trip meter	Operation guide for trip meter
6	Instruction Manual of Operation of REAL Mini	Operation guide for REAL Mini
7	Instruction Manual of Starting and Ending Point Setting Application	Guide for application to set the starting and ending points
8	Instruction Manual of Data Conversion Application	Guide for data conversion application
9	Instruction Manual of Data Analysis Application	Guide for data analysis application
10	Instruction Manual of Location Setting Application	Guide for location setting application
11	Instruction Manual of Data Processing Application	Guide for data processing application
12	Instruction Manual of Assembly	Guide for assembly of REAL Mini
13	Instruction Manual of Calibration	Guide for calibration of REAL Mini
14	Instruction Manual of Maintenance	Guide for maintenance of REAL Mini
15	Troubleshooting	Troubleshooting for devices, field work and applications
16	Wiring diagram	Wiring diagram of REAL Mini
Appendix 1	Configuration diagram	Configuration diagram of REAL Mini

Table 1.1 Composition of this Manual
--

1.2 Relationship between Work flow and each Chapter

Figure 1.3 shows the relationship between work flow and each chapter in this Instruction Book. Please read each manual carefully before work.

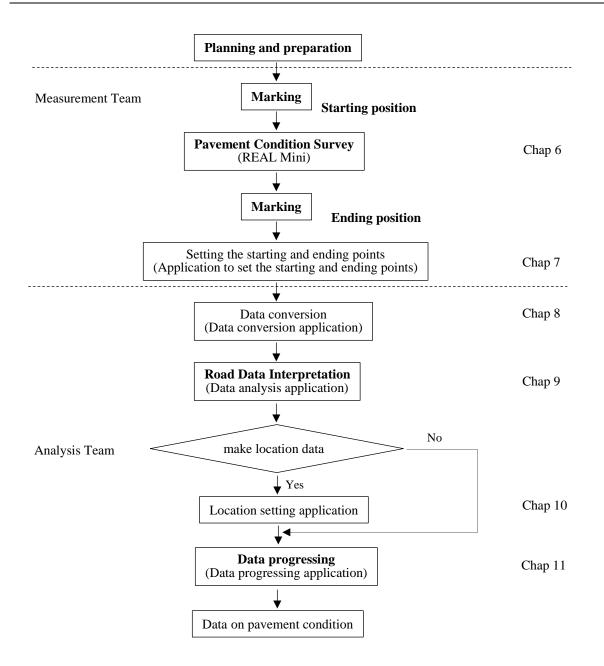


Figure 1.3 Detailed Implementation Flow

1.3 Management of this Manual

This Manual shall be updated whenever the operation has been revised. All the parties concerned shall be notified of any update.

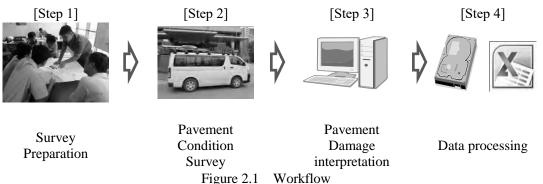
2. Introduction

2.1 Purpose

This System is intended, using a measuring vehicle, to acquire data on pavement condition, interpretation and process the data, and create data files on pavement condition.

2.2 Workflow

As illustrated in Figure 2.1, a pavement condition survey consists of four stages: field reconnaissance, rpavement condition survey, Pavement damage interpretation and road data processing.



(1) Survey Preparation

Survey preparation will confirm the location of the starting and ending points of the survey route, make a "Survey Plan", prepare the HDD to store the measurement data and prepare the human resource. The computer of data analysis and data processing should move for one room from RTC-C to conduct place, if needed.

(2) Pavement Condition Survey

Images of the road surface, cross-section profile, longitudinal profile, forward image of the road and positional coordinates will be recorded with a survey vehicle.

(3) Pavement Damage Interpretation

Images of the road surface will be taken in a pavement condition survey and used to check the road surface condition and find out any damage.

(4) Data processing

Data files on pavement condition will be created by combining the data obtained in the field survey and interpretation of the pavement condition. The files will be created in text and excel formats.

*Figure 2.1 lists equipment (including applications) to be used in each step.

Table 2.1 List of Equipment Used in Stages						
Work type	Equipment	Description	Used by			
	REAL Mini	Vehicle and measuring device to measure road condition				
	HDD	HDD for data surveyed (for PCs 1 and 2)				
Pavement Condition	Field notes	The Field notes with data recorded in field survey	Measurement Team			
Survey	Application to set the starting and ending points	Application setting the starting and ending points for data surveyed				
	Digital camera	To take evidence photographs				
	PC	Computer for data analysis				
	HDD					
Pavement Damage	Data conversion application	Application converting data surveyed to data for analysis				
Interpretation	Data analysis application	Application setting the scope of analysis (road width) and checking on cracks	Analysis Team			
	Location setting application	Application setting locations (kilo-post stations and bridges) to mark out data				
	PC	Computer for data processing				
Data processing	Data processing application	Application compiling and editing data outputted from data analysis application				

 Table 2.1
 List of Equipment Used in Stages

	Condition Survey	Pavement Damage Interpretation) Pavement Damage Interpretation		
Equipment	Image	Equipment	Image	
REAL Mini		PC		
HDD	2 HDDs for 1 survey	HDD		
	2 HDDs for T survey		For converted data	
Field notes		Data conversion application		
Application to set the starting and ending points		Data analysis application		
Digital camera		Location setting application		

Table 2.2Images of Equipment(for Pavement Condition Survey and Pavement Damage interpretation)

Table 2.3	Images of Equi	pment (for Data]	Processing)

Equipment	Image	Equipment	Image
PC		Data processing application	

2.3 Work Formation

Table 2.4 shows the work formation of the survey stages.

Survey Stage	Tasks/Persons in charge	No. of personnel	Remarks
	Driver	1	
Pavement Condition Survey	Operator	3	1 each for PCs 1 and 2 1 for Trip meter and set the KP point
Data analysis	Operator	8	Up to 8 operators
Data processing	Operator	2	

Table 2.4 Work Formation

2.4 Definition of terms

Table 2.5 lists the terms used in this Manual.

Table 2.5Definition of Terms

Terminology	Definition
Road Code	Road Code is 10 digit codes. Road code consists of road category, road number, road number supplement and branch number. Each road code have road name.
Geographical Area	A geographic unit that is used to identify management unit.
Road Categoly	A information used to identify the road category; whether the road national highway, expressway, provincial road, or others road.
Road Number	A number that identifies a road in a country. Generally, two to the digits are used.
RoadNumber Supliment	A alphabetical part or combination of alphabet and number given to the road name.
Branch Number	A branch road number is used to differentiate a road number in detail.
Left bound	The direction that the number displayed on the kilo-post station becomes smaller.
Right bound	The direction that the number displayed on the kilo-post station becomes larger.
Single bound	The section where only one vehicle pass
Lane classification	Differentiation of lanes with marking on road surface to indicate where traffic flow follows.
Lane Number	The targeted lane number for the survey
Station Number	It shows the kilo-post station number and distance from the nearest kilo-post station and the one on the side of the starting point.
Kilo-post station	A road sign on the side of the road to indicate distances from major cities.
Kilo-post station number	The number indicated on the kilo-post stations in the side of the road.
Management Area / Administrative Jurisdiction	Administrative division to manage roads or a section of a road.
Management Company	An entity that conduct road maintenance work including road facilities.
Overlapped Road	A road where two roads use the same section of a road, or a road where inbound and outbound traffic uses the same segment of road within a same road.
Carriageway marking	A lane marking on the road surface
Bridge	A fly-over structure to pass an obstacle or hazard.
Tunnel	Underground structure placed to a planned location with a minimum finished section area of 2 m^2 .
Rock shed	A tunnel like structure to protect a road from avalanche, rock fall or mudslide.
Intersection	Different roads intersecting at grade
Round-about	A circular intersection where traffic flows in one direction around a central island.
Viaduct	Sections of a road where two roads meet at different levels. It is a name of intersection structure that over passes the targeted survey road. When the targeted road crosses at grade or over the other road, the intersecting structure is not included to the viaduct structure.
Railroad Crossing	The section where railroad and road crosses at the same level.
Toll Gate	A facility that collects toll on the roads

Road Structure	Bridge, tunnel, rock shed
Pothole	A pothole is a type of disruption in the surface of a roadway where a portion of the road material has broken away, leaving a hole.
Crack	A break or fissure on a road.
Rut	A rut is a depression or groove worn into a road or path by the travel of wheels.
Profile	Displacement data of the vertical section or direction

3. Output data of the system

3.1 Final Outputs

Figure 3.1 to 3.3 illustrates the final outputs of the System. Please refert to "Data Preparation manual on pavement condition survey" for detail contants. The output file consists of the below figure and table.

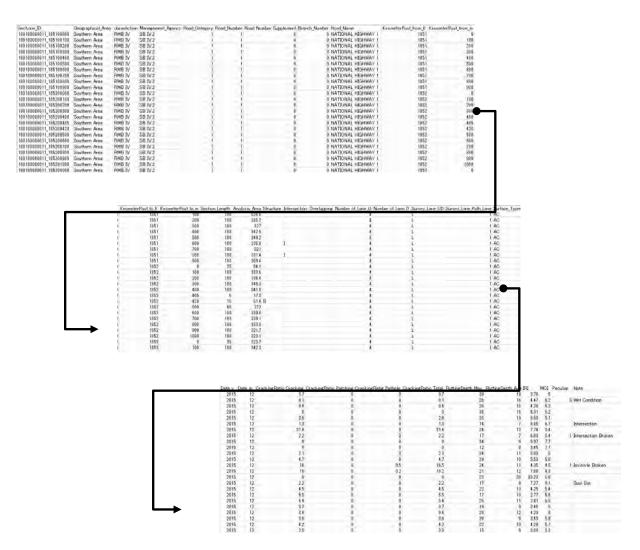


Figure 3.1 Pavement condition data file

1 009000001 21 000000000	1	1	9	0	1 R	1	16.8423	107.0839	6.163 2016¥NH9BvpessNorth¥Right 1¥00000001.jpg
1 009000001 21 000000000	2	1	9	0	1 R	1		107.0838	5.86 2016¥NH9BvpassNorth¥Right 1¥00000002.jpg
1 009000001 21 000000000	3	1	9	0	1 R		16.84226		5.927 2016¥NH9BypassNorth¥Right 1¥00000003.jpg
1 009000001 21 000000000	4	1	9	0	1 R	1	1684224	107.0837	6.1 29 201 6¥NH9 BypassNorth¥Right_1 ¥00000004.jpg
1 009000001 21 000000000	5	1	9	0	1 R	1	16.84222	107.0837	6.296 2016¥NH9BvpassNorth¥Right 1¥00000005.jpg
1 009000001 21 000000000	6	1	9	0	1 R	1	16.8422	107.0837	6.33 2016¥NH9BypassNorth¥Right 1¥00000006.jpg
1 009000001 21 000000000	7	1	9	0	1 R	1	16.84219	107.0836	6.304 2016¥NH9BvpassNorth¥Right 1 ¥00000007.jpg
1 009000001 21 000000000	8	1	9	0	1 R	1	16.84217	107.0836	6.266 201 6¥NH9 BypassNorth¥Right 1 ¥00000008.jpg
1 009000001 21 000000000	9	1	9	0	1 R	1	16.84215	107.0835	6.207 2016¥NH9BypassNorth¥Right 1¥00000009.jpg
1 009000001 21 000000000	10	1	9	0	1 R	1	16.84214	107.0835	6.162 2016¥NH9BypassNorth¥Right 1¥00000010.jpg
1 009000001 21 000000000	11	1	9	0	1 R	1	16.84212	107.0834	6.095 2016¥NH9BypassNorth¥Right_1¥00000011.jpg
1 009000001 21 000000000	12	1	9	0	1 R	1	16.8421	107.0834	6.01 2016¥NH9BypassNorth¥Right 1¥00000012.jpg
1 009000001 21 000000000	13	1	9	0	1 R	1	16.84209	107.0834	5.945 2016¥NH9BypassNorth¥Right_1¥00000013.jpg
1 009000001 21 000000000	14	1	9	0	1 R	1	16.84207	107.0833	5.896 2016¥NH9BypassNorth¥Right_1¥00000014.jpg
1 009000001 21_000000000	15	1	9	0	1 R	1	16.84205	107.0833	5.862 201 6¥NH9 BypassNorth¥Right_1 ¥0000001 5.jpg
1 009000001 21_000000000	16	1	9	0	1 R	1	16.84204	107.0832	5.873 2016¥NH9BypassNorth¥Right_1¥00000016.jpg
1 009000001 21 _000000000	17	1	9	0	1 R	1	16.84202	107.0832	5.864 201 6¥NH9BypassNorth¥Right_1¥0000001 7.jpg
1 009000001 21_000000000	18	1	9	0	1 R	1	16.842	1 07.0831	5.853 201 6¥NH9BypassNorth¥Right_1¥0000001 8.jpg
1 009000001 21_000000000	19	1	9	0	1 R	1	16.84198	107.0831	5.864 2016¥NH9BypassNorth¥Right_1¥00000019.jpg
1 009000001 21 _000000000	20	1	9	0	1 R	1	16.84197	107.083	5.845 201 6¥NH9BypassNorth¥Right_1¥00000020.jpg
1 009000001 21_0000001 00	1	1	9	0	1 R	1	16.84195	107.083	5.837 2016¥NH9BypassNorth¥Right_1¥00000021.jpg
1 009000001 21_0000001 00	2	1	9	0	1 R	1	16.84193	107.083	5.83 201 6¥NH9BypassNorth¥Right_1¥00000022.jpg
1 009000001 21 _0000001 00	3	1	9	0	1 R	1	16.84191	107.0829	5.836 2016¥NH9BypassNorth¥Right_1¥00000023.jpg
1 009000001 21_0000001 00	4	1	9	0	1 R	1	16.8419	107.0829	5.879 201 6¥NH9BypassNorth¥Right_1¥00000024.jpg
1 009000001 21_0000001 00	5	1	9	0	1 R	1	16.84188	107.0828	5.922 2016¥NH9BypassNorth¥Right_1¥00000025.jpg
1 009000001 21 _0000001 00	6	1	9	0	1 R	1	16.84186	107.0828	5.98 2016¥NH9BypassNorth¥Right_1¥00000026.jpg
1 009000001 21_0000001 00	7	1	9	0	1 R	1	16.84184	107.0827	6.042 201 6¥NH9BypassNorth¥Right_1¥00000027.jpg
1 009000001 21_0000001 00	8	1	9	0	1 R	1	16.84182	107.0827	6.096 2016¥NH9BypassNorth¥Right_1¥00000028.jpg
1 009000001 21 _0000001 00	9	1	9	0	1 R	1	16.84181	107.0827	6.161 2016¥NH9BypassNorth¥Right_1¥00000029.jpg
1 009000001 21_0000001 00	10	1	9	0	1 R	1	16.84179	107.0826	6.243 201 6¥NH9BypassNorth¥Right_1¥00000030.jpg
1 009000001 21_0000001 00	11	1	9	0	1 R	1	16.84177	107.0826	6.288 201 6¥NH9BypassNorth¥Right_1¥00000031 .jpg
1 009000001 21 _0000001 00	12	1	9	0	1 R	1	16.84175	107.0825	6.381 2016¥NH9BypassNorth¥Right_1¥00000032.jpg
1 009000001 21_0000001 00	13	1	9	0	1 R	1	16.84173	107.0825	6.447 2016¥NH9BypassNorth¥Right_1¥00000033.jpg
1 009000001 21_0000001 00	14	1	9	0	1 R	1	16.84171	107.0825	6.541 2016¥NH9BypassNorth¥Right_1¥00000034.jpg
1 009000001 21_0000001 00	15	1	9	0	1 R	1	16.8417	107.0824	6.625 2016¥NH9BypassNorth¥Right_1¥00000035.jpg

Figure 3.2 Image data with coordinate file

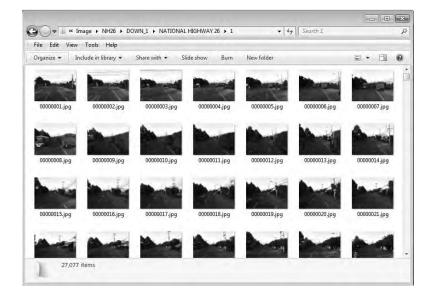


Figure 3.3 Image file

Table 3.1 Data format of the	pavement condition data file
------------------------------	------------------------------

Column No.	Data Content	Column No.	Data Content
1	Section_ID	19	Number_of_Lane_L
2	Geographical_Area	20	Number_of_Lane_R
3	Jurisdiction	21	Survey_Lane_LR
4	Management_Agency	22	Survey_Lane_Path_Lane
5	Road_Category	23	Surface_Type
6	Road_Number	24	Date_Y
7	Road Number Supplement	25	Date_M
8	Branch_Number	26	CrackingRatio_Cracking
9	Road_Name	27	CrackingRatio_Patching
10	KirometerPost_From_K	28	CrackingRatig_Pothole
11	KirometerPost_From_m	29	CrackingRatio_Total
12	KirometerPost_To_K	30	RuttingDepth_Max
13	KirometerPost_To_m	31	RuttingDepth_Ave

Pavement Condition Survey

14	Section_Length	32	IRI
15	Analysis_Area	33	MCI
16	Structure	34	Peculiar
17	Intersection	35	Note
18	Overlapping		

 Table 3.2
 Data format of the image data with coordinate file

Column No.	Data Content	
1	Section_ID	
2	Sequential No. (from 1 to 20)	
3	Road Category	
4	Road Number	
5	Road Number Supplement	
6 Branch Number		
7	Direction (L/R)	
8	Lane Number	
9	Latitude	
10	Longitude	
11	Height	
12	Data relative Path	

3.2 Definitions of Items on Pavement Condition Data

This section provides the definition of items in data on pavement condition.

(1) Section_ID

Section ID is created by road, direction, lane number, KP. Section ID is unique data. The format is shown in Table 3.3. Details of items are to refer to the explanation of each item.

Road Category	Road Number	Road Number Suppleme	Branch Number	Direction	Lane position Number	Under bar	From Km	From M
1 digit	3 digits	3 digits	3 digits	1 digit	1 digit	1 digit	4 digits	5 digits

Table 3.3	Section ID	Format
1 4010 5.5	Dection ID	1 Officiat

(2) Geographical_Area

"Geographical_Area" indicates which area the point in data pavement condition belongs to. It will be selected from those listed in Table 3.4.

No.	Management Areas
1	Northern Area
2	Northern Middle Area
3	Southern Middle Area
4	Southern Area

Table 3.4	Geographical	Area Category

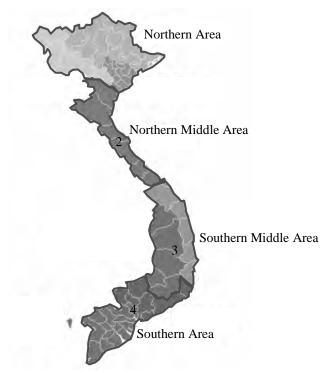


Figure 3.4 Management Area Classification Map

(3) Jurisdiction

"Jurisdiction" indicates the type of an organization in charge of the subject zone in data on pavement condition. It will be selected from those listed in Table 3.5.

	Table 3.5 Jurisdiction	
Administration category	Description	
RMB I	RMB I manages the target segment	
RMB II	RMB II manages the target segment	
RMB III	RMB III manages the target segment	
RMB IV	RMB IV manages the target segment	
Province	Province manages the target segment	
Company	Company manages the target segment	
Militaly	Militaly manages the target segment	
Under construction	The target segment is under construction	

Table 3.5 Jurisdictio	n
-----------------------	---

(4) Management Agency

"Management Agency" indicates the type of an organization in charge of maintenance of the subject segment in data on pavement condition. It will be selected from those listed in

Table 3.6. "Other" will be selected if the maintenance organization falls under none of the organizations listed.

Admin	SB	Admin	SB	Admin	SB	Admin	SB
RMB I	SB I.1 SB I.2 SB I.3 SB I.4 SB I.5 SB I.6 SB I.7 SB I.8	RMB II	SB II.1 SB II.2 SB II.3 SB II.4 SB II.5 SB II.6	RMB III	SB III.1 SB III.2 SB III.3 SB III.4 SB III.5	RMB IV	SB IV.1 SB IV.2 SB IV.3 SB IV.4 SB IV.5 SB IV.6 SB IV.7

Table 3.6Management Agency

(5) Road category

Road Category is the information used to identify the road category; whether the road national highway, expressway, provincial road, or others road. Road category consists only one digit number.

(6) Road number

Road Number is the number assigned to each road. It consists of 3 digit numbers.

(7) Road_Number_Supplement

Road_Number_Supplement is the alphabetical part number given to the number part of the road name. It consists of 3 digit numbers. In which Road Number Supplement is natural numbers such as 010, 020, 030, etc for A, B and C respectively.

(8) Branch number

"Branch number" is given to distinguish among branch roads of a main road. A branch number is given to a branch road, and Branch number "000" is given to any main road. Normally, the number begins with "001".

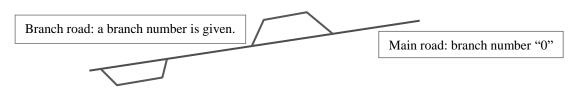


Figure 3.5 Conceptual Diagram of Branch Number

(9) Road Name

"Road Name" is the names that road administrators use to identify individual roads.

(10) Kilometer Post

Kilometer Post Information (From-To) is indicating the information of kilometer-post installed on site and distance from the nearest kilometer-post on the starting point side in units of 5m. Kilometer Post Information is defined by combination between kilometer-post number as "Km" and distance from kilometer-post as "m".

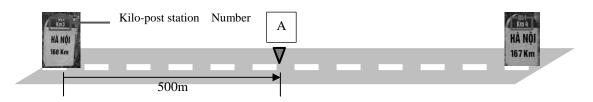
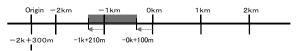
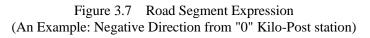


Figure 3.6 Conceptual Diagram of Kilometer Post

To input data on the kilometer post at Point A, numerical value "3" will be input in the box for "km" and numerical value "500" in the box for "m".

If the number of kilo-post station is negative or a road segment starts from the zero kilo-post station to the negative direction, the absolute value of the distance to the negative direction is expressed from the nearest kilo-post station of the positive direction. The example shows from [-2k+210] to [-0k+100]; the negative signs show the negative direction from the kilo-post stations.





(11) Section Length

"Section Length" is the total distance between the points stated after "From" and that stated after "To".

(12) Analysis Area

"Analysis Area" is the area of the subject segment, where an analysis has been conducted. It is calculated by the segment length multiplied by the segment width.

(13) Structure

If any of the structures listed in Table 3.7 exists in the subject segment, the corresponding code will be displayed. The structure name shall be stated in the box "Note".

Table 5.7 Types and Codes	of Structures
Structure	Code
Bridge	В
Tunnel	Т
Rock shed	R
Others	ОТ

 Table 3.7
 Types and Codes of Structures

(14) Intersection

If any of the intersections listed in Table 3.8 exists in the subject segment, the corresponding code will be displayed. The System covers intersections with major roads, in which traffic signals and tollgates are placed.

Table 3.8	Types and Codes of Intersections, and Descriptions	in "Note"
1 4010 5.0	Types and codes of menseenons, and Descriptions	111 11000

Intersection	Code	Description in "Note"
Intersection (with traffic signals)	Ι	Name of the intersection or U/N
Roundabout	RA	Name of the main road connected or U/N
Viaduct	V	Name of the intersection or U/N
Railway crossing	RC	Name of the railway or U/N
Toll Gate	TG	Name of facility or U/N
Other	OT	Other

The location of an intersection will be the point in which the center line of the subject road intersects with that of the road intersected.

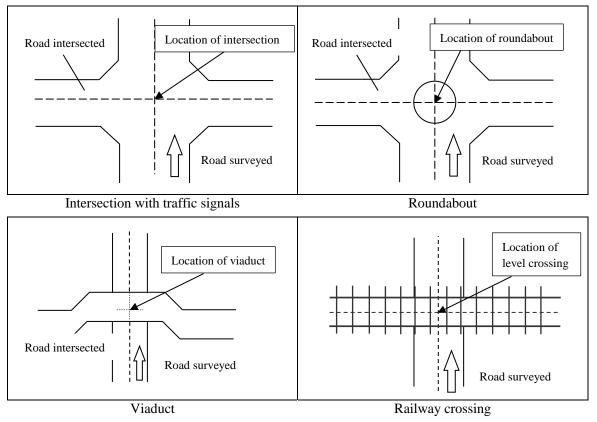


Figure 3.8 Types and Locations of Intersections

(15) Overlapping

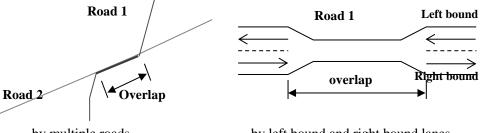
Table **3.9** lists places called "Overlapping".

Туре	Description
Overlap with multiple roads	The state where two or more roads are overlapped in part
Overlap with left bound and right bound lanes	Single-lane roads that are too narrow to allow left and right vehicles to simultaneously pass

Table 3.9Types of Overlapping

Figure 3.9 illustrates the two types of overlapping segment. The organization in charge of overlapping segment will create data, and administrators will follow the handling rule given in Table 3.10.

Table 3.11 lists the codes displayed in data on pavement condition.



by multiple roads

by left bound and right bound lanes

Figure 3.9 Overlapping segment

	1 able 5.10		for overlapping segme	
Overlapping segment	Road		Organization managing	Road subject to data creation (overlapping
	1	2	overlapping segment	segment)
by multiple roads	Administered by DRVN	Administered by Province	DRVN	Road 1
	Administered by DRVN	Administered by Province	Province	Road 2
by left bound and rightbound lanes	by left bound and rightbound lanes	-		Right bound lane

Table 3.10 Handling Rule for overlapping segment

Table 3.11 Codes of Ov	erlapping segment
------------------------	-------------------

Overlapping segment	Code Name
by multiple roads	R
by left bound and right bound lanes	LR

(16) Number of lanes

Table 3.12 provides the definition of the number of lanes.

Lane mark	No. of lanes
Yes	Number of lane marks except centerline
No	Number of vehicles that can travel parallel to each other

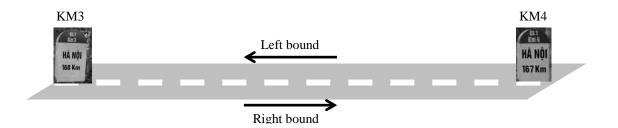
Table 3.12 Definition of Number of Lanes

(17) Direction

Direction is the direction of inspection. The direction in which the kilopost number increases is "Right" and the direction in which the kilopost number decreases is "Left".

Classification	Code Name
Left(Up)	L
Right(Down)	R
Single	S

Table 3.13	Direction Code	
1 4010 5.15	Diffection Code	



(18) Lane Position Number

Lane Position Number is input the measured lane number as an integer. The lane number is given from the center to the shoulder.

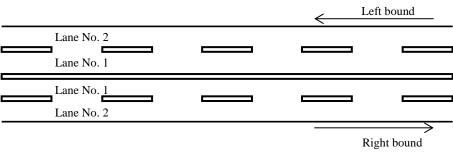


Figure 3.10 Definition of Lane Number

(19) Pavement type

For pavement type, one of the codes listed in Table 3.14 will be displayed.

Surface type	Code
Asphalt concrete	AC
Bituminious Surface Treatment	BST
Cement concrete	CC
Other	Other
N/A	*

 Table 3.14
 Category of pavement Type

(20) Condition_Year, Condition_Month

Condition Year / Month is the measured date. The date will be displayed as "yyyy/mm".

(21) Cracking ratio

The cracking ratio is the proportion of area cracked to the entire area of the survey area.

(22) Patching ratio

The patching ratio is the proportion of area to which patching has been applied to the entire area of the survey area.

(23) Pothole ratio

The pothole ratio is the proportion of potholes to the entire area of the survey area.

(24) Total

The total crack ratio is the sum of the cracking, patching and pothole ratio of the subject area.

(25) Maximum of rutting depth

A rutting depth is a depression or groove worn in the pavement in the transverse direction by the repeated travel of vehicles or flows of asphalt mixture.

The maximum of rutting depth is the maximum amount of rutting depth in the survey segment.

(26) Average of rutting depth

The average of rutting depth is the average amount of rutting depth in the survey segment.

(27) International Roughness Index (IRI)

The IRI is the roughness index for the roughness of roads in the longitudinal direction in the survey segment.

(28) MCI

MCI stands for Maintenance Control Index. MCI is calculated to used by crack ratio, rutting depth and IRI. 10 of MCI value is the perfect condition. 0 of MCI value is the worst condition.

(29) Peculiar

Peculiar is a road surface damage which can't be expressed with crack interpretation. the Classification of peculiar condition corresponding to Note field will be inputted.

Surface type	Discription
1.Broken	Once paved sections, but there is serious damage which cannot be evaluated.
2.Unpaved or unidentified Pav. Type	Unpaved: never paved. Unidentified Pavement type: besides, AC, CC and BST.
3.Wet Condition	The lane is covered with water or wet.
4.Other damage	Other type damages that cannot be judged as cracking. (Ex. Raveling, Scratch, etc.)
5.Invisible	Surface cannot be seen due to coverage of pavement surface by other objects, such as sand, soil, construction material, etc.
6.Under construction	Ongoing construction work on the survey lane.

 Table 3.15
 Category of peculiar conditon

(30) Note

Note is used to state the names of bridges, road name of the road intersected with the survey road, other structures, and peculiar condition as well as reasons for impassable roads.

4. General rule in survey

4.1 Impassable Road Segments

The end of a segment that cannot be surveyed shall be marked with a stick or equivalent. The location shall be photographed so that the location can be identifiable during data collection with the survey vehicle. For example, if there is a national boarder, a vehicle or person cannot enter the other side to record a starting point or end point. If it is the case, the starting point can be shifted to a point where a survey vehicle can enter. From the national boarder to the starting or end point, a walking measure is used. In the following example, a 10 meter distance is measured using a walking measure.

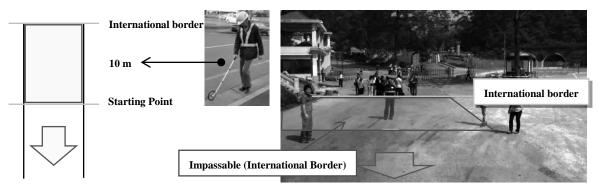


Figure 4.1 Work at Impassable Road Segments

4.2 Safety Control

The safety control measures listed in Table 4.1 will be thoroughly taken when using this System, in particular to conduct the field works. If any shortage is found, the list will be updated from time to time to incorporate items currently unlisted.

Work type	Situation	Hazardous event	Measure
Pavement condition survey	Traveling	having measuring devices caught in a cable hanging low	Drivers will pay attentions to up in the air.
		taking a misstep and falling	Using footsteps.
	Making preparation	Other vehicle hit the surveyor during the marking	While the operator mark in the road at the marking position, other operator make sure and keep the surrounding safety.
	The vehicle is parked	being rear-ended by a vehicle	Warning vehicles behind with hazard indicator

 Table 4.1
 Hazardous Events and Preventive Measures in the work

4.3 Storage and Management of Data

Basically, the Analysis Team will store and manage the data. As Table 4.2, trip meter data and measurement data may be deleted when data on pavement condition has been completed and it has been confirmed that the data has <u>no problem</u>.

Data	Description	Timing of Deletion
Trip meter data	Data obtained from measurement by trip meter	After data on pavement condition has been completed
Measurement data	Data acquired by REAL Mini	After data on pavement condition has been completed
Converted data	Data converted for reading the road surface	Not deleted
Road surface reading data	Data for reading, for which the width of the survey zone has been set	Not deleted
Road surface property data	Data processed and listed in a table format	Not deleted

Table 4.2	Timing of Data Deletion

5. Instruction Manual of Trip Meter

5.1 Introduction

One set of Trip Meter including a Trip Meter and an iPad that are stored in an aluminum case.

- Trip Meter is a device to record distance using the pulse signal from a vehicle.
- iPad is a viewing and parameter encoding device used in association with Trip Meter.

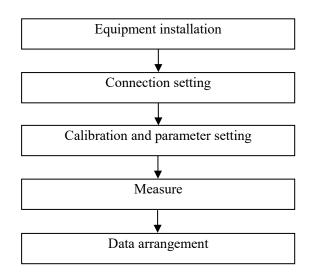


Figure 5.1 Trip Meter in an Aluminum Case

Trip Meter is installed to a car to conduct field reconnaissance- the first phase before pavement condition survey. By using Trip Meter stations of kilometer posts, road structures would be defined. Please don't update the "iOS". The application will not use in the new iOS enviorment.

5.2 Work flow

To use the Trip meter for measuring distance, it's necessary to be follow the work flow below:



5.3 Installing Equipment

Installation of Trip Meter requires following connections:

- 1) Vehicle Speed Pulse Signal Input Cable
- 2) Power cable connection
- 3) USB cable connection
- 4) Wi-Fi connection.

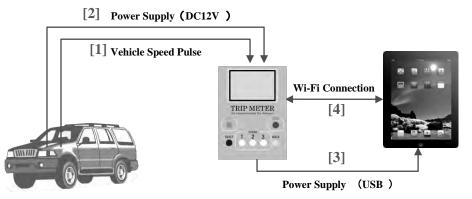


Figure 5.3 Vehicle, Trip Meter and iPad Connection

5.4 Vehicle Speed Pulse Signal Cable Connection

The vehicle speed pulse input cable from Trip Meter shall be connected to the vehicle speed pulse output cable of the vehicle. The cable shall be securely connected so that it would not be disconnected due to vibration from the vehicle. It is to note that the location of the cable of pulse out may be different from vehicle to vehicle. It is advised to prepare a vehicle speed pulse cable beforehand.

5.5 Power Cable Connection

Trip Meter shall have 12 Volt power supply. The power cable from Trip Meter shall be connected to the cigar socket. When power is supplied, Trip Meter automatically starts.



Figure 5.4 Power Cable Connection

5.6 USB Cable Connection

Trip Meter and iPad should be connected to supply power to iPad. It is to note that the USB cable is only to supply power; not data will be transferred.

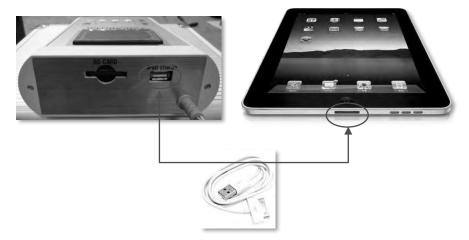


Figure 5.5 USB Cable Connection

5.7 Data Connection Setting

Trip Meter and iPad should be connected through Wi-Fi to transfer data.

(1) Wi-Fi Setting

Wi-Fi connection of Trip Meter and iPad is established. Five seconds after Trip Meter is turned on, Trip Meter emits Wi-Fi signal. iPad shall be turned on after Trip Meter emits the Wi-Fi signal. Setting of iPad is as follows:

1) Tap "Setting" icon of iPad.



Figure 5.6 Setting Icon

2) Tap Wi-Fi icon at the left side.

P.0		10.0
Settinge	Contract of Contra	
Airplana Mode		
Welfi Nel Committee	About	1.1
Notifications	Software Update	- E +
Location Services	Diage	
G Brightness & Walpoper	Sounds	
Reture Frame		
Gi General ID	Network	1.0
C iCloud	Diverbath	24.1
Mail, Contacts, Celendura	ITunes Wi-Fi Sync	
E Tutter	Spotlight Search	
* FaceTene		
CH ALL	Auto-Lock	Airog 3

Figure 5.7 Selecting the Wi-Fi Icon

3) Among the list of network connections, SSID with a colon will be shown:

70:d5:7e:xx:xx.

Tap the connection to establish connection with Trip Meter.

et-R lanapha		U-D listenis	-
WiFi	Co Co	onnect wife	er
Chanse & Hernort		Choose a himwark	
70:d5:7e:xx:xx:xx Select	4* 6	70:d5:7e:xx:xx	1+ 0
emart IP Prionets	* 6	emart IP Phone5	+ Q
Kanematsu	4 T B	Kimematsu	14.0
KEB	47.0	KEB	
LottieShopping 02	47.0	LotteShopping 02	11.00

Figure 5.8 The Network Name

(2) Initial Connection

When Wi-Fi connection between Trip Meter and iPad is established for the first time, following setting shall be established.

1) Tap 🕑 and show details.

- 2) Tap the "Static" button.
- 3) Tap the IP address and input"192.168.100.2."
- 4) Tap subnet mask, and enter"255.255.255.0."
- 5) Tap the top-left corner button to go back to the previous page.

6) When the network name (SSID), which was initially set, is tapped, the system asks a password. Enter [pasco_9821431].

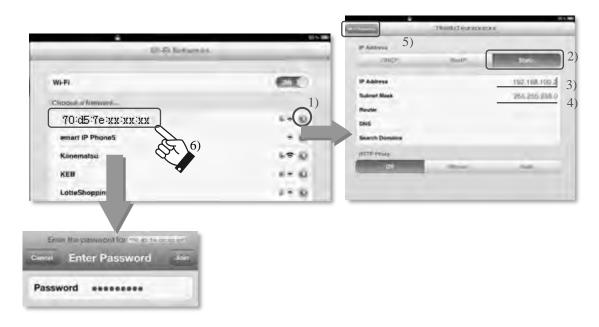


Figure 5.9 Initial Setting Procedure

5.8 Starting Application

Tap the Dtmeter on iPad to start the application.



Figure 5.10 Trip meter Icon

When the application is started, a connection between Trip Meter and iPad is established. After the connection establishment, "0" will be displayed when the vehicle is stopped. When the vehicle is moving, the display shows the distance. The time counter starts in seconds and displayed as indicated with the red arrow.

When the counter does not start, Trip Meter and iPad are not connected. Refer the trouble shooting section and try to establish the connection.



Figure 5.11 Application View

5.9 Initial Setting for Measurement

The initial setting for measurement shall be conducted when: Trip Meter is installed to a vehicle for the first time; Trip Meter is transferred to another vehicle; a tire is changed; Trip Meter has not been used for more than a month.

(1) Time Setting

Time is set using the iPad application Dtmeter as in the following procedure:

1) Tap the Open button.

When Trip Meter has been active and measuring distances, the display would not change to the Setting mode even when the Open button is tapped.

- 2) Tap the Date text box.
- 3) Enter the date in a date format: yy/mm/dd.
- 4) Tap "Enter" to end.
- 5) Tap the TIME text box.
- 6) Enter the time in a time format: hh:mm:ss.
- 7) After entering, Tap "Enter" to end the operation.
- 8) The SET button is displayed; Tap the SET button.
- 9) The setting button and other menu are hidden under the OPEN button and the time will be displayed.

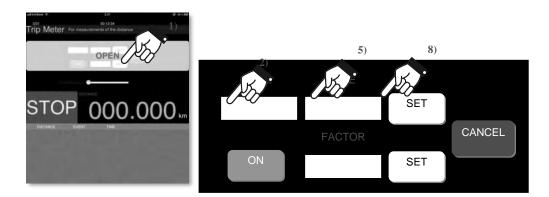


Figure 5.12 Time Setting Procedure (iPad)

(2) Distance Calibration

Trip Meter should be calibrated to determine the adjustment value. The calibration is conducted on a straight segment of road with one kilometer distance actually measured.

The starting point and end point should be marked as in Figure 5.13.



Figure 5.13 Marking Example – 1 km Distance

Notes:

- The calibration place needs conditions such as low traffic, Easy to turn.
- Trip Meter should be calibrated to determine the adjustment value once a year.
- When the vehicle changes the tire, Trip Meter should be calibrated to determine the adjustment value.
- a. Setting before the Calibration Run
 - 1) Tap the OPEN button. It is to note that while measuring the system cannot be changed to the Setting mode.
 - 2) If the FACTOR text box is not shown, tap the ON button.
 - 3) Tap the FACTOR text box.
 - 4) When the keyboard is shown, enter 10000 as a preparation value of adjustment. 10000 mean an adjustment value of 1.0000.
 - 5) After entering tap "Enter."
 - 6) When the SET button is displayed, tap the SET button.
 - 7) The SETTING button and others are hidden under the OPEN button, and the adjustment value 1.0000 is set. After the SETTING is completed, run the calibration distance.

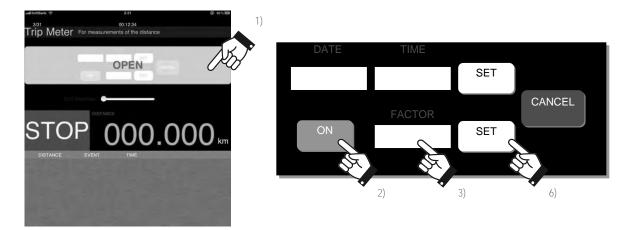


Figure 5.14 Operation Procedure before the Calibration Run

b. During the Calibration Run

- 1) Press the START button at the starting point.
- 2) Confirm [0] m, [S] on the iPad screen.
- 3) Drive one kilometer along the calibration segment set.
- 4) At the end point of the segment, press the STOP button of Trip Meter.
- 5) On the iPad screen, [travelled distance] m, and [E] will be shown.

The calibration runs shall be conducted more than three times.

When three similar values are acquired from reading the [distance travelled] on the screen, calculate the average.

The average value times ten will become the adjustment value. For example, the average of the three values 1234, 1230, and 1232 is 1232; the adjustment value is 1232 time 10 which is 12320. It is to note that during calibration, the unit of [distance travelled] becomes the number of pulse; during actual measurement, the number of pulse is converted to meter automatically.

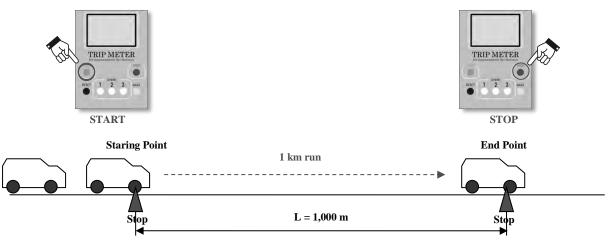


Figure 5.15 Operation Procedure during the Calibration Run



Figure 5.16 Distance Record View Section

(3) Distance Adjustment Parameter Setting

Distance adjustment parameter setting shall follow the following procedure.

- 1) Tap the OPEN button.
- 2) Tap the ON button.
- 3) Tap the FACTOR text box when it is shown.
- 4) Enter the five digit parameter for the distance adjustment.
- 5) Tap [SET].
- 6) Tap the SET button, when it appears.
- 7) The adjustment value appears under the OPEN button.

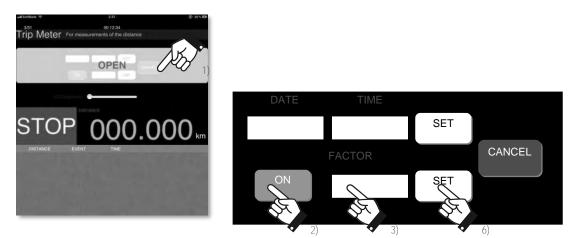


Figure 5.17 Procedure of Distance Calibration Parameters

After setting the trip meter, indicate starting points and ending points shall be marked and noted. The leader shall indicate the roads of the day onto the road map.

5.10 Measure

(1) Functions of each button

Functions of each button has are follows.

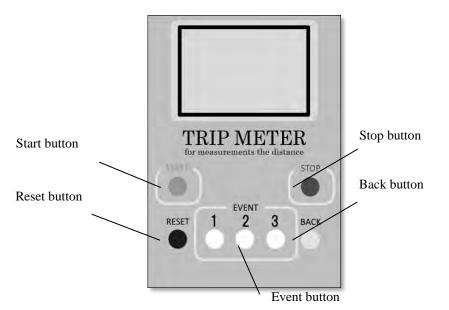


Figure 5.18 Functions of event buttons

1) Start button

When the operator pressed the "Start" button, the trip meter start the measurement of distance.

- Stop button When the operator pressed the "STOP" button, the trip meter Stop the measurement of distance.
- Reset button When the operator pressed the "Reset" button, the trip meter save the distance at that time.

The operator press the "Reset" button when there are kilometer posts or starting, ending points.

4) Event button

When the operator pressed the "Event" button, the trip meter save the event number and the distance at that time.

-Button No.1

The operator press the button No.1 when there are road structures such as bridge, tunnel...

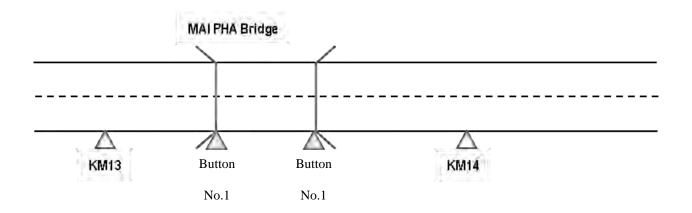


Figure 5.19 Pressing the Event Button No.1 at Bridge

-Button No.2

The operator press the button No.2 at intersections

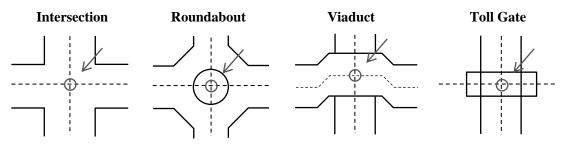


Figure 5.20 Locations of Pressing the Event Button 2 at Intersections

- Button No.3

The operator press the button No.3 at the other events such as Jurisdiction classification, overlapping, lane number change...

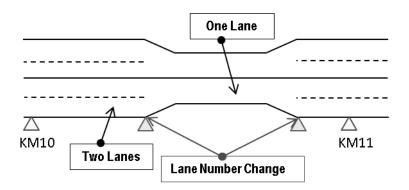
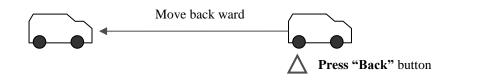
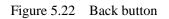


Figure 5.21 Lane number change – button No.3

5) Back button

When the car move back ward, Press "Back" button then the Trip Meter would count negative distance. Therefore the car can be move back ward during measure time without effect to accuracy of result.





(2) Measure

The Measurement of distance follows the following procedure.

- 1) Press the "Start" button
- 2) Press the "Reset" button at starting point
- 3) Press the "Reset" button at each kilometer post
- 4) Press the button No.1 at structure such as bridge, tunnel...
- 5) Press the button No.2 at intersection
- 6) Press the button No.3 at the other events such as Jurisdiction classification, overlapping, lane number change...
- 7) Press the "Reset" button at ending point
- 8) Press the "Stop" button

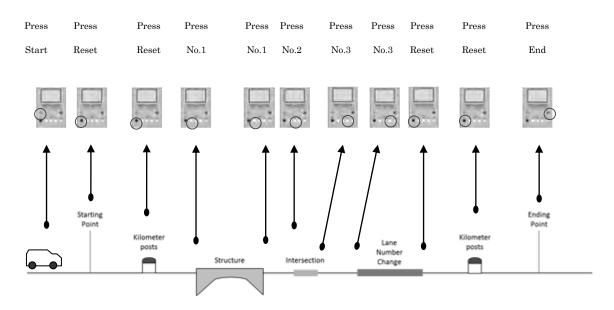


Figure 5.23 Procedure of measurement

(3) Notes of the measurement

During the measurement, the vehicle should keep the right lane. The driver doesn't drive the vehicle in zigzag.

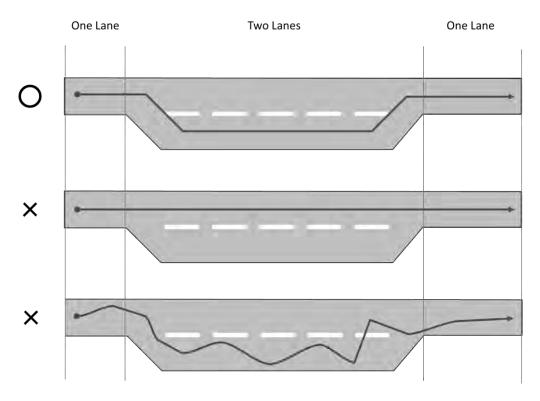


Figure 5.24 Notes of the measurement

(4) Data format

Measured data save to the SD card. Data construct and Data format shows the Figure 5.25.

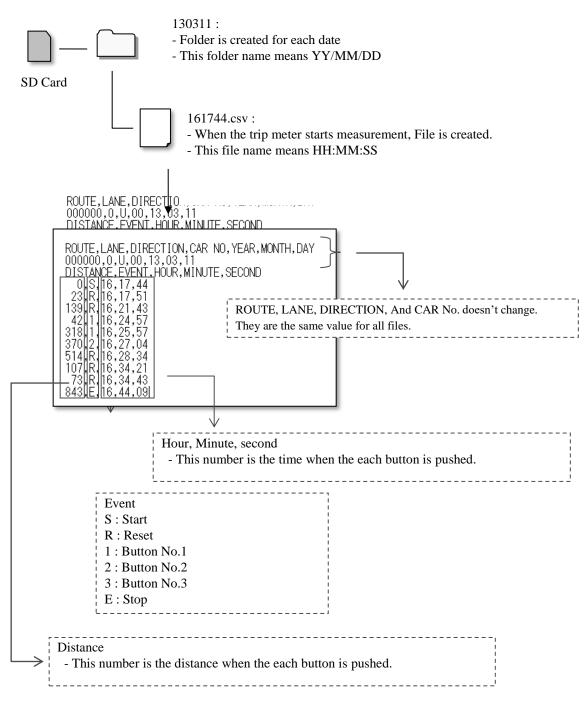


Figure 5.25 Data Construct and Data Format

6. Instruction Manual of Operation of REAL Mini

6.1 Objective of Survey

- The objectives of road surface survey are to:
- take a picture of the Road Surface images for crack analysis
- measure the crossing road profiles for rut
- measure the vertical road profiles for IRI
- measure the location by GPS
- take a picture of forward view images

6.2 Intended Users of the Manual

This manual was intended to be used by surveyer of pavement condition survey.

6.3 Overview of REAL Mini

REAL Mini has the following sensors: Camera for front image (FC), GPS, Inertial Measurement Unit (IMU), Laser Scanner (LS), Cameras for road image (RC), Laser Displacement Sensors (LDS). FC record front images; GPS records locations; IMU and LDS identify longitudinal profile; RC record road images in black and white to identify cracks; LS records cross section profiles to identify rut depths. On the roof of the vehicle, a solar panel is installed to secure additional power to the on-board equipment.

All the sensors are mounted to the vehicle in a secure way. As the FC record the front view, the location of the FC should be high enough not to include the front of the vehicle itself. The clearance of vehicle should be high enough to have sufficient space between the road surfaces to the LDS.

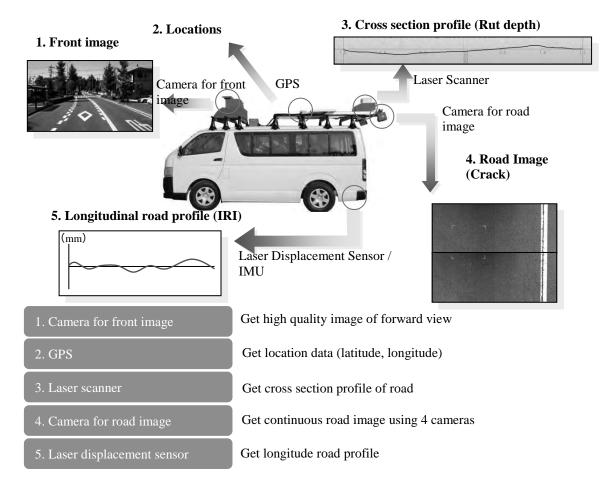


Figure 6.1 Outside of REAL Mini

	1 1
Name	Explanation
Camera for front image (FC)	Equipment which measure the forward view images
GPS	Equipment which measure the location of measurement point.
IMU & Leaser Displacement Sensor (LDS)	Equipment which measure the vertical Profiles (IRI)
Camera for road image (RC)	Equipment which measure the road surface images (Crack)
Laser Scanner (LS)	Equipment which measure the crossing Profiles (Rut)

Table 6.1	Equipment of	Outside	Vehicle
-----------	--------------	---------	---------

There are two computer monitors and control devices in the vehicle. The Right monitor shows the images from the camera for road images. The Left monitor shows the front view, data and information from GPS, IMU & LDS, and LS.

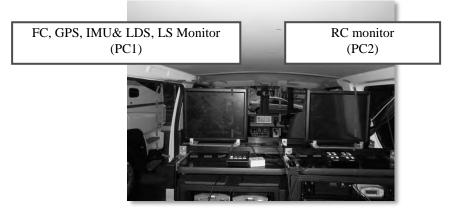


Figure 6.2 Inside of the Vehicle

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Figure 6.3 Survey application (PC1, PC2)

On the front of the inside vehicle various pieces of equipment are set-up and installed.

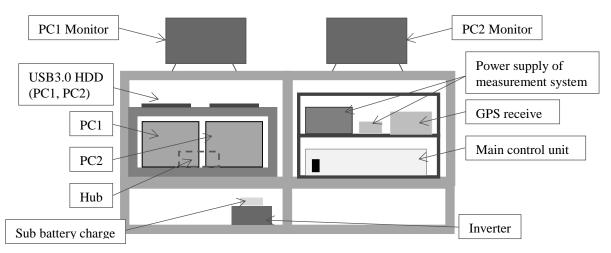


Figure 6.4 On-board Equipment in the Rack of the Vehicle

Table 6.2	On-board Equipment
-----------	---------------------------

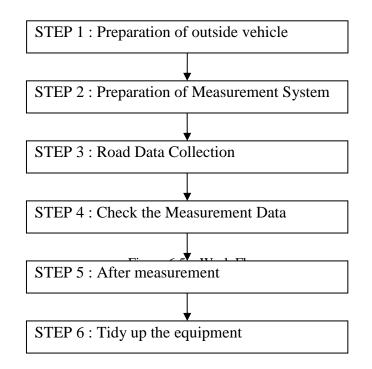
Name	Explanation
Monitor	Equipment which show the measurement application.
Power supply of measurement system	Equipment which supplies stable electric power in order to prevent the malfunction according the output (100V AC) of an inverter to the instability of electric power to each equipment (Main Control Unit,

Name	Explanation
	E-SATA HDD, Hub, Monitor).
Power supply of solar panel	Equipment which transforms the electric power of solar panel into 12V AC electric power. This electric power is automatically supplied to sub-battery at the time of parking.
GPS receiver	Equipment which receives positioning electric wave to compute longitude, latitude, and altitude from positioning satellites.
Main Control Unit	Power-source supply is carried out to each equipment (Camera for front image, Laser displacement Sensor, IMU, camera for road image, Laser Profiler, PCs 1 and 2). The unit calculates distances based on the pulse data to be sent to PC1 and PC2.
USB3.0 HDD	The external storage for moving data to the data conversion PC data. Both PC1 and PC2 are equipped with one E-SATA HDD each. After the data collection survey, the data are transferred to the storage.
PC1	A PC to record GPS positioning data, travel distance, IMU data, data from Laser Displacement Sensor as it controls the sensors. It records the basic survey data such as starting and ending the survey.
PC2	A PC for the camera for road image displaying to the monitor and records the camera for road image setting such as road, aperture and gain.
Hub	A hub for an interface to build a network with the road surface camera (four sets) and PC2 which are GigE, in order to record the images on PC2.
Sub battery charger	The device supplies the power from vehicle to sub-battery.
Inverter	The device transfers power of the sub-battery (12 V direct current) to 100 V alternative current. The AC power is supplied to the equipment after stabilized through the power supply measurement system.

6.4 Method

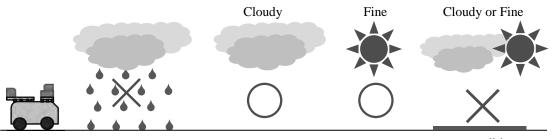
(1) Work Flow

Work flow of REAL Mini is shown below Figure 6.5.



NOTE:

- REAL Mini cannot to measure the data when the weather is rain.
- Even if the weather is fine or cloudy, REAL Mini cannot to measure the data if the road surface is wet.



wet condition

(2) Method

- 1) STEP 1 : Preparation of outside vehicle
- Tighten the screw of roof rail
- Open the cover (RC,LP)
- Open the cover (LDS)
- Clean the lens (FC, RC, LP)
- a) Tighten the screw of roof rail



Figure 6.6 Tighten the screw of roof rail

b) Open the cover (RC,LP)

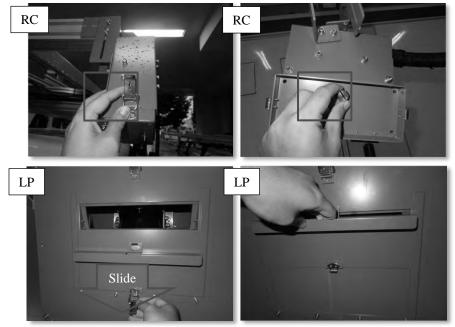


Figure 6.7 Open the cover (RC,LP)

c) Open the cover (LDS)



Figure 6.8 Open the cover (LDS)

d) Clean the lens (RC ,LP, FC)

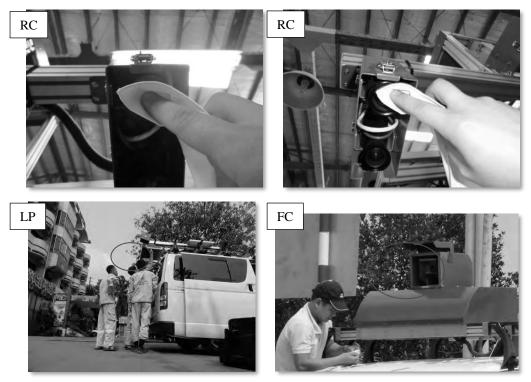
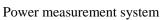


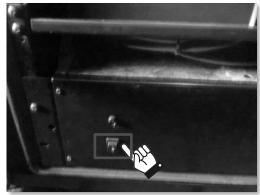
Figure 6.9 Clean the lens (RC, LP, FC)

2) STEP 2 : Preparation of measurement system

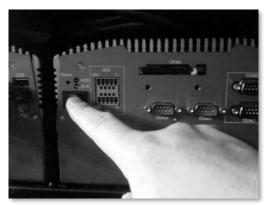
- Turn on power (Power measurement system, Main control unit, PC1 and PC2)
- Check the activation of PC and Main Control Unit (MCU)
- Select "Measure"
- Select "Vietnam" from the list
- Press "OK"
- Input the road information
- Check the connection with the measurement devices
- Set the shutter speed and gain of the camera
- a) Turn on the power





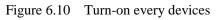


Main control unit



After turn on the power, wait more than three minutes

PC1 and PC2



b) Check the activation of PC and Main Control Unit (MCU)

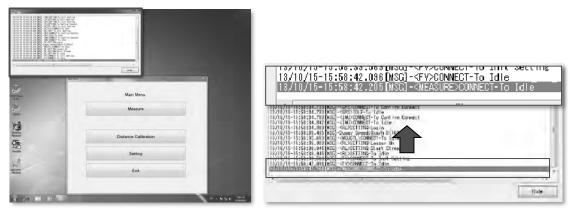


Figure 6.11 Main Control Unit Monitor

NOTE:

If PC isn't connect to MCU, turn off power and turn on power. If the connection still cannot be confirmed, please check the slack of the wiring.

c) Select "Measure"

Log			
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Figure 6.12 Selecting the Measure Button

- d) Select the Project from the list
- e) Press "Next"

No.	Project	Road Catego	orv	Road No.	Road No.	Suppleme
1	test	1:National H		0	0	
2	trainig	1:National H	lighway	0	0	
3	RTC	1:National H	lighway	0	0	
4	JICA	1:National H	lighway	0	0	
•						•
					_	

Figure 6.13 Selecting Appropriate Data

f) Input the road information: The form has the text boxes to enter:

EDIT	
Project:	test
Date:	2017 / 11 / 21
Road Category:	1:National Highway
Road Number:	0
Road Number Supplement:	0
Road Branch:	0
Distance From:	0.0000 km To 100.0000 km
Direction:	Right •
Lane No:	1 •
Lane Pos:	0 •
Operator:	OPERATOR •
	OK Back

Figure 6.14 Road Information Dialogue Box

Text Box	Note
Project (Project name)	Automatic input
Date (Measurement date)	Automatic input
Road Category (Road kind)	Automatic input
Road Code (Code of measurement road)	Input the 3 digit number
Road Number Supplement	Input the 3 digit number
Road Buranch	Input the 3 digit number
Distance from to (KP information of measurement road)	Input KP of start and end
Left Right (Direction of road)	Select from the list (1 Left, 2 Right, 3 Single)
Lane No (Number of lane)	Select from the list
Lane Pos (Position of lane)	Select from the list
Operator (Operator)	Select from the list

 Table 6.3
 Entering the Data to Text Boxes

g) Check the connection with the measurement devices

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Figure 6.15 Operation State (Green)

The colors indicate the connection conditions.

Table 6.4	Measurement Device Connection Status
1 abic 0.4	Measurement Device Connection Status

Color	Condition		
Red (Busy)	Not connection		
Yellow (Unsettled)	Search		
Green (Idle)	Connection		

NOTE:

- Measurement is possible even "Search" state of the GPS
- If measurement device is not connect, turn off power and turn on power
- If the connection still cannot be confirmed, please check the slack of the wiring
- h) Set the shutter speed and gain of the camera.

Mensure	2017/11/21-14.0015
Internation Status Distance 127.842m Speed 0.0km/h Logalsteet	92% Trans Rest 92% Measure Folder No Trans
Stella: Distance 127.042 m speed 0.00m/m Lacalified	S2A Trans Res3.52A Messure Folder No Trans
Device Status	
Forward View IX.E Road View IX.E Road Leaser IX.E SV	DLE MU DLE UPS HOUSE HOU TLE
Road Information	
Project lest Date (2017/11/2) Road Category 1National Highway Road No.Suppleme	ntBranch: 808,000,000 Direction Right Lane Nu,Pos: 1,1 Operator DPERATOR Settine_
Forward View	JMU Information
	Roll(deg) 0.000 Pitch(deg) 0.000 Yaw(deg) 0.000 Z Accel 0.000
	GPS Internation
Min	Latitude 0.001000 Lovaihude 0.001000 Status 0 Capture 0
	Road Laser/IMU
	//W m #
	SV Value -89554mm
	Base
	19354nm
Dani: 5dB + Up Down Shatter: 1/120 + Up Down	KP Information
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	0100 km
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H - B - F Now(m)	6 7 8 9 0 BS DEL NEXT
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NantenanceForward ViewLos	RV4FVT8W0R1 Back
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Gain: 5dB - Up Down Shu	tter: 1/120 🔹 🛛 Up 🖉 Down

Figure 6.16 Shutter Speed and Gain Control PC1

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	Come (Christel)	Shutter:	1/100 -
	Property (Arrow	Gain:	52dB •
	14 M B P P	Camera 2,4(Sh	adow)
the second se	- History (#	Status:	DLE,632 794 DLE,632 794
		Shutter:	1/100 -
Andra V		Gain:	52dB: -

Figure 6.17 Shutter Speed and Gain Control PC2

- 3) STEP 3 : Road Data Collection
- Push the white switch of control box
- Check the translation to state "Ready"
- Start the measurement by push the white switch of control box
- During measurement,
 - Push the green switch of control box to register the KP information
 - Change the camera settings to suit the image of state
- End the measurement by hold down the red switch of control box

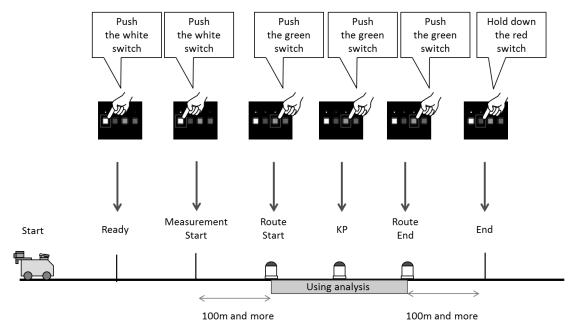


Figure 6.18 Operation Sequence of the Buttons

a) Push the white switch of control box



Figure 6.19 White Button (Ready)

b) Check the translation to state "Ready"



Information Status: DLE Distance:	127.842m Speed: 0.0km/h	Local Rest 52% Trans Rest 99% Measure Folder:	No Trans
Device Status Forward View: IDLE Road View:	IDLE Road Leaser IDLE	SV: IDLE IMU: IDLE GPS Unstitled	MCU: IDLE

Figure 6.20 Confirm the Ready View

c) Start the measurement by pushing the white button of the control box



Figure 6.21 Pressing the White Button to Start the Measurement

NOTE:

- REAL Mini should start the measurement before 100m and more of raod start.
- REAL Mini should stop the measurement after more than 100 meters from the end point.
- When a capacity of HDD is small (under 5%), the road condition data would not be collected.
- In that case, the operator should delete the data in HDD of PC.
- When the voltage of sub-battery is under 11.7V, the measurement system shut down. (Usually, the voltage of sub-battery is 12.3V 12.4V)



- Operator sometimes should check the voltage of sub-battery during measurement.

d) During the measurement

Push the green button to register the kilo-post station information



Figure 6.22 Kilo-post Station Recording

Change the camera settings to suit the image of state by controlling the switch as in Figure 6.22. The camera for front image changes the iris of the lens by Iris controller.

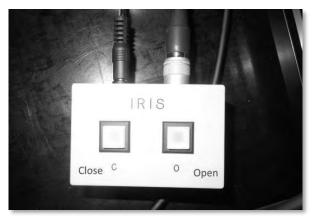


Figure 6.23 Aperture Setting

Change the shutter speed: click **"Forward view"** button then enlarged forward view window would appear. Change shutter speed to get the clearest image.



Figure 6.24 Changing the Shutter Speed of Camera for front image

The shutter speed and gain of the rear cameras can be changed by measurement application or controller.

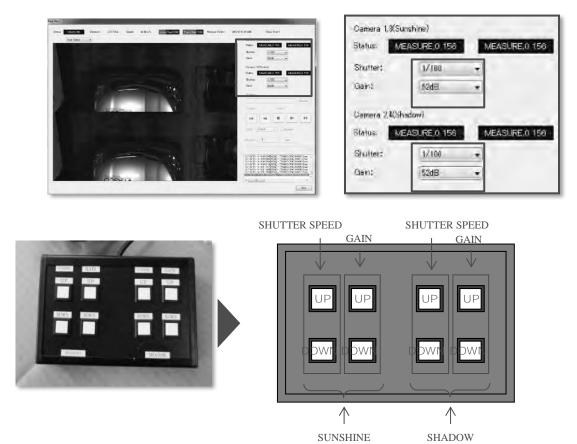


Figure 6.25 Changing the Shutter Speed and Gain of Rear Cameras

e) End the measurement by hold down the red switch of control box



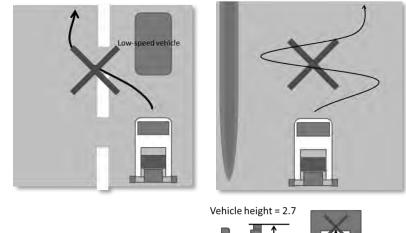
Figure 6.26 End the Measurement

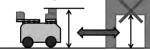
NOTE:

The driver should keep to the rule of driving as follows.

- Keep the lane

In order to obtain the correct measurement data, the vehicle keep to the lane during measurement. The driver doesn't drive the vehicle in zigzag.





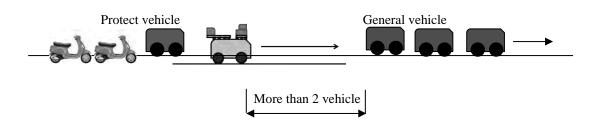
- Attention to the height of vehicle

The driver should be careful to the height of the vehicle in order to not hit the obstacles (tree, overpass, and so on ...) the vehicle while driving.

⁻ Attention to the speed of vehicle (Keep the speed under 60km/h) Vehicle Speed < 60km/h



If the speed of the vehicle is greater than 60 km / h, the measurement data will be missing. - Attention to the forward vehicle (keeo the distance more than two vehicle) If the distance for the forward vehicle is too short, operator in the data analysis can not the pavement in the forward view image. On the other hand, if there are some motor bike in the backward of the survey vehicle, the crack in the road image is hidden by the mortor bike. Protect vehicle should follow the survey vehicle, if need.



4) STEP 4 : Check the measurement data

- Select the check box [Replay]
- Select the data folder
- Replay the data
- a) Select the check box [Replay]
- b) Click "Browser" button then select the data folder



Figure 6.27 Selecting a Folder (PC1)

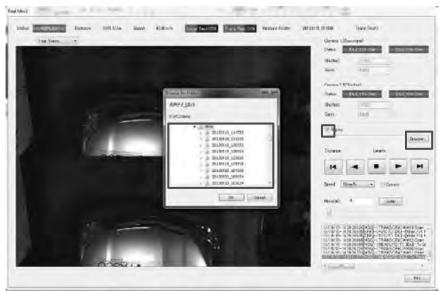


Figure 6.28 Selecting a Folder (PC2)

c) Replay the data - PC1

Mossure		2010/10/13-10.0201			
2/smaker					
Status RUELAW Dutarce 897,480m Speed 40.2km/h	Trans Rost Res Trans Rost D4X Measure Folder 20131015_161409	No Trans			
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Figure 6.29 Control Panel in the User Interface (PC1)

Function Name	Image	Description
A : Button Control	[Piece Back] [Back] [Stop] [Replay] [Piece Forward]	
B : Replay Speed	Flay Saeset 60km/h T	Select the replay speed
C : Jump	Mavata) 0 Amp	Jump to position of the input number
D : Slid Bar	0	According to the position of the button in the Slid Bar, Move the position of the data

Table 6.5Description of Interface (PC1)

- PC2

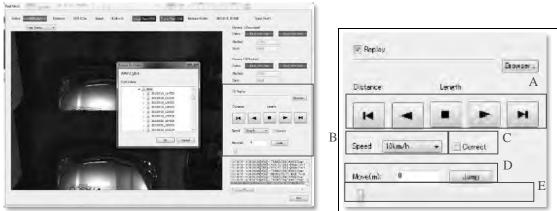


Figure 6.30 Control Panel in the User Interface (PC2)

Function Name	Image	Description
A : Button Control	[Piece Back] [Back] [Stop] [Replay] [Piece Forward]	
B : Reaplay Speed	Speed 10km/h -	Select the replay speed
C : Correct	Correct	Display the road surface image obtained by projecting correction.
D : Jump	Morelind. 0 Jamo	Jump to position of the input number
E : Slid Bar	0	According to the position of the button in the Slid Bar, Move the position of the data

Table 6.6Description of Interface (PC2)

5) STEP 5 : After measurement

- a) Continuous measurement
- Click "Setting"
- Input the road information
- Follow the steps to end the measurement

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Figure 6.31 Click "Setting"

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Figure 6.32 Input the road information

b) Termination of Data Recording

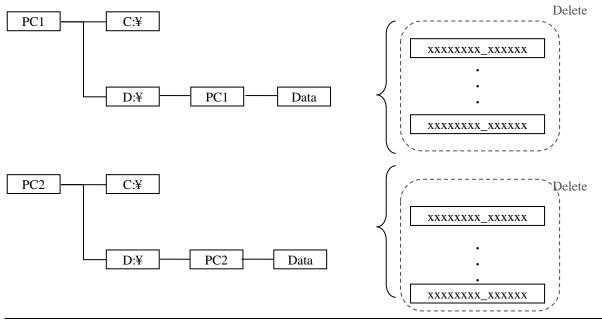
Shut down the system The operator don't have to copy the measurement data from PC to External HDD (This system automactically copyes the data to HDD during measuring time)



Figure 6.33 Shutting Down the System

NOTE:

- When a capacity of HDD is small (under 5%), the road condition data would not be collected.
- If a capacity of HDD is small, the operator should delete the data in HDD of PC before the shut down the system.



- 6) **STEP 6 : Tidy up the equipment**
- Close the cover (RC,LP)
- Close the cover (LDS)
- a) Close the cover (RC,LP)



Figure 6.34 Close the cover (RC,LP)

b) Close the cover (LDS)



Figure 6.35 Close the cover (LDS)

7. Instruction Manual of Start and End Point Setting Application

7.1 Purpose

This Application is run by the Measurement Team to confirm the data measured in the field. On the other hand, the Analysis Team analysis the data measured between the starting point and the ending point set by the Measurement Team in this Application so that smooth transferring of positional setting will be realized.

7.2 Input and Output of Data

Table 7.1 shows input and output data in this Application.

 Table 7.1
 Input and output data in this application

Input data	Output data	Remarks
PC1 Data	PC1 Data	
PC2 Data	PC2 Data	

7.3 Device

Table 7.2 shows devices used for running this Application

Device	Imaga	Domontes
	Image	Remarks
PC		Vehicle-mounted PC is also available.
HDD	~	HDD which data is stored (PC1, PC2)
This Application		
Materials for checking starting and ending points		Diagram, official documents, etc.

Table 7.2 List of devices

7.4 Interface

<Setting screen >

Replay					
Forward Back 0.50	m	Forward,Back(Step)	0.50	m	
Rut			IRI		
Width	50mm		Width	25mm	
Invalid Threshold	10		Forward View		
Invalid Continuous	40	m		-10.00	m
Sample Distance	50cm		20050		
OI DATA				В	rowser.
C2 DATA				B	rowser

Figure 7.1 Interface of setting screen

Table 7.3 Items and their contents for settings						
Item	Contents	Remarks				
Replay	Playback of the screen					
Forward, Back	Continuous playback of distance					
Forward, Back(Step)	Frame forward, back of distance					
Rut	About rutting volume					
Width	Select the display width / Distance	10mm, 20mm, 50mm				
	between each point in a cross section					
Invalid Threshold	Specify the threshold for detecting invalid	Standard deviation of rutting				
	values	value of each point in a cross				
		section				
Invalid Continuous	Continuous range of invalid volume					
Sample Distance	Sample distance of invalid volume	10cm、50cm				
	checking					
IRI	About pavement longitudinal profile					
Width	Select the display width	12.5mm, 5mm,50mm,100mm				
Forward View	About forward view					
Offset	Specify distance of offset displaying					
	analysis window and front view					
PC1 DATA	Specify the folder in which PC1 is stored					
PC2 DATA	Specify the folder in which PC2 is stored					

Table 7.3	Items and their contents for settings	
-----------	---------------------------------------	--

<Data selecting screen>

No.	St	Measure Date	Reset Line	Rut Check	RV Data	RD Data	IRI Data
1	ок	2013/09/19 11:47:33			OK	OK	ок
2	OK	2013/09/19 11:55:35			OK	OK	OK
3	OK	2013/09/19 12:05:33			OK	OK	OK
4	OK	2013/09/19 12:09:54		Done	OK	OK	OK
5	ок	2013/09/19 12:57:15		Done	OK	оĸ	OK
6	OK	2013/09/19 14:34:56		Done	OK	OK	OK
7	OK	2013/09/19 15:02:09		Done	OK	ÖK	OK
8	NG	2013/09/19 15:23:30		Done	NG	OK	OK
9	OK	2013/09/19 15:59:29		Done	OK	OK	ОК
10	NG	2013/09/19 17:09:48			NG	OK	OK
11	OK	2013/09/19 17:10:39		Done	OK	OK	OK

Figure 7.2 Interface of data selection

Item	Contents	Remarks
No.	Serial numbers in folders	
Status	Data acquisition status	Check whether any defection in data acquisition
Measure Date	Measured time (year, month, date, hour, minutes, and second)	
Reset Line	Whether the starting and ending positions are set in the Application	
Rut Check	Whether invalid volume of rutting are confirmed	
RV Data	Confirmation of the number of road surface images	
RD Data	Confirmation of the number of rutting data	
IRI Data	Confirmation of the number of longitudinal profile data	
FV Data	Confirmation of the number of forward views	



Figure 7.3 Interface of main screen

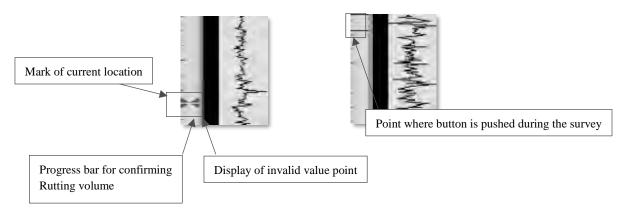


Figure 7.4 Contents of additional information

Distance: Survey Data:	0.000m / 2803.55 2013/09/19 11:55		Select
M			
Push Positio		Set Position (pro	gram) Jump
Road Displa	ay ▼		
		Setting	Exit

Figure 7.5 Interface of control panel

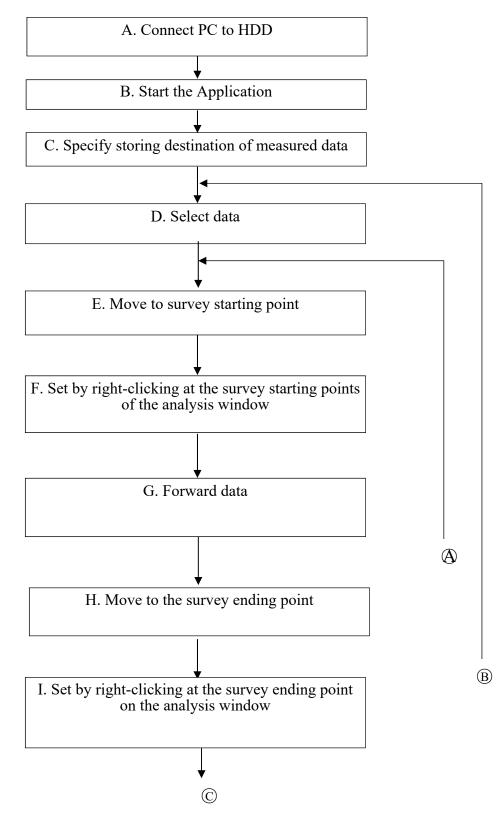
Item	Contents	Remarks			
Distance	Position where the screen is displaying at the moment	Cumulative distance since the commencement of survey			
Survey Date	Measured time (year, month date, hour, minute, and second)				
Select	To go to data selecting screen				
	Frame back				
•	Continuous back				
	Stop				
•	Continuous forward				
×	Frame forward				
Push Position(survey)	List of positions where button was clicked during the survey	Click "Jump" to go to the list			
Set Position(Application)	List of positions set in the Application	Click "Jump" to go to the list			
Road Display	Switch the road display (Sunshine/Shade)				
Setting	Jump to the setting screen				
Exit	To exit				

 Table 7.5
 Contents of control panel

7.5 Operating Procedure

(1) Workflow

Figure 7.6 shows the workflow of the Starting and Ending Point Setting Application.



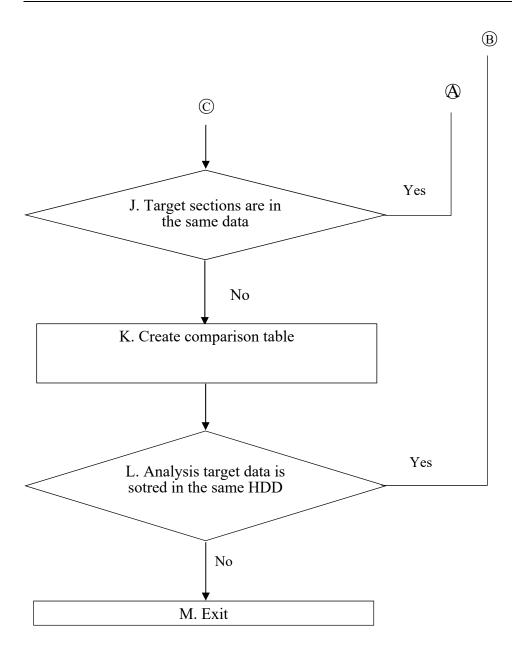


Figure 7.6 Workflow

A. Connect PC to HDD

Connect a PC to the HDD in which the data (PC1, PC2) is stored. The PC to be connected shall be either laptop or a PC mounted on REAL Mini.

B. Start the Application

Double-click the Application (the icon is shown in) on the desktop of the PC connected to the HDD.



Figure 7.7 Icon of the Application

C. Specify storing destination of measured data

Click "Setting" of the Application and specify the storing destination by clicking "Browser" of both "PC1 DATA" and "PC2 DATA" shown in the lower parts of the setting screen.

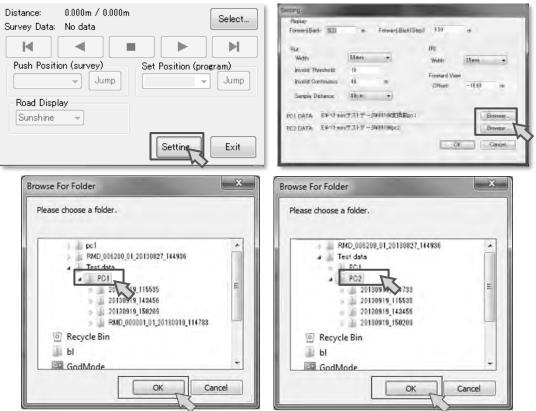


Figure 7.8 Method to specify storing destination of measured data

D. Select data

Specify data for setting starting and ending points. Click "Select" to select the data.

Distance: 0.000 Survey Data: No c	0m / 0.000m data	Select	faller) Dem				RV FMPs	ati tina	ties many
Ruck Desition (a)			1 0 1 0 1 0	2013/08/29 14:34:36	Ā	Dave Dave	CR CR	DK DK	da da da
Push Position (su Road Display		Jump							
	Setting	Exit	/					4	2

Figure 7.9 Data selecting method

E. Move to the survey starting point

Each data is displayed on the screen when data selection is completed in D. Then, jump to the survey staring point as shown in Table 7.6.

Button operation	Transferring method			
Button operation	• Select the position of button operation in the field from the list of "Push			
	Position(Survey)" and click "Jump".			
	• Use \square , \square and other button to adjust an accurate position.			
Non-button	· Checking front view, roughly move by clicking the section where			
operation	presented in Ministry is displayed.			
	•When the display shows near starting point, use \square , \square and other			
	button to adjust an accurate position.			

Table 7.6	Methods to move to the survey staring point by button operation

	Distance: 2758.644m / 2803.551m
	Survey Data: 2013/09/19 11:55:35
	Push Position (survey) 2431.100 m Jump 429.652 m
	Road Display Sunshine
Balance for Same Tigge	Setting Exit

Figure 7.10 Methods to move to the survey staring point by button operation

F. Set by right-clicking at the survey starting points of the analysis window

After jumping to the survey starting position, match the position of cursor to the survey starting position and right-click. After that, click "Set Line".

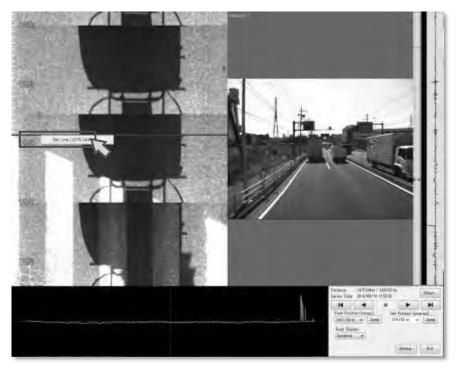


Figure 7.11 Position setting screen

G. Forward data

After setting the survey starting position, forward data to set the ending position where data analysis is conducted.

	Data playback method		
Playback method	Contents		
H A = P H	Frame back, continuous back, continuous forward, frame forward		
-	Jump to the clicked position		
Proc. Prod. on tear or 1 Prof. Prot. pr	Jump to the position where button operation was performed in the field.		

Table 7.7Data playback method

H. Move to the survey ending point

By using any of Table 7.6, go to the sending position where data is to be analyzed. Stop the screen when the ending position is showing on the analysis window.



Figure 7.12 Ending point (example)

I. Set by right-clicking at the survey ending point on the analysis window

Right-click after locating the cursor at the survey ending point on the analysis window. "Set Line (distance)" is then displayed and set the position by clicking it.



Figure 7.13 Ending position setting screen

* Positions set by "Set Line" are displayed accordingly in Set Position (application) of the control panel.

Distance Survey Data	27723984m 2833/89/1	2 2466501 8 335520		Select.
н	4			H
Park Prints 2411 181 m Road Displ Damaking	-	a later	nt Position (or national) 277.516 m 275.689 m	
			Setter.	[Lat

Figure 7.14 Selection of set position

* Positions set by "Set Line" are displayed by red line in the field for current location of additional information.

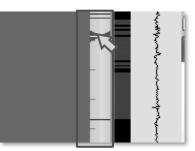


Figure 7.15 Field for current location of additional information

Table 7.8Meaning of the color of horizontal lines

Color	Meaning
Blue	Position of button operation in the field
Red	Position set in this Application

J. Target sections are in the same data

When multiple target sections are in the data of 1 scene (Figure 7.16), go to the starting point of the next section in a manner described in Table 7.6. On the other hand, when only a single target section is in the data of 1 scene, go to K of the workflow.

Continuous measurement (measure 2 sections without interruption)

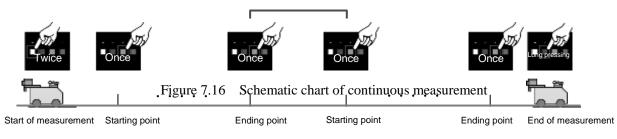


Table 7.9	Action to be taken after setting the ending position	
	8 8 8	

Target section (in 1 scene)	Action
Multiple sections	Transfer data and go to the starting point of the next section
Single section	Select the next scene (select data by clicking "Select")



Figure 7.17 Go to the next section

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K. Create comparison table

Measurement Team creates a comparison table so that Analysis Team is able to identify road, kilometer-post, lane, direction and other relevant information for confirming measured data. Table 7.10 shows items to be listed in the comparison table. In addition,

shows an example of the table.

	14010	7.10 Item	s fisted in comparison table	
Column	Header		Contents	Remarks
А	Road Cate		Road Category	
В	Road No.		Road number	
С	Road No. Sup		Road number supplement	
D	Branch No.		Branch number	
Е	Left/Right		Left and Right	
F	Lane No.		Lane number	
G	Kilometer-post	From	Kilometer-post (from)	
Н	То		Kilometer-post (to)	
Ι	Length		Length of data	
J	Folder Name		Name of folder	
Κ	Note		Special notes	

Table 7.10	Items	listed	in	comparison	tab	le

2	66		fe.					-		
2	Д,	E	0	D	E	F	G	н	1	
	Route No.	Branch No	Up/Down	Lane No	From	ter-post To	Langth	Folder Name	Note	
	1	0	nwab	1	KM181+570	KM235+885	54800 2	0121003_112614		
1	1) dawn		KM235+885	KM258+900		0121007_091623		
8	1	0	(BDWN		KM258+900	KM285+400	28125-2	0121007_091623		
ł										
1	a al Steart	Street, 3	Start? Part				TH	et		 -
21		STREE S	A REFEACE				114		1-101日 100~ ->	 1

Figure 7.18 An example of comparison table

L. Analysis target data is stored in the same HDD

Select data from those stored in the HDD, of which the starting and ending positions are not set, and repeat the work D to I as described in the workflow.

	20m / 2803.551r 09/19 11:55:35	n	Select
Push Position (surv 2431.100 m →		t Position (pr 4.162 m 🕞	ogram) Jump
Road Display Sunshine 👻			
		Setting	Exit

Figure 7.19 Data selecting button

Data:							
NO.	5t	Measure Date	Reset Line	Rut Check	RV Data	RD Data	IRI Data
1	OK.	2013/09/19 11:55:35	Done	Done	OK.	OK	OK
2	OK	2013/09/19 14:34:56		Done	OK:	OK OK	OK
3	OK	2013/09/19 15:02:09			OK.	OK	OK

Figure 7.20 Data selecting screen

Data displaying "Done" in "Set Line" on the data selecting screen means that it has already been set. Hence, it is necessary to select blank column and set the position of starting and ending points.

M. Exit

Make sure that "Done" is displayed in all "Set Line" before exiting this Application.

Distance: Survey Data:	2772.420m / 280 2013/09/19 11:5		Select
			M
Push Positio 2431.100 m Road Displa Sunshine	▼ Jump	Set Position (progr 874.162 m ╺	am) Jump
		Setting	Exit

Figure 7.21 Application exit button

(2)Data delivery

By using this Application, data setting the starting and ending positions is transferred to Analysis Team. Data needed by the Analysis Team is listed in Table 7.11.

Tuble	Table 7.11 Derivered data of derivering method							
Delivered data	Delivering method	Remarks						
PC1 data	HDD							
PC2 data	HDD							
Comparison table	HDD							

 Table 7 11
 Delivered data of delivering method

8. **Instruction Manual of Data Conversion Application**

8.1 Purpose

This application is designed to convert data gathered by road surface measuring vehicles into a format readable by the analysis application.

8.2 Input and Output Data

Data that are used (input) and created (output) by the analysis application are as described in Table 8.1.

Table 8.1 Input and Output Data of the Data Conversion Application						
Name	Туре	Notes				
PC1 measurement data	Input	PC1 data collected by REAL Mini				
PC2 measurement data	Input	PC2 data collected by REAL Mini				
Analysis data	Output					

Table 8.1	Input and	Output Data	of the Data	Conversion Application

8.3 Equipment

Equipment required is as described in Table 8.2.

Equipment name	Image	Notes
Computer		
HDD	2	HDD which data stored PC1 and PC2 data
This application (RM2_DATA_CNV.exe)	RM2_DATA_CNV.exe	
Road information resources		Field surveys, field notes, drawings, official documents, etc.

Table 8.2 List of Equipment

8.4 Interface and Contents

<Main Window>

	i2 Data Convert Program Vers	ion 1.03				3
leasure (Data					
No.	Date	Distance(Km)	Project	Road Type	Road Code	
mi i	2013/09/19 11:55:35	2.8036	Test	9.#8市高	1	
2	2013/09/19 12:05:88	2.3561	Test	市高	1	
3	2013/09/19 12:09:54	9.0688	Test	市高	144	
4	2013/09/19 12:57:15	39.4466	Test	市高	0	
5	2013/09/19 14:34:56	13.6103	Test	市高	0	
6	2013/09/19 15:02:09	5.3365	Test	市高	0	
7	2013/09/19 15:23:30	20.3890	Test	市高	0	
8	2013/09/19 15:59:29	25.9456	Test	市高	0	
9	2013/09/19 17:09:48	0.1577	Test	市高	0	
10	2013/09/19 17:10:39	12.5761	Test	市高	0	
*				All Select All Clea	r Updat	ė
	r:D¥H25_Vietnew¥ゴロバニ /.コ	E_ni≯Wdata (DamaineR))187/3⊡ T⊷∔s⊩174 N		r Updat	ė
ta Folder				(1926)	r Updat	
ta Folder				(1926)		
ita Foldei				(1926)		
ta Folder	n: D#H25_Vietnam¥H7144= 7.= 0[105901] [MSG]-Real Mini2 D 0[105901] [MSG]-Finding Mea 0[110343] [MSG]-Finding Mea 0[110343] [MSG]-Finding Mea			(1926)		
ta Folder				(1926)		
ta Folde				(1926)		
ta Folde				(1926)		
ta Folde				(1926)		
ta Folde				(1926)		
ta Folde				(1926)		

Figure 8.1 Main Menu

Feature	Description	Notes	
Measure Data	Measure Data Displays a list of measurement data		
All Select	Selects all data		
All Clear	Cancels selection		
Update	Updates the current display		
Convert	Execute conversion		
Setting Opens the Setting menu			
Exit	Shuts down the application		

<Setting Menu>

Data Fold	er		
PG1:	G#Vietnam Surveyed Data¥pc1		Browse
PG2:	G:¥Vietnam Surveyed Data¥pc2		Browse
Output:	G¥Vietnam Surveyed Data		Browse
Detail Rut		GPS	
Oistano	e(mm).	Distance(mm): 100	
IRI		ти	
Distance	e(mm). 100 Gerrect	(2)(e/lanse/imm) 100 Correct	
Pas Infa			Browse Disable
RV Gali			Browse Disable

Figure 8.2 Setting Menu Interface

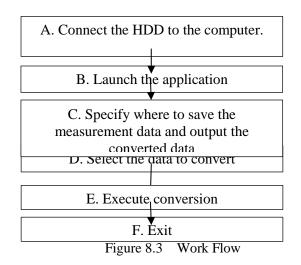
Table 8.4 Features of the Setting Menu	ares of the Setting Menu
--	--------------------------

Feature	Description	Notes
Data Folder	Settings for the Input and Output data folders	
Browser	Specifies the destinations for saving the input data and output data.	
OK	Accept	
Cancel	Cancel	

8.5 Procedures

(1) Work Flow

The work flow for setting up the origin-destination application is as described in Figure 8.3.



A. Connect the HDD to the computer.

Connect the HDD containing data (PC1 and PC2) to the computer.

B. Launch the application

Double click the application within PC-01 of the connected the HDD to launch the application. The icon of the application is a shown in Figure 8.4.



Figure 8.4 Icon of the Application

C. Specify save locations of the measurement data

Click the "Setting" button on the Main menu to display the Setting menu. Click the "Browse..." button for the items "PC1", "PC2" and "Output" under the Data Folder pane of the Setting menu and specify the save location for each data.

Convert Program Version 1.03 2013.11.28 Data Data Tourae(s)	
	Setting Exit
ting	
Data Folder	
PC1: G:¥Vietnam Surveyed Data¥pc1	Browse
PC2: G¥Vietnam Surveyed Data¥pc2	Browse
	(minute)
a Collisteen Connected Data	(Boundary)
Output: G¥Vietnam Surveyed Data	Browse.
🗌 Detail	Browse
Detail Rut GPS	
🗌 Detail	
Detail Rut GPS Dir Kancelmini 100 I=DCorrect Distancelmi	m) 100 ElCorrect
Detail Rut GPS On Fonce (mm) 100 Detail Browse For Folder	
Detail Rut GPS Dir Kancelmini 100 I=DCorrect Distancelmi	m) 100 ElCorrect
Detail Rut GPS On Fonce (mm) 100 Detail Browse For Folder	m) 100 @(Correct Browse For Folder Please choose a folder.
Detail Rut GPS Di Fonus (mm) 100 Distance (mm) Browse For Folder Please choose a folder.	m) 100 Correct Browse For Folder Please choose a folder.
Detail Rut OFForce(mm) 100 Correct Desence(mm) Browse For Folder Please choose a folder.	m) 100 Correct Browse For Folder Please choose a folder. RMD_006200_01_20180827_144936 Test data PC1
Detail Put GPS Or Fonce(mm) 100 Domect Descence(mm) Browse For Folder Please choose a folder. Please choose a folder. I multiple pot I met data I met data I PO1 I met data I	m) 100 Correct Browse For Folder Please choose a folder. RMD_005200_01_20180827_1144936 Test data PC1 PC2
Detail Rut GPS On Fance (mm): 100 Demonstration Browse For Folder Please choose a folder. Please choose a folder. Please choose a folder. Test data POI	m) 100 Correct Browse For Folder Please choose a folder. PRMD_0006200_01_20180827_144936 PC1 PC2
Detail Rut GPS Di Fonus (mm) 100 Denent Distance (mm) Browse For Folder Please choose a folder. Please choose a fold	m) 100 Browse For Folder Please choose a folder. Please choose a folder. RMD_006200_01_20180827_144936 Test data PC1 PC2 20130919_114733 20130919_142456
Detail Rut GPS Or Fance (mm) 100 Domest Detail Rut GPS Or Fance (mm) 100 Domest Detail Pol Pol Pol Pol 20130919_115535 20130919_115555 20130919_115555 20130919_115555 20130919_115555 20130919_115555 Pol RuD_000001_01_20130019_114783	m) 100 Correct Browse For Folder Please choose a folder. Please choose a folder. Please choose a folder. PC2 PC2 20130919_114733 20130919_114733 20130919_114733 20130919_114735 20130919_142356 20130919_150209
Detail Rut GPS Or Fonce (mm) 100 Dorrect Detail Receive from Please choose a folder. Pleas	m) 100 Correct Browse For Folder Please choose a folder. PC2 PC2 20130919_114233 20130919_114235 20130919_14256 20130919_15355 20130919_16209
Detail Rut GPS Or Fonce (mm) 100 Dorrect Detail Rut GPS Or Fonce (mm) 100 Dorrect Detail Please choose a folder. Please choose a	m) 100 Correct Browse For Folder Please choose a folder. PC1 PC2 20130919_114233 20130919_14256 20130919_16209 Recycle Bin bl
Detail Rut GPS Or Fonce (mm) 100 Dorrect Detail Rut GPS Or Fonce (mm) 100 Dorrect Detail Please choose a folder. Please choose a	m) 100 Correct Browse For Folder Please choose a folder. PC2 PC2 20130919_114233 20130919_114235 20130919_14256 20130919_15355 20130919_16209

Figure 8.5 Specifying the Save Locations of Measurement Data

D. Select the data to convert

Select the data to convert from the list of measurement data under the Measure Data pane. To select an item, check the checkbox under the "No." column.

leasure Da	ata					
No.	Date	Distance(Km)	Project	Road Type	Road Code	
1	2013/09/19 11:55:35	2.8086	Test	2都市高	1	
2	2013/09/19 12:05:88	2.8561	Test	市高	1	
	2013/09/19 12:09:54	9.0688	Test	市高	1	
	2013/09/19 12:57:15	39.4466	Test	市高	0	
	2013/09/19 14:34:56	13.6103	Test	市高	0	
	2013/09/19 15:02:09	5.3365	Test	市高	0	
7	2013/09/19 15:28:30	20.3890	Test	市高	0	
8	2013/09/19 15:59:29	25,9456	Test	市高	0	
9 10	2013/09/19 17:09:48	0.1577	Test	市高	0	
10	2013/09/19 17:10:39	12.5761	Test	市高	0	
				All Select All Clea	ar Updat	ė
ta Folder:	:D¥H25_Vietnam¥プログラムチ	Fェック¥data (Remain 1)	09.513GB Total:174.062GI		r Updat	9
					er Updat	
13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea	lata Convert Program Vi sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20		lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data				
13/12/20 13/12/20 13/12/20 13/12/20 13/12/20	[13:54:00] [MSG]-Real Mini2 D [13:54:00] [MSG]-Finding Mea: [13:54:00] [MSG]-Finding Measure [15:38:21] [MSG]-Finding Meas	lata Convert Program Vi sure Data Data found(s) sure Data			Convert	-

Figure 8.6 Data Selection

E. Execute the conversion

Click the "Convert..." button to execute the conversion.

easure [Jata					
No,	Date	Distance(Km)	Project	ad Type	Road Code	F
1 i	2013/09/19 11:55:35	2.8086	Test	都市高	1	(
2	2013/09/19 12:05:88	2.8561	Test	都市高	1	- (
1 3	2013/09/19 12:09:54	9.0688	Test	都市高	1	-0
4	2013/09/19 12:57:15	39.4466	Test	都市高	0	-0
5	2013/09/19 14:34:56	13.6103	Test	都市高	0	- 0
6	2013/09/19 15:02:09	5.3365	Test	都市高	0	- 01
7	2013/09/19 15:23:30	20.3890	Test	都市高	0	. (
8	2013/09/19 15:59:29	25.9456	Test	都市高	0	
9	2013/09/19 17:09:48	0.1577	Test	都市高	0	. (
10	2018/09/19 17:10:39	12.5761	Test	鄙市高	0	(
+		nı.				+
				All Select All Clea	ar Update	
ta Foldei		ata Convert Program Vi	arcion 102 2012 11 20		Convert.	-
0 /10 /0		Jata Convert Program ve	ersion 1.08 2018.11.28			
13/12/2 13/12/2	0[13:54:00] [MSG]-Real Mini2 [0[13:54:00] [MSG]-Finding Mea 0[13:54:00] [MSG]-10 Measure 0[15:38:32] [MSG]-Finding Mea	Data found(s) sure Data				
13/12/2 13/12/2	0[13:84:00] [MSG]-Real Mini2 [0[13:64:00] [MSG]-Finding Mea 0[13:84:00] [MSG]-I0 Measure 0[15:88:92] [MSG]-Finding Mea	Data found(s) sure Data			_	
13/12/2 13/12/2	0[13:54:00] [MSG]-10 Measure 0[15:38:32] [MSG]-Finding Mea	Data found(s) sure Data			_	
13/12/2 13/12/2	0[13:54:00] [MSG]-10 Measure 0[15:38:32] [MSG]-Finding Mea	Data found(s) sure Data				
13/12/2 13/12/2	0[13:54:00] [MSG]-10 Measure 0[15:38:32] [MSG]-Finding Mea	Data found(s) sure Data				

Figure 8.7 Execute Conversion

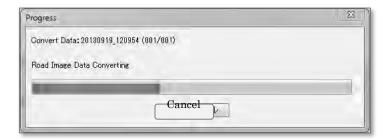


Figure 8.8 Conversion in Progress

F. Exit

Confirm that the log window at the bottom of the Main menu displays the message, "[MSG[-<<<Finish **m**s>>>".

Click "Exit" to exit the application.



Figure 8.9 Log Window

8.6 Re-execute

If it is necessary to re-execute the data conversion, delete the "DATACNV.INF" folder created under the PC measurement folder that was created to the HDD and also delete the "RMD_XXXXX_XXX_XXXXXXXXXXXXXX" folder containing the converted data in the output folder.

8.7 Event Log

While the data conversion is in progress, logs are displayed at the bottom of the Main menu. A log consists of a timestamp, a log type and a message.

Table 8.5 List of Displayed	a Ever	115		
Log		D	Description	
YYYY/MM/DD-HH:MM-SS.MSS [KKK]-message	KKF	K: log typ	be	
		MSG	WNG	ERR
		Event	Warning	Error
	Ame	essage is	displayed.	
YYYY/MM/DD-HH:MM:SS.MSS year, month, date,	Indic	ates the	time of occ	urrence.

Table 8.5 List of Displayed Events

hour minute, second, millisecond

Log	Description
REAL Mini2 Data Convert Application	The version information displayed when the
Version X.XX XXXX.XX.XX	application is launched.
Finding measure data	The application is searching for measurement
	data.
N Measure data found(s)	N record[s] of measurement data was found.
Convert data : XXXXXXXX XXXXXXX	Converting data XXXXXXXX_XXXXX.
(NNN/NNN)	
Start processing	Pre-processing the data to prepare for
	conversion.
This data is converted to previous[XXXX]	XXXX has already been converted.
End processing[N]	Pre-processing is complete.
XXX Start data converting	Starting data conversion of "XXX".
XXX Data donverting error	An error occurred while converting data
	"XXX".
XXX End data converting	Data conversion of "XXX" is complete.
Cancel data converting	The data conversion has been cancelled.
<<< <finish xxmxxs="">>></finish>	Data conversion of the entire data is complete.

Table 8.6List of Events

Table 8.7List of Errors

Log	Description
XXX Fail to create output folder	Failed to create the folder for "XXX".
Fail to write measure info[N]	Failed to write the measurement information.
POSITION.INF File is not found	POSITION.INF could not be found.
PC1_MEASURE.INF File not found	PC1_MEASURE.INF could not be found.
KP_LIST.CSV File not found	KP_LIST.CSV could not be found.
MARK_LIST.CSV File not found	MARK_LIST.CSV could not be found.
KP_RESET.INF File not found	KP_RESET.INF could not be found.
RUT_CHECK.INF File not found	RUT_CHECK.INF could not be found.
DATACNV.INF File not found	DATACNV.INF could not be found.
PC2_MEASURE.INF File not found	PC2_MEASURE.INF could not be found.
ROAD_CAL.INF File not found	ROAD_CAL.INF could not be found.
Memory is not enough[Size:XXXX]	Failed to allocate the required amount of
	memory.

9. Instruction Manual of Data Analysis Application

9.1 Purpose

This application is responsible for creating data regarding cracking, rutting, and IRI data and GPS coordinates using the road surface data collected by REAL Mini.

9.2 Input and Output Data

Data used for this application and the data output are as described in Table 9.1.

Table 9.1 Input and Output Data of the Analysis Application				
Name	Туре	Notes		
RMD 999999 999 99999999 999999	Input	Converted data		
C3_*****.csv	Output	Cracking analysis		
R3_*****.csv	Output	Rutting analysis		
S3_*****.csv	Output	IRI analysis		
FA_*****.csv	Output	GPS coordinates		

Table 9.1 Input and Output Data of the Analysis Application

9.3 Equipment

Table 9.2 describes the equipment required for this application.

Equipment Name	Table 9.2 List of Equipmen Image	Notes
Computer		INDICS
HDD	2	HDD where data is stored.
This application (RM2_RISA.exe)	RM2_RISA.exe	
Road information resources		Field surveys, field Notes , drawings, official documents, etc.

Table 9.2 List of Equipment

9.4 Interface and Contents

<Launch Menu>

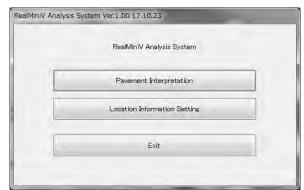


Figure 9.1 Launch Menu

Table	9.3 Fe	atures o	of the l	Launch	Menu	
		_				

Item	Description	Notes	
Pavement Interpretation	Launches the analysis application.		
Location information Setting	Launches the Location setting application.	This feature will not be discussed in this section.	
Exit	Exits from the application.		

<Data Selection Menu>

	older:				
):¥H2	5_V'		an an an		Browse Upda
ata					
No.	Road	Lane	Measure Date	Inspected	Folder
1	000000	01	2013/09/18 13:22:50	Exist	RMD_000000_01_20130918_132250
2	000000	01	2013/09/19 14:34:56	Not Exist	RMD_000000_01_20130919_143456
3	000000	01	2013/09/19 15:02:09	Not Exist	RMD_000000_01_20130919_150209
4	000000	01	2013/09/19 17:10:39	Not Exist	RMD_000000_01_20130919_171039
5	000001	01	2013/09/19 11:47:33	Exist	RMD_000001_01_20130919_114733
6	000001	01	2013/09/19 12:09:54	Not Exist	RMD_000001_01_20130919_120954
					and the second sec
					Next Back
					Next

Figure 9.2 Data Selection Menu Interface

Table 9.4	Features of the Data Selection Menu	

Item	Description	Notes
Data Folder	Displays the folder path of the current file location.	
Browse	Opens the Data Folder Selection window.	
Update	Updates the Data pane.	
Data	Displays a list of analysis data present in the specified folder.	
No.	List number.	
Road	Road number configured at the time of measurement.	
Lane	Lane number configured at the time of measurement.	
Measure Date	Time stamp of when the measurement was taken.(Year, month, date, hour and minutes)	yyyy/mm/dd hh:mm:ss
Inspect	Presence of the analysis data	Exist/Notesxist
Folder	Folder path of the analysis data	
Next	Go forward to the Information menu	Enabled when a data is selected from the list.
Back	Go back to the Launch menu.	

<Information Menu>

esore le	normation					
No.	From(Km)	To	(Km) Me	asure(Km)	Total(Km)	6
1	0.0	0	.000	0.582	0.582	
2	0.0	1	000	0.960	1542	
3	1.0	2	.000	0.078	1.619	E
4	20	3	000	0.550	2.169	1
5	3.0	4	000	0.182	2.351	
6	4.0	5	.000	0.570	2.921	
7	5.0	6	1000	0.899	3.821	
8	6.0	0	000	0.049	3.870	
spect hr	omation					
No.	Start(m)	End(m)	Distance(m)	Start Point(m)	End Point(m)	
000	0 000	147.766	147.766	0.0	0.0	
001	147 766	3769.766	3622.000	0.0	0.0	
002	3769 766	3870,192	100.426	0.0	0.0	
				-		

Figure 9.3 Information Menu Interface

Table 9.5	Features	of the	Informat	ion Menu
1 4010 7.0	I catalob	or the	monna	nom miche

Item	Description	Notes
Information	Displays the measurement timestamp of the selected data.	
Road category	Describes the road type category.	1 degit
Road Number	Displays the road number.	3 degits
Road Number Supplement	Displays the road number supplement.	3 degits
Branch number	Displays the brunch number.	3 degits
Measure Information	Information of the events interval in measurement	
Inspect Information	Information of an analysis section	
Next	Go forward to the Analysis menu.	
Back	Go back to the Data Selection menu.	

<Analysis Screen>

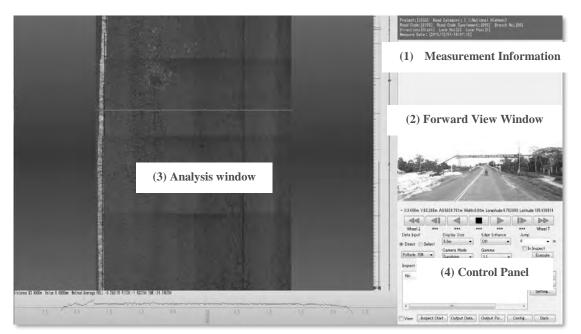


Figure 9.4 Analysis Screen

Table 9.6	Features	of the	Analysis	Screen

Item	Description	Notes
(1) Measurement	Displays the measurement information,	Information entered at the
Information	such as the road, measurement timestamp	time of measurement.
	and others.	
(2) Forward View	Displays the forward view image.	
Window		
(3) Analysis Window	Displays the road surface image, cross and	
	longitudinal sections.	
(4) Control Panel	Used for operations such as playing back	
	images, jumping from point to point and	
	other operations.	

(1) Measurement Information

Figure 9.5 Measurement Information

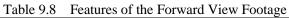
Table 9.7 F	Features of the	Information Pane	
-------------	-----------------	------------------	--

Item	Description	Notes
Project	Name of the project	
Road Category	Road category of the target road	1 degit
Road Code	Displays the road and branch numbers.	3 degits
Road Code	Supplement number of the road code	3 degits
Supplement		
Branch No.	Branch number of the road code	3 degits
Direction	Left bound or Right bound	
Lane No.	Traffic lane	
Lane Pos	Lane position of the measurement	
Measure Data	Time stamp of the time of measurement (year, month, date, hour and minutes)	

(2) Forward View Image



Figure 9.6 Forward View Image



Item	Description	Notes
Forward view Image	Displays the forward view image.	

(3) Analysis Window

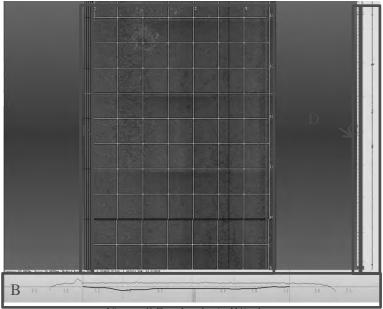


Figure 9.7 Analysis Window

Feature	Description	Notes
A: Road surface image	Displays the image of the road surface.	
	Interprets road cracks.	
B: Cross section	Displays the cross section of the road	
	surface	
C: Longitudinal section	Displays the longitudinal section of the	
	road surface.	
D: Position information bar	Displays information regarding the	
	current position, event positions and	
	such.	
E: Management Data bar	Configurations for managing data, such	
	as specifying the road type category and	
	others.	

(4) Control Panel

	1						
Wheel ↓	***		**	***	***	***	Wheel 1
Data Input		Display	Size	Edge	Enhance	Jump	
Direct © S	Salact	4.5m	+	Off	*	0	+
Direction	Vertere et	Camera	Mode	Gamn	na	🗐 In	Inspect
Pothole 75%	•	Sunshi	Dieles.	1.1	na -	1	Execute
No.	Start(r	n)	End(m)) Distan	ce(m) St	tart Point(Move
		0	146.274		6.274 6.274	art Foint([0.000
	0.00		140.414			10	Clear
000	0.00 146-20		3820 774	367	4 500		
	0.00 146.23 3820.73	4	3820.774		4.500 2.000		Setting
000 001	146.23	74 74				1 1 1	Setting
000 001 002	146.23 3820.73	74 74	3822.774		2.000		Setting

Figure 9.8 Control Panel Interface (full view)



Figure 9.9 Operation Panel Interface

Table 9.10	Features of the Operation Panel
------------	---------------------------------

Item	Description	Notes
X, Y, All, Width, Longitude, Latitude	Coordinates of the cursor placed on the road surface image	Displays the distance and longitude and latitude information retained by the data.
	Frame backward	
<1	Mesh backward	Go back one mesh at a time
	Continuous backward	
	Stop	
	Continuous forward	
L Laure	Mesh forward	Go forward one mesh at a time
	Frame forward	

Data Input	Display Size		Edge Enh	nance
Direct @ Select	4.5m •		Off	*
Direct V Select	Action in the second se	_		
Pothole 75%	Camera Mode		Gamma	

Figure 9.10 Road Surface Image Operation Interface

Table 9.11	Features of the Road	Surface Image	Operation Interface
------------	----------------------	---------------	---------------------

Item	Description	Notes
Data Input	Configure the input setting for interpreting road cracks	
Direct	Input directly from a keyboard	
Select	Input by selecting from the list	
Display Size	Configure the display size of the road surface image	
Camera Mode	Switch the lighting mode of the road surface image	

	sunshine, shadow or synthetic.	
Edge Enhance	Configure the level of edge enhancement	
Gamma	Configure the gamma correction value.	



Figure 9.11 Jump Operation Interface

Table 9.12 Features of the Jump Operation	Table 9.12	Features	of the Jump	Operation
---	------------	----------	-------------	-----------

Item	Description	Notes
Jump	Jump to the position specified	
Specify distance	Select a event positions from the list, or, enter a specific distance manually	Dropdown list (input is also allowed)
In Inspect	Configure the movement range.	ON: Movement within the current range OFF: Movement within the entire data
Execute	Execute movement	

No.	Start(m)	End(m)	Distance(m)	Start Point(Move
000	0.000	146.274	146.274	11	Clear
001	146.274	3820.774	3674.500	17	
002	3820.774	3822.774	2.000		Setting
003	3822.774	3870.192	47.418	1	
0 T	- 1	n.	-	*	

Figure 9.12 Configuration Panel Interface

Table 9.13	Features of the Configuration Panel
------------	-------------------------------------

Feature	Description	Notes
Inspect Data List	Displays the data list	Displays a list by sections
Move	Moves to the starting point of the data selected from the list.	
Clear	Deletes the selected data from the list.	Integrates the selected data with the previous section data.
Setting	Determines the analysis interval	
View	Turns on/off the HUD on the road surface image	
Inspect Start	Begin the configuration of the analysis section.	
Output Data	Opens the Data Output menu.	
Output Picture	Opens the Road Surface Image Output menu.	
Configuration	Opens the Configuration menu	
Back	Go back to the Data Selection menu.	

Common Ite	em							
Road Catego	ory: 🔟 F	load No: 0	Road No Su	upplement: 0	Branch No: 0	Direction	t -	
Lane No:	0 Lane	Position: 0	Méasure Dat	te: 20161201	Operator: TSUCHI	YA Vehicl	es: Real Mini	
Coefficient								
Rut X Rate:	0.000.0	Rut Y Rate:	0.0000	Rut Count	40	ź		
Output Item	r.							
Crack	. <u>∎</u> 0	rack(detail) 🖉	Crack(ratio)	Rut	Rut(depth)	Profile	IPI	
Fwd V	Course III Co	arface Type	Structure	Coordinate	All Fwd View	IMU		
	view	итасе Туре	Structure		TAT WILLING VIEW	- ANICO		
			orractore	Coordinate	TAT WILLING VIEW	L AVIO		
File Name: C	3PS02		Structure		131 wil Fwa view			
File Name: C			Structure		IAT WILLING VIEW			Browse
File Name: C	3PS02					End Point(m)		Browse
File Name: C Folder: C No. 000	3PS02 C¥Users¥005555¥I Data 0/0	Documents¥H29 Start(m) 0.0	End(m) .50.6	Distance(m) 50.6	Start Point(m) 1 0.0	End Point(m) 0.0		Browse
File Name: C Folder: C No: 000 001	3PS02 2¥Users¥005555¥I Data 0/0 2/41	Documents¥H29 Start(m) 0.0 50.6	End(m) .50.6 .255.8	Distance(m) 50.6 205.0	Start Point(m) 1 0.0 0.0	End Point(m) 0.0 0.0		Browse
File Name: C Folder: C No. 000	3PS02 C¥Users¥005555¥I Data 0/0	Documents¥H29 Start(m) 0.0	End(m) .50.6	Distance(m) 50.6	Start Point(m) 1 0.0	End Point(m) 0.0		Browse
File Name: C Folder: C No: 000 001	3PS02 2¥Users¥005555¥I Data 0/0 2/41	Documents¥H29 Start(m) 0.0 50.6	End(m) .50.6 .255.8	Distance(m) 50.6 205.0	Start Point(m) 1 0.0 0.0	End Point(m) 0.0 0.0		Browse
ile Name: 0 folder: 0 No: 000 001	3PS02 2¥Users¥005555¥I Data 0/0 2/41	Documents¥H29 Start(m) 0.0 50.6	End(m) .50.6 .255.8	Distance(m) 50.6 205.0	Start Point(m) 1 0.0 0.0	End Point(m) 0.0 0.0		Browse
File Name: C Folder: C No: 000 001	3PS02 2¥Users¥005555¥I Data 0/0 2/41	Documents¥H29 Start(m) 0.0 50.6	End(m) .50.6 .255.8	Distance(m) 50.6 205.0	Start Point(m) 1 0.0 0.0	End Point(m) 0.0 0.0		Browse

Figure 9.13 Data Output Menu Interface

Feature	Description	Notes
Common Item	Settings of common items	Specified at the time of measurement.
Road Category	Grade of the road	1: National Highway 2: Expressway 3: Provincial Road 4: Others Road
Road No.	Road number.	
Road No Supplement	Supplement No. of road No.	
Branch No.	Branch number	
Direction	Left-bound, Right-bound, Single-bound	Left: 1, Right: 2, Single: 3
Lane No.	Traffic lane number	
Lane Position	Position of the traffic lane number	
Measure Date	Timestamp of the measurement	YYYYMMDD
Operator	Name of the operator	
Vehicles	Name of the measuring vehicle	
Coefficient	Rut coefficient	
Rut X Rate	X coefficient	
Rut Y Rate	Y coefficient	
Rut Count	The number of output points of a rutting profile.	
Output Item	Selection of output data	
Crack	Number of meshes with cracks	

Table 9.14Features of the Data Output Menu

Crack(detail)	Details of crack interpretation	
Crack(ratio)	Crack ratio	
Rut	Rut profile	
Rut(depth)	Rut depth	
Profile	Longitudinal section/ profile	
IRI	IRI	
Fwd View	Forward view footage (target data only)	
Surface Type	Surface type	
Structure	Structures	
Coordinate	Coordinates	
All Fwd View	Forward view footage (entire data)	
IMU	IMU data	
File Name	Input the file name of the output data	
Brows	Specify the folder path to output the data	
Data list	Select the data to output	
Execute	Execute output	
Back	Go back to the Analysis menu	

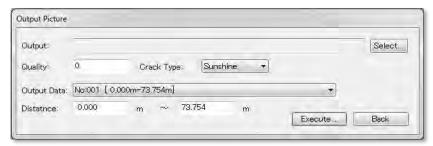


Figure 9.14 Road Surface Image Output Menu Interface

item	Description	Notes
Select	Select the folder path to output data.	
Quality	Specify the compression level of the image.	
Crack Type	Select the road surface camera.	
Output Data	Select the output range.	
Distance	Enter the distance (origin/destination)	
Execute	Execute output	
Back	Go back to the Analysis menu	

Table 9.15Features of the Road Surface Image Output Menu

Road	Output
Scale V Interval: 0.2 m Position: 1800 Disaply Position H Interval: 0.2 m Position: 20 Interval: Center Right Management Data Disaply Rut	Item Scale Vertical Scale Horizontal Piece Line Divide Line Road Width Line Rat Road Width Line Management Data Forward View
Scale Horizontal Size Scale Text Size Scale Text Border Size Piece Line1 Piece Line2 Piece Line2 Piece Line3 Replay Size Replay Size State Size	Image: Constraint of the second of the se
Forward,Back: 5 2.5m	Key Assign
Forward View Offset Down: −20.0 m ∐p: 0.0 m Sut	Wheel J Frame Back Off #### Back Wheel Î #### Stop F1 #### Stop F1 #### Piece Forward F2 #### Piece Forward F3 Wheel Î Back Forward F4 #### Select Input F6 #### Select Input F7
Width: 50mm	www Dipelct input F6 www Display Size Up F7 www Display Size Down F8 www Display Size Down F8 www Drack Sunshine F9 www Drack Sunshine F10 www Drack Sunshine F11 www Drack Compose F11 www Edge Enhance Low 1 www Edge Enhance High 3 www Gamma Down 5 www Gamma Down 5 www Management: RDAD Doncrete 7 www Management: RDAD DST 3 www Management: RDAD Dther 9

Figure 9.15 Configuration Menu Interface

	Table 9.16 Features of the Configuration Menu	
Item	Description	Notes
Road	Configure the scale displayed to the road surface	
	image	
V interval	Graduation of the vertical scale	
Position	Position of the vertical scale	
H interval	Graduation of the horizontal scale	
Position	Positioning of the horizontal scale	
Display Position	Select the base position.	
Management Data	Display position of the Management Data	
	Configuration bar.	
Color	Specify the color of each configuration item.	
Replay	Playback configuration.	
Replay Back	Configure the movement when Replay Back is	Specify in crack mesh
	executed.	counts
Forward Back	Configure the movement for playing forwards	Specify in crack mesh
	and backwards.	counts
Speed	Specify the playback speed.	
Forward View	Offset configuration for the forward view.	
Right	Offset for the Right-bound data.	
Left	Offset for the Left-bound data.	
Rut	Configuration for the cross section display.	
Width	Width of the display range.	
Outlier Remove	Threshold for abnormal value.	

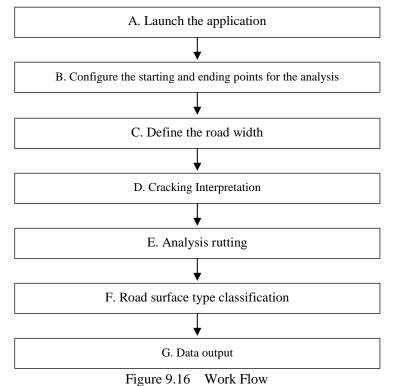
Table 9.16 Features of the Configura	tion Menu	
--------------------------------------	-----------	--

Average	Select how to process the moving average. Distance: moving average based on the specified length Count: moving average based on the specified data count	
Surface Smoothness	Configuration for the longitudinal section display.	
Width	Width of the display range.	
Output	Configuration of displayed items.	Check the check box to display an item
Key Assign	Assign shortcut keys	
Execute	Accept the configurations made.	
Back	Go back to the Analysis menu.	

9.5 Operation Procedure

(1) Work Flow

The workflow of the Data Analysis Application is as described in Figure 9.16.



i iguite y i lo i i oli

(2) Data Analysis

A. Launch the Application

Double click on [RM2_RISA.exe] found on the computer and launch the application.



Figure 9.17 Icon of the Application

Select [Pavement Interpretation].

	Real Mini Analysis System	
	Pavement Interpretation	
	Location Information Setting	
-	Exit	

Figure 9.18 Application Selection

Click on [Browse] and specify the folder path of the analysis data.

ata F	older:						_
):¥H2	25_Vie					Browse	Update
ata							13
No.	Road	Lane	Measure Date	Inspected	Folder		
						_	
						Next	Back

Figure 9.19 Selection of Data Available for Analysis

Specify the folder storing the data output by the data conversion application and click on [OK].

Select Folder		
D:¥Program check	¥data	
- III	Program check	*
	🐊 data	
	RMD_000000_01_20130918_132250	
	RMD_000000_01_20130919_143456	
	RMD_000000_01_20130919_150209	
	RMD_000000_01_20130919_171039	
	RMD_000001_01_20130919_114733	
	RMD_000001_01_20130919_120954	+
+	m	
		-

Figure 9.20 Folder Selection

From the list, select the data to analyze and click [Next].

lata F	older:				
D:¥H2	5_Vietnam				Browse Updat
ata					
No.	Road	Lane	Measure Date	Inspected	Folder
1	000000	01	2013/09/18 13:22:50	Exist	RMD_000000_01_20130918_132250
2	000000	01	2013/09/19 14:34:56	Not Exist	RMD_000000_01_20130919_143456
3	000000	01	2013/09/19 15:02:09	Not Exist	RMD_000000_01_20130919_150209
4	000000	01	2013/09/19 17:10:39	Not Exist	RMD_000000_01_20130919_171039
5	000001	01	2013/09/19 11:47:33	Exist	RMD_000001_01_20130919_114733
6	000001	01	2013/09/19 12:09:54	Not Exist	RMD_000001_01_20130919_120954
	1 06	lect d	aiu		
_					Next Back

Figure 9.21 Data Selection

Click [Next].

1 0.0 0.000 0.582 0.582 2 0.0 1.000 0.990 1.542 3 1.0 2.000 0.078 1.619 4 2.0 3.000 0.550 2.169 5 3.0 4.000 0.192 2.351 6 4.0 5.000 0.570 2.921 7 5.0 6.000 0.0896 3.821 spect Innomation start(m) cmdm Distance(m) Start Point(m) End Point(m) 000 0.000 147.765 147.765 0.0 0.0	No	From(Km)	Tel	(Km)	asure(Km)	Total(Km)	4
2 0.0 1.000 0.980 1.542 3 1.0 2.000 0.078 1.619 4 2.0 3.000 0.550 2.169 5 3.0 4.000 0.182 2.351 6 4.0 5.000 0.570 2.921 7 5.0 6.000 0.899 3.821 8 6.0 0.000 0.049 3.870	1.12						0
3 1.0 2.000 0.078 1.619 4 2.0 3.000 0.550 2.169 5 3.0 4.000 0.182 2.351 6 4.0 5.000 0.570 2.921 7 5.0 6.000 0.899 3.821 8 6.0 0.000 0.049 3.871							
4 20 3.000 0.550 2.169 5 3.0 4.000 0.182 2.351 6 4.0 5.000 0.570 2.921 7 5.0 6.000 0.899 3.821 8 6.0 0.000 0.049 3.870							
5 3.0 4.000 0.182 2.351 6 4.0 5.000 0.570 2.921 7 5.0 6.000 0.896 3.821 8 6.0 0.000 0.049 3.870 respect Innomation No Start(m) End(m) Distance(m) Start Point(m) End Point(m) 000 0.000 147.765 147.765 0.0 0.0							E
8 4.0 5.000 0.570 2.921 7 5.0 6.000 0.899 3.821 8 6.0 0.000 0.049 3870 spect Innomation No. Start(m) End(m) Distance(m) Start Point(m) End Point(m) 000 0.000 147.765 147.765 0.0 0.0							
7 5.0 6.000 0.899 3.821 8 6.0 0.000 0.049 3.870 spect Innonation No. Start(m) End(m) Distance(m) Start Point(m) End Point(m) 000 0.000 147.766 147.766 0.0 0.0							
B 6.0 0.000 0.049 3.970 repect Innomation No. Start(m) End(m) Distance(m) Start Point(m) End Point(m) 000 0.000 147.766 147.766 0.0 0.0							1.0
ispect Information No. Start(m) End(m) Distance(m) Start Point(m) End Point(m) 000 0.000 147.766 147.766 0.0 0.0				2000			-
		and the second	End(m)	Distance(m)	Start Point(m)	End Point(m)	_
001 147 766 3769 766 3622,000 0.0 0.0	000	0 000	147.766	147 766	0.0	0.0	
	001	147 766	3769.766	3622.000	0.0	0.0	
002 3769.766 3870.192 100.426 0.0 0.0	002	3769 766	3870,192	100.426	0.0	0.0	

Figure 9.22 Data Confirmation

This will launch the Analysis menu.

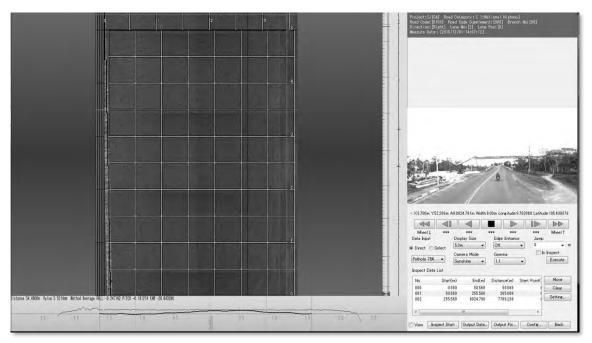


Figure 9.23 Analysis Menu

B. <u>Configure the Starting and Ending Points of the Analysis</u> Click [Inspect Start].

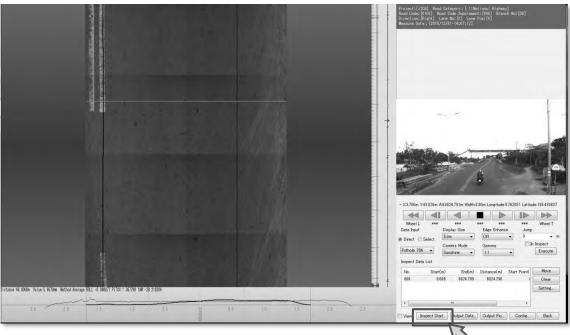


Figure 9.24 Configuration of the Starting Point

Placing the cursor on the road surface image will cause a red line to appear. Move the cursor to the starting point and click.

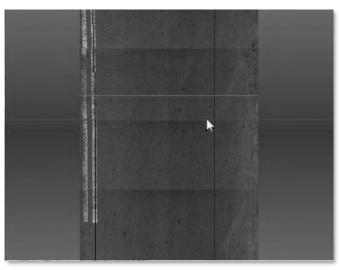


Figure 9.25 Align the Red Line to the Starting Position

Real Mini Analysis System	
Are you sure you se	et this position?
Yes (Y)	No (N)

Figure 9.26 Configuration Confirmation Message

Specify the [Size] under the [Crack]-[Mesh] section and the [Unit Of Interval] under the [Rut] section, and click [OK]. The base values for these fields are shown in Table 9.17.

Section No: 001 Distance
Start: 0.0 ★ m End: 0.0 ★ m
Orack Mesh
Size: 0.5 m Unit Of Interval: 10 Mesh 5.0 m
Target
All Segment Segment Sampling Segment Mesh 1 Mesh 1 Mesh 1 Mesh 1 Mesh 1 m
Rut Method
Average Peak Straight Edge Unit Of Interval: 1 m Width Shift: 0.0 m
OK Back

Figure 9.27 Section Setting

Click [Yes].

Table 9.17	Analysis Preset Value
------------	-----------------------

Item	Preset Value
Size	0.5
Unit Of Interval	1

Repeat the same steps to configure the ending point.

Confirm that the configured section is displayed to the [Inspect Data List] pane of the Analysis menu.

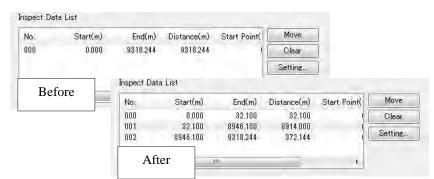


Figure 9.28 Confirm the Configuration Change

The analysis target section will now show that the road surface distress interpretation is made available, and meshes and scales are displayed, as shown in Figure 9.29.

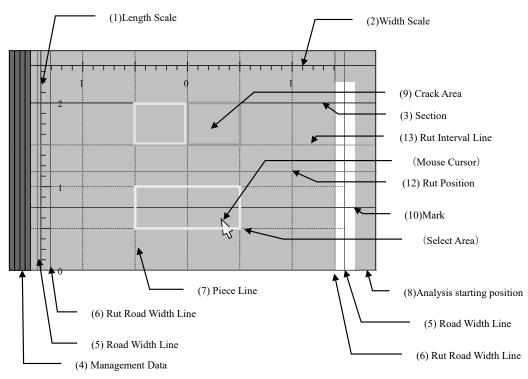


Figure 9.29 Road Distress Interpretation Menu Details

Tips-1 Reference for Configuring the Road Width

On the road surface image and position information bar, the starting and ending points configured from the [Starting and End Point Configuration Application] will appear as green lines. Use these lines as a guide to determine the starting and ending points.

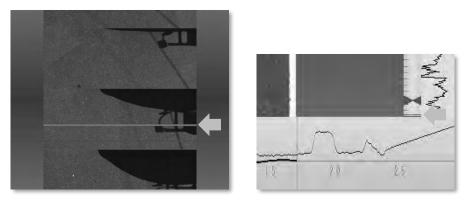


Figure 9.30 Flags Displayed by the Application to set the starting and ending points

Tips-2 How to Correct Configurations

If the configuration should be changed or corrected, select the data to delete from [Inspect Data List] and click on the [Clear] button.

Make sure that you carefully execute this step as clicking on [Clear] will also delete the road surface interpretation data if it is already present.

No:	Start(m)	End(m)	Distance(m)	Start Point(Move
000	0.000	32.100	32.100		Clear
001	32.100	8946.100	8914.000		0.0
002	8946.100	9318.244	372.144	(L	Setting

Figure 9.31 Deleting a Section

C. Define the Road Width

1) Example of Defining the Road Width

Both the cracking analysis and rutting analysis require the road width to be defined. Generally, both cracking analysis and rutting analysis should use the same road width definition.

Case1 Two Lane Marks are visible

If lane marks are present on both sides of the road, the distance between the inner edge of the lane mark to the inner edge of the opposite lane mark defines the road width.

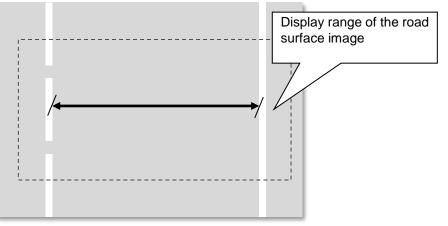


Figure 9.32 Two Lane Marks on Both Sides

In the case of a broken line, assume that the lane mark extends on both sides and do not modify the road width.

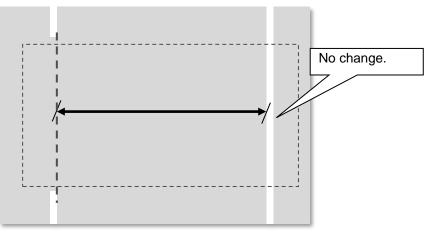


Figure 9.33 For Broken Lines

Case 2 One Lane Mark is visible

If only a centerline is present, the road width should be measured by starting from the inner edge of the centerline to the farthest edge on the opposite side so that the width is set as wide as possible.

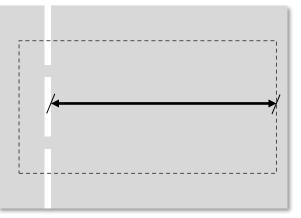


Figure 9.34 When Only a Center Line is Visible

Additionally, if the lane mark is present only on the opposite side, the road width should be measured by starting from the inner edge of the lane mark to the farthest edge of the opposite side so that the width is set to as wide as possible.

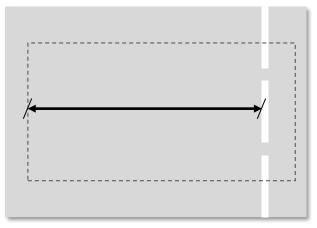


Figure 9.35 Only Lane Mark of Shoulder is Visible

If the opposite lane is still unpaved, the road width should be defined at the boundary between the paved lane and the unpaved lane.

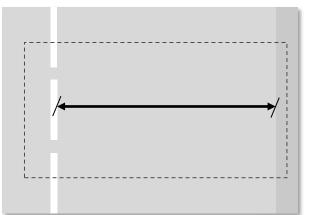


Figure 9.36 One Lane is Unpaved (Example 1)

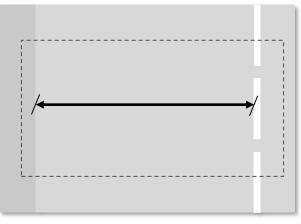


Figure 9.37 One Lane is Unpaved (Example 2)

Case 3 No Lane Marks

When there are no lane marks present, set the road width to the maximum.

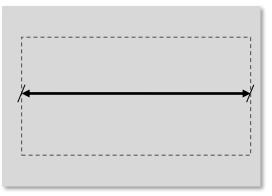


Figure 9.38 No Lane Marks 1

If both edges are unpaved, define the entire paved plane as the road width for analysis.

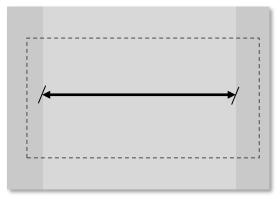


Figure 9.39 No Lane Marks 2

Case 4 Increase/Decrease in Number of Lanes

When the number of lanes of the road increases or decreases, the connecting section should not change the road width. However, if the connecting section includes an unpaved section, the road width should be defined by using the widest road width of the paved section.

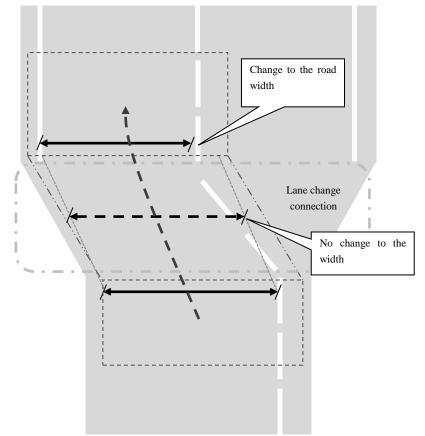


Figure 9.40 Example of Change in Number of Lanes

Case 5 Overtake

When the survey vehicle had over taken another vehicle or passed over an obstacle to avoid it during the course of its travel, the road width should not change but maintain the width from the immediate section. However, t if another vehicle or an obstacle is captured together within the analysis range, only change the rutting width so that the range capturing the vehicle is avoided.

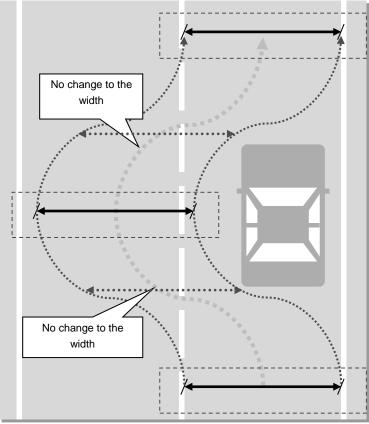


Figure 9.41 Example of an Overtake

2) How to Define the Road Width

The pink lines running along the sides of the road surface image indicate the width for cracks, and the purple lines indicate the width for rutting. Place the cursor on the line and perform the operation described in Table 9.18 to define the widths.

*The line pair for both cracks and rutting is displayed overlapping by default.

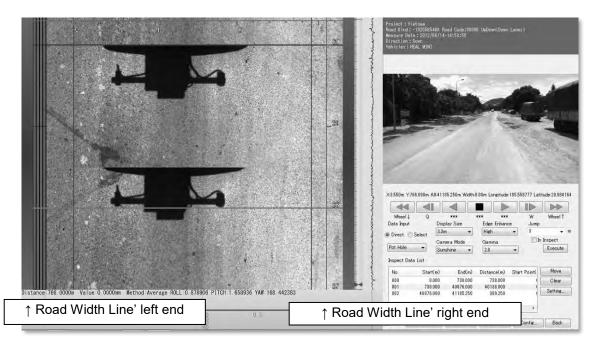


Figure 9.42 Defining the Width

-	Table 9.18	Operation for Defining the Width
	Ĵ	The width of both sides can be changed once the cursor changes its form to the symbol as seen on the left.
Crack	┥┠╴	Holding down the "Ctrl" key will change the cursor to the symbol as seen on the left, allowing the width of one section to be changed.
	← →	When the mouse cursor pushing the Shift key looks like this, the road width moved by parallel translation.
	⊷ ∥ ⊳	When the mouse cursor pushing Ctrl+Shift key looks like this, the road width of 1 sector moved by parallel translation.
	<u></u>	Holding down the "Alt" key will change the cursor to the symbol as seen on the left, allowing the rutting analysis width to be changed.
Rut	┥╟ _╈	Holding down the "Alt" and "Ctrl" keys together will change the cursor to the symbol as seen on the left, allowing the rutting analysis width of a single section to be changed.

Table 9.18Operation for Defining the Width

D. Cracking Interpretation

1) Example of Cracking Interpretation Pattern

Cracks, patches and potholes are interpreted and classified into thirteen categories. To each category, one key is assigned.

	Table 9.19 Class	incation of Cracking interpretation
No.	Classification	Description
1	Two or More Crack	There are two or more cracks in the mesh
2	Single cracking	There is one crack in the mesh
3	Patching 75%	Patching occupies an area of more than 75% of the mesh
4	Patching 25%	Patching occupies an area of more than 25% to less than 75% of the mesh
5	Pothole 75%	Pothole occupies an area of more than 75% of the mesh
6	Pothole 25%	Pothole occupies an area of more than 25% to less than 75% of the mesh
7	Pothole	Pothole occupies an area of greater than 0% to less than 25% of the mesh
8	Concrete cracking 25cm	Total length of crack in the mesh are more than 25cm to less than 50cm
9	Concrete cracking 50cm	Total length of crack in the mesh are more than 50cm to less than 75cm
10	Concrete cracking 75cm	Total length of crack in the mesh are more than 75cm to less than 100cm
11	Concrete crack 100cm	Total length of crack in the mesh are more than 100cm to less than 125cm
12	Concrete cracking 125cm	Total length of crack in the mesh are more than 125cm to less than 150cm
13	Concrete cracking 150cm	Total length of crack in the mesh are more than 150cm

Table 9.19	Classification of Cracking Interpretation

1~2: Asphalt concrete and BST pavement

3~7: Asphalt, BST and cement concrete pavement

8~13: Cement concrete pavement

The below describes patterns of cracking interpretations.

Case 1 Asphalt Pavement: Crack

The below are examples of asphalt pavement with Two or More Crack and One Crack.



Figure 9.43 Crack Observation (Asphalt Pavement)

Here is an example of a one crack.



Figure 9.44 One Crack

Here is an example of two or more crack.



Figure 9.45 Two or More Crack

Case 2 Asphalt Pavement: Patching + Crack

The below example is an asphalt pavement with patching and cracking.

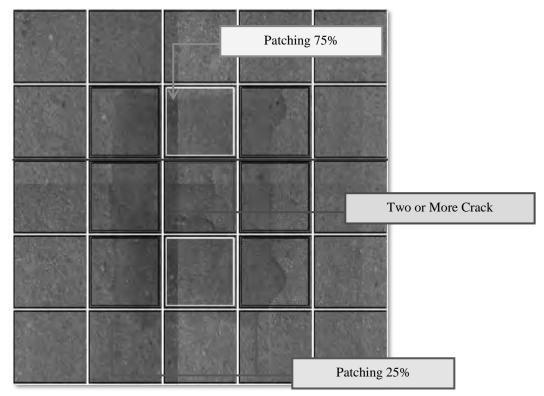


Figure 9.46 Patching 75%, Two or More Crack, Patching 25% (Example)

Case 3 Asphalt Pavement: Pothole

The below is an example of an asphalt pavement with a pothole.



Figure 9.47 Pothole – Forward View

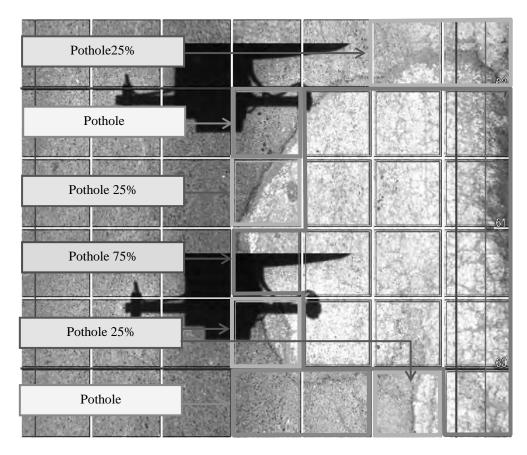
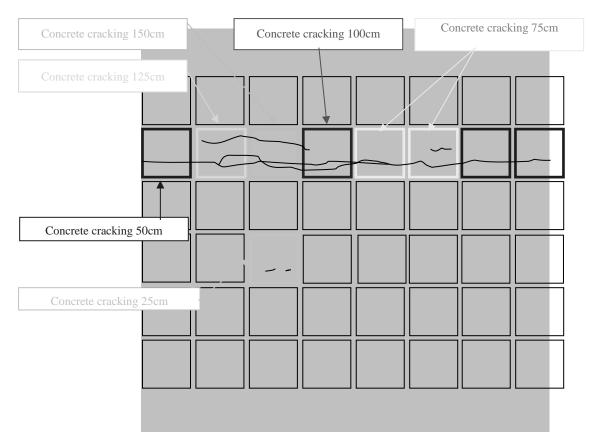


Figure 9.48 Pothole Interpretation (Asphalt Pavement)

Case 4 Cement Concrete Pavement: Crack

The below is an example of cracking in a cement concrete pavement. Cracking in cement concrete pavement are interpreted by their lengths.





2) How to Interprete Crack

Place the cursor to the cracking displayed in the road surface image, and opreate the keys described in Table 9.20 and Figure 9.50 to enter the classification of the cracking.

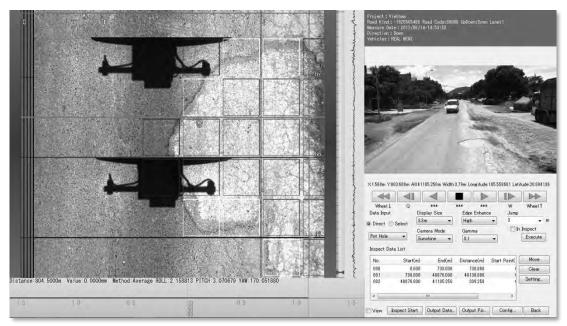


Figure 9.50 Example of Crack Recording Operation

No.	Key	Classification	No.	Key	Classification
1	А	Two or More Crack	8	Q	Concrete cracking of 25cm
2	S	one crack	9	W	Concrete cracking of 50cm
3	D	Patching 75%	10	Е	Concrete cracking of 75cm
4	F	Patching 25%	11	R	Concrete cracking of 100cm
5	Ζ	Pothole 75%	10	Е	Concrete cracking of 75cm
6	Х	Pothole 25%	11	R	Concrete cracking of 100cm
7	С	Pothole	12	Т	Concrete cracking of 125cm
			13	Y	Concrete cracking of 150cm

Table 9.20 Key Assignments

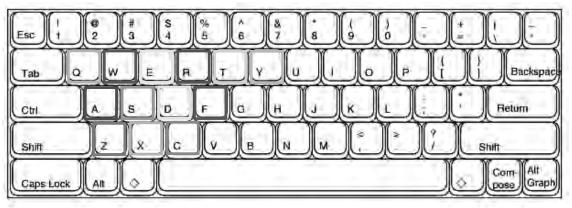


Figure 9.51 Key Assignments

E. <u>Rut Analysis</u>

1) Examples/Cases of Rut Analysis

Generally, a rutting is automatically processed when the road width is configured. However, when dealing with a wet road surface and/or an image obscured by another vehicle, calibration such as moving the data capture point or minimizing the road width will become necessary.

Case 1 Normal Rut

The below is an example of the display of a normal rut.

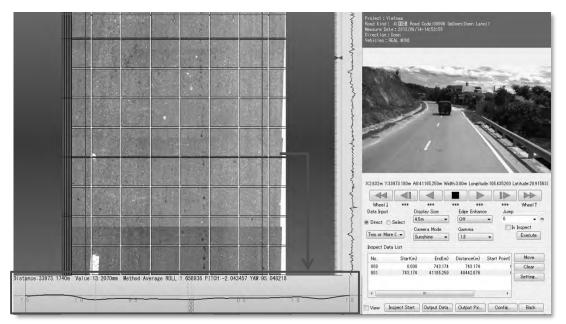


Figure 9.52 Example of Rut (Normal Case)

Case 2 Abnormal Rut 1

The below example describes a case where the rut properties are not properly captured due to obstacles (such as a puddle). Obstacles can also include traveling vehicles as well as objects fallen to the road. To avoid these noises, either move the data capture point or, minimize the road width of the rutting analysis for the target section.



Figure 9.53 Rut (Abnormal Case 1)

Case 3 Abnormal Rut 2

The below example describes a case where the measuring vehicle suffered a temporary data anomaly. As far as the forward view image shows, there seem to be no distress on the road surface. It is possible that the other anomalies of the captured data are due to the result of metals, such as metal joints of a bridge. To deal with situations like this, shift the data capture point to solve the problem.

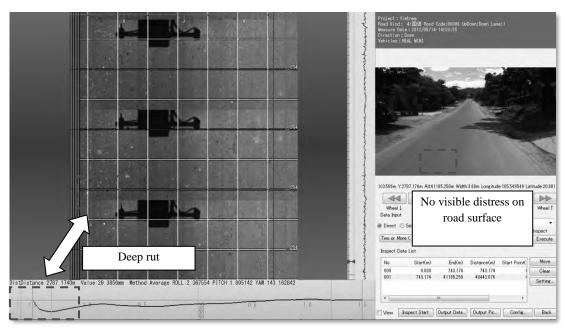


Figure 9.54 Deep Rut

2) How to Rut Interpretation

Placing the cursor on the road surface image will display a green line. In the cross section view, the rut shape is displayed exactly at the position where the green line appears. The red horizontal line indicates the output point of the rut data.



Figure 9.55 Display of the Rut

Tips-1 Handling Abnormal Data 1

When the rutting profile at the position of the red line indicates an aabnormality similar to that of cases 2 and 3, place the cursor to the red line and click and drag the line once the cursor symbol changes to the form shown in Figure 9.56.

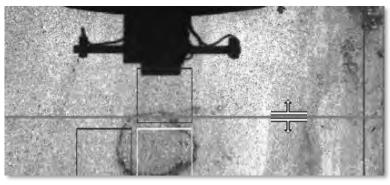


Figure 9.56 Navigating the Rutting Position

Tips-2 Handling Abnormal Data 2

When the rut shape of the red line indicates an abnormality similar to that of cases 2 or 3 due to somesort of an obstacle, change the position of the road width so the obstacle can be evaded.

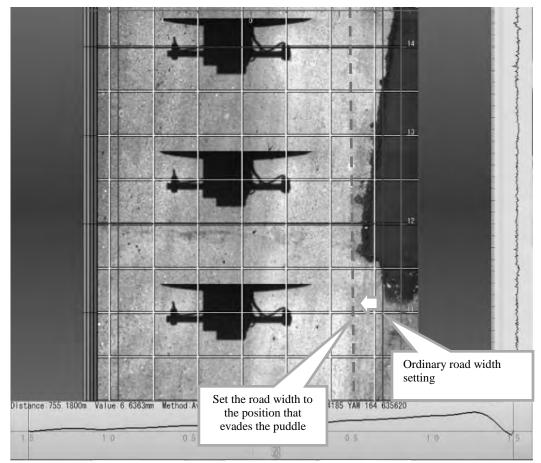


Figure 9.57 Handling by Changing the Road Width Setting

F. Pavement Type Classification

1) Pavement Types

Road surfaces are categorized to any of the three types listed in Table 9.21 .

-	Table 9.21 Koau Sullace I	ypes
No.	Туре	Abbreviation
1	Asphalt Concrete	AC
2	BST	В
3	Cement Concrete	CC
4	Other	Other
5	N/A	*

Table 9.21 Road Surface Types

2) How to Categorize Road Surfaces

Place the cursor to the Management Data Bar to display "1", and then right click to select the road surface type. In the example shown in Figure 9.58, the road is an asphalt pavement, so [ROAD: Asphalt] is selected.

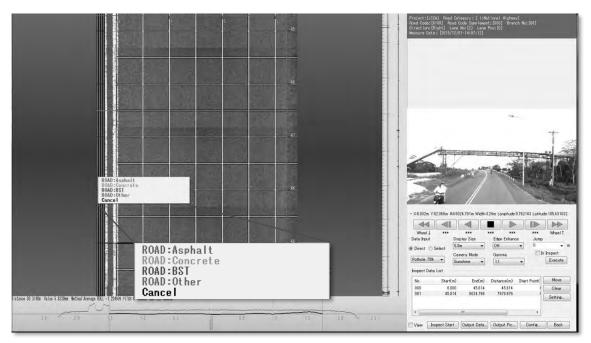


Figure 9.58 Road Surface Classification Images

3) Data Output

Click [Output Data] on the Config menu.

No.	Start(m)	End(m)	Distance(m)	Start Point(Move
000	0.000	146.274	146.274	11	Clear
001	146.274	3820.774	3674.500	17	
002	3820.774	3822.774	2.000		Setting
003	3822.774	3870.192	47.418	1	
*)[m	-	٠	
View	Inspect Start	Output Data	Output Pic	Config	Back
		Figure 9.59	Data Out	put	

Fill in the fields displayed in the [Common Item] section.

Lane No: 0	Lane	Road No: 0 Position: 8		Supplement: 1 Date: 20161201	Operator: TSL	11 Direction		
	carto	1 dontion	modeare		operator			
Coefficient Rut X Rate:	0.0000	But Y Ra	ite: 0.000	0 Rut Co	iunt: 80	*		
Output Item	The	rack(detail)	Crack(ratio)	Rut	Rut(depth) Profile	IV) IRI	
					the second second		(W) that	
Fwd Vie	w Si	urface Type	Structure	Coordina	te 🛛 🗐 All Fwd V	iew 🔲 IMU		
ile Name: GPS	502							
older: G:¥	Test datā							Browse
No:	Data	Start(m)	End(m)	Distance(m)	Start Point(m)	End Point(m)		
000	0/0	0.0	45.8	45.8	0.0	0.0		
001	2/698	45.8	3532.8	3487.0	0.0	0.0		
002	0/899	3532,8	8024.8	4492.0	0.0	0.0		

Figure 9.60 Output Configuration 1

From the [Output Item] section, check the items to output. Required items are the following four items: Crack(ratio), Rut(depth), IRI and All Fwd View.

Common Item Road Categor:	-	koad No: 0	Boad No.	Supplement: 1	111 Branch No:	11 Direc	tion: 1	
Lane No: 0								
Lane No: 9	Lane	Position: 8	Measure D	Jate: 20101201	Operator: TSI	Ve Ve	hicles: Real Mini	
Coefficient								
Rut X Rate:	0.0000	Rut Y Rate	e: 0.000	0 Rut Co	unt: 80	×		
1.00		-	_					
Output Item	-			-				
Crack			Crack(ratio)	Rut	Rut(depth		IV) IPI	
Fwd Vie			Structure	Coordina	te 🛛 🗐 All Fwd 🔪	/iew IMU		
_ Pwid Vie	ewou	urface Type	Duracture		te INT WILLING V	TMC		
		artace Type	- otractore			New	-	
ile Name: GF	2502	urrace Type			is išī vii rwa v	usw Truc		
ile Name: GF		artace Type			ie <u>Ist</u> All riva i	NAM TUNC		Browse
ile Name: GF	2502	start(m)	End(m)	Distance(m)	Start Point(m)	End Point(m)		Browse
ile Name: GF older: G4 No:	PS02 FTest dată Data 0/0	Start(m) 0.0	End(m) 45.8	Distance(m) 45.8	Start Point(m) 0.0	End Point(m) 0.0		Browse
ile Name: GF older: G4 No:	2502 FTest dată Data 0/0 2/698	Start(m) 0.0 45.8	End(m) 45.8 3532.8	Distance(m) 45.8 3487.0	Start Point(m) 0.0 0.0	End Point(m) 0.0 0.0		Browse
ile Name: GF older: GA No: 000	PS02 FTest dată Data 0/0	Start(m) 0.0	End(m) 45.8 3532.8 8024.8	Distance(m) 45.8	Start Point(m) 0.0	End Point(m) 0.0		Browse
ile Name: GF older: G4 No:	2502 FTest dată Data 0/0 2/698	Start(m) 0.0 45.8	End(m) 45.8 3532.8	Distance(m) 45.8 3487.0	Start Point(m) 0.0 0.0	End Point(m) 0.0 0.0		Erowse
ile Name: GF older: G4 No:	2502 FTest dată Data 0/0 2/698	Start(m) 0.0 45.8	End(m) 45.8 3532.8 8024.8	Distance(m) 45.8 3487.0	Start Point(m) 0.0 0.0	End Point(m) 0.0 0.0		Browse

Figure 9.61 Output Configuration 2

Enter the output file name to the [File Name] field. Typically, the file name should be named in a [Road code+Left/Right+Lane_Origin_Destination] format.

Example: NH1001000000R1_000k00000_023k00250 (National Highway 1, Right, Lane 1, From:0k0 To 23k250)

Common Item								
Road Category:	II Ro	ad No: 0	Road No S	upplement: 111	Branch No: 1	1 Direction:	1	
Lane No: 0	Lane F	Position: 8	Measure Da	ste: 20161201	Operator: TSUCH	MA Vehicle	_{s:} Real Mini	
Coefficient								
Rut X Rate:	0.0000	Rut Y Ra	ite: 0.0000	Rut Coun	rt: 80	ž		
Output Item								
Crack	Cra	ack(detail)	Crack(ratio)	Rut	Rut(depth)	Profile	🕡 IRİ	
Find View	Su	rface Type	Structure	Coordinate	All Find View	IMU 🗇		
In Manage GPS03	9	_						
	_	_						
	_							Browse
older: Gr¥Te:	_	Start(m)	End(m)	Distance(m)	Start Point(m)	End Point(m)		Browse
older: G¥Te: No.	st data Data 0/0	0.0	45.8	45.8	0.0	0,0		Browse
older: G¥Te: No.	st data Data 0/0 2/698	0.0 45.8	45.8 8532.8	45.8 3487.0	0.0 0.0	0,0 0,0		Browse
older: G:¥Te: No.	st data Data 0/0	0.0	45.8	45.8	0.0	0,0		Browse

Figure 9.62 Output Configuration 3

Click on the [Browse] button and specify the folder path for the output data. where to output the data.

ommon Item	_							
oad Category:	II R	load No: 0	Road No S	Supplement: 11	11 Branch No:	11 Directio	n: 1	
ane No: 0	Lane	Position: 8	Measure D	ate: 20161201	Operator: TSU	CHIYA Vehi	cles: Real Mini	
Coefficient								
ut X Rate:	0.0000	Rut Y Ra	ite: 0.0000	Rut Co	unt: 80	×		
utput Item	E Cr	ack(detail)	Crack(ratio)	Rut	Rut(depth)	Profile	IV IRI	
Fwd View			Structure	Coordinat				
	Loc	aface Type			e lynain rwain	iew 🔲 IMU		
		artace Type	Structure		e ištuni taka k	ew Two		
Name: GPS0		artace Type			s TXT wit two o	iewIMU		Brows
Name: GPS0 Jer: G:¥Te	2	Start(m)	End(m)	Distance(m)	start Point(m)	End Point(m)		Brows
Name: GPS0 Jer: G¥Te o.	2 est data Data 0/0	Start(m) 0.0	End(m) 45.8	Distance(m) 45.8	Start Point(m) 0.0	End Point(m) 0.0		Brows
Name: GPS0 der: G¥Te	2 est data Data 0/0 2/698	Start(m) 0.0 45.8	End(m) 45.8 3532.8	Distance(m) 45.8 8487.0	Start Point(m) 0.0 0.0	End Point(m) 0,0 0,0	_	Brows
Name: GPS0 der: G¥Te lo.] 000	2 est data Data 0/0	Start(m) 0.0	End(m) 45.8	Distance(m) 45.8	Start Point(m) 0.0	End Point(m) 0.0		Brows
Name: GPS0 Jer: G¥Te o.	2 est data Data 0/0 2/698	Start(m) 0.0 45.8	End(m) 45.8 3532.8 8024.8	Distance(m) 45.8 8487.0	Start Point(m) 0.0 0.0	End Point(m) 0,0 0,0		Erows

Figure 9.63 Output Configuration 4

Click on the [Execute] button to output the data. The output data is created to the speficied path as a CSV file.

Common Item								
oad Category	y II F	Road No: 0	Road No	Supplement: 1	Branch No:	11 Direction:	1	
ane No: 0	Lane	Position: 8	Méasure D	ate: 20161201	Operator: TSUC	HIYA Vehicle	es: Real Mini	
Defficient								
ut X Rate:	0.0000	Rut Y Rate	e: 0.0001	0 Rut Co	unt: 80	×		
Output Item								
Crack	ĒÓ	rack(detail)	Crack(ratio)	Rut	Rut(depth)	Profile	🖉 iri	
Fwd Vie	ew Si	urface Type	Structure	Coordina	te 🖳 All Find View	w 🗍 IMU		
e Name: GPS	S02							
	S02 (Test data							Browse
lder: G¥		Start(m)	End(m)	Distance(m)	Start Point(m)	End Point(m)		Browse
lder: G¥	(Test data Data 0/0	0.0	45.8	45.8	0.0	0.0		Browse
lder: G.¥ No:	Test data Data							Brows
lder: G¥	Test dată Data 0/0 2/698	0.0 45.8	45.8 3532.8	45.8 3487.0	0.0 0.0	0.0 0.0		Browse
lder: G¥	Test dată Data 0/0 2/698	0.0 45.8	45.8 3532.8	45.8 3487.0	0.0 0.0	0.0 0.0		Browse
lder: G¥	Test dată Data 0/0 2/698	0.0 45.8	45.8 3532.8	45.8 3487.0	0.0 0.0	0.0 0.0		Browse
lder: G¥	Test dată Data 0/0 2/698	0.0 45.8	45.8 3532.8	45.8 3487.0	0.0 0.0	0.0 0.0	Execute	Browse

(3) Data Check

The Data Analysis application has a function of judging a value exceeding a certain range at the timing of data output as an abnormal value and outputting a list of abnormal data records as "ERROR.txt". The operator shall check whether the data judged to be an abnormal value is due to a mistake in analysis work as the following way;

- · Open the file of abnormal value list (ERROR.txt) and find the location information
- · Check the road condition on the Data Analysis application
- · In case of a mistake in analysis, it shall be analyzed again

Output Data Common Item Road Category: 001 Road No:	Read No Supplement 1111 Branch No. 11 D	rector 1	7
Lone No. 3 Lone Position F Coefficient Rut X Rate: 0.0000 R		nicles Real Mini	1. 11
Output Item © Crack © CrackGetan © Five View © Surface Ty File Name: GP582 Folder: GVTest data	(Ad. (dpth)) Strate Delatered 2166 11mm Volume 11 Mmm * Pol (dpth) Strate Delatered 2166 11mm Volume 12 Strate * Volume 12 Strate Delatered 2166 11mm Volume 12 Strate * * Volume 12 Strate Strate Delatered 2166 11mm * * * Volume 12 Strate Strate Delatered 2166 11mm Volume 12 Strate * * Volume 12 Strate Strate Delatered 2166 11mm Volume 12 Strate * * Volume 12 Strate Strate Delatered 2166 11mm Volume 12 Strate * <td< td=""><td>्र इत</td><td></td></td<>	्र इत	
No: Data Ster ☐ 000 6/0 ♥ 001 2/598 ☐ 002 8/599 35	Ref Hand José Cardon Barrier Hand Angel Hand Angel Hand Angel Hand Hand Hand Hand Hand Hand Hand Hand		Alle24.791% Wide:2.58% Long-tudy:3.76891 Lennus: 115.4450
		ExecuteBook	Gamma Woln Gamma V In Inspect Sunshine + 1.1 + Execute Start(m) Exc(m) Distance(m) Start Point(000 45.814 45.814 Clear

Figure 9.65 Data check in the analysis application

1) Data Check Method

Data check shall be done following contents

- Crack Ratio (%)
- Rut Depth (mm)
- IRI (mm/m)

When output the data from the data analysis application, data check would start automatically. The progress of the data check can confirm in the progress bar. When complete the data check, "Done" would be indicated in the window.

Fwd View data output now 1604/1604	_
Rut (depth) Error Diatance:2890.814 m Value:73.93mm Rut (depth) Error Diatance:2890.814 m Value:93.95mm Rut (depth) Error Diatance:2800.814 m Value:93.95mm Rut (depth) Error Diatance:2910.814 m Value:81.35mm Rut (depth) Error Diatance:2910.814 m Value:87.35mm Rut (depth) Error Diatance:2910.814 m Value:87.51mm Rut (depth) Error Diatance:2910.814 m Value:83.61mm Rut (depth) Error Diatance:2910.814 m Value:38.91mm Rut (depth) Error Diatance:2910.814 m Value:38.91mm Rut (depth) Error Diatance:393.814 m Value:38.91mm Rut (depth) Error Diatance:393.814 m Value:35.12mm Rut (depth) Error Diatance:393.614 m Value:56.93mm Rut (depth) Error Diatance:313.614 m Value:57.94mm Rut (depth) Error Diatance:313.614 m Value:27.194mm Rut (depth) Error Diatance:313.614 m Value:27.194mm Rut (depth) 56 Error(s)	

Figure 9.66 Data check window

The result of the data check would save the same folder of the other output files. In the "ERROR.TXT", the value exceeding of the threshold and position information are recorded in the order of Crack Ratio, Rut Depth, and IRI.

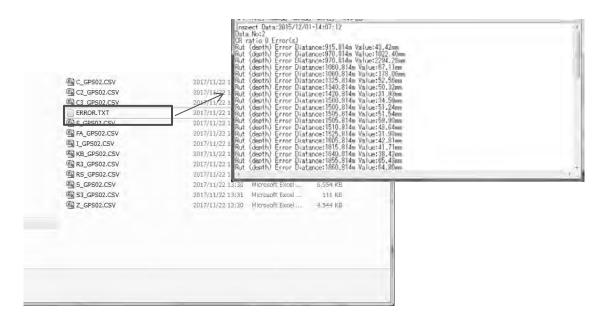


Figure 9.67 Sample of "ERROR.TXT"

Operator would open "ERROR.TXT" and confirm the judged as abnormal value using the data analysis application. If the interpretation of data analysis have mistaken, operator should re-analysis the mistaken part and re-output the data.

When rutting or IRI value is 0, data convert shall be done again. If the data still cannot be corrected, there is a possibility of device failure. So operator must contact to provider.

Data Item	Criteria	Mistaken
Crack Ratio	More than 70%	Interpretation mistaken
Rut Depth (Max.)	More than 50mm	Setting mistaken of road width
Rut Depth (Ave.)	More than 30mm	Setting position mistaken
Rut Depth (Max.)	0mm	Data conversion error
Rut Depth (Ave.)	0mm	Device failure
IRI	0mm/m	Device failure

Table 9.22 Possible reasons of analysis errors

2) Setting the Threshold

The threshold to extract the abnormal value would be set in "System.ini". "System.ini" is saved at the same folder with data analysis application. Below table shows the contents of "System.ini". Further, if threshold is set "-1", the threshold would not use in the data check.

Table 9.23 System.ini content				
Content	Description	Note		
LANGUAGE	Display language in the system	1: English, 0: Japanese		
CR RATE TH LOW	Smaller threshold	Crack ratio		
CR_RATE_TH_HI	Larger thershold	Crack ratio		
RUT TH LOW	Smaller threshold	Rut depth		
RUT_TH_HI	Larger threshold	Rut depth		
IRI_TH_LOW	Smaller threshold	IRI		
IRI_TH_HI	Larger threshold	IRI		

Table 9.23 'System.ini' content

"System.ini" is normally set as shown in Figure 9.68, data check is performed as follows.

- " CR_RATE_TH_LOW=-1" : Invalidate the smaller threshold of crack ratio
- " CR_RATE_TH_HI=70" : Error the section of crack ratio more than 70%
- " RUT TH LOW=0" : Error the section of rut depth is 0mm
- " RUT_TH_HI=30" : Error the section of rut depth more than 30mm
- " IRI TH LOW=0" : Error the section of IRI is 0mm/m
- " IRI_TH_HI=15" : Error the section of IRI more than 15mm/m

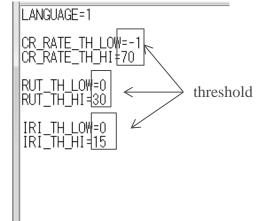


Figure 9.68 Threshold in "System.ini"

(4) Data Delivery

The data output by this analysis application is used for the data processing. Table 9.24 describes the list of data required for the Data Processing.

	Table 9.24 Delivery Data			
No.	Data	Notes		
1	C3_*****.csv	Cracking analysis		
2	R3_*****.csv	Rutting analysis		
3	S3_******.csv	IRI analysis		
4	FA *****.csv	GPS coordinates		

Positional information data

10. Instruction Manual of Location Setting Application

10.1 Purpose

This application is responsible for creating the positional data of road managing information, such as road structures, intersections, and number of traffic lanes, by using forward view images and road surface images captured by REAL Mini.

10.2 Input and Output Data

The data used for and output by this application are as described in Table 9.1.

Table 10.1Input and Output	Data of the Locat	tion Setting Application
Name	Туре	Notes
RMD 999999 99 99999999 999999	Input	Converted data

Output

10.3 Equipment

*****.csv

The equipment required for this application is described in Table 10.2.

Equipment Name	Image	Notes
Computer		notes
HDD	2	HDD containing data.
This application (RM2_RISA.exe)	RM2_RISA.exe	
Road information resources		Field survey, field notes, drawings, official documents and others.

Table 10.2List of Equipment

10.4 Interface and Contents

<Launch Menu>

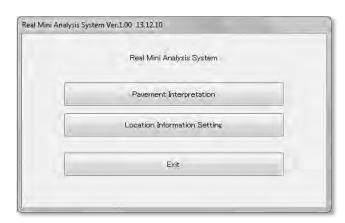


Figure 10.1 Launch Menu

Item	Description	Notes
Pavement Interpretation	Launch the analysis application.	This feature will not be discussed in this section.
Location-based information Interpretation	Launch the Positional Information application.	
Exit	Exit the application.	

Table 10.3	Features of the Launch Menu
------------	-----------------------------

<Data Selection Menu>

Da	5_V ta				Browse	Jpdate
No. 1 2 3	Road 000000 000000 000000	Lane 01 01 01	Measure Date 2013/09/18 13:22:50 2013/09/19 14:34:56 2013/09/19 15:02:09	Data Inspect/Position Not Exist Not Exist	Folder RMD_000000_01_20130918_132250 RMD_000000_01_20130919_143456 RMD_000000_01_20130919_150209	-
1 5 6	000000 000001 000001	01 01 01	2013/09/19 17:10:39 2013/09/19 11:47:33 2013/09/19 12:09:54	Not Exist Inspect/Position Not Exist	RMD_000000_01_20130919_171039 RMD_000001_01_20130919_114733 RMD_000001_01_20130919_120954	

Figure 10.2 Data Selection Menu Interface

Item	Description	Notes
Data Folder	Displays the current folder path.	
Browse	Opens the data folder path selection window.	
Update	Refreshes the display of data.	
Data	Displays the list of analysis data within the selected folder.	
No.	List number	
Road	Road number configured at the time of measurement.	
Lane	Lane number configured at the time of measurement.	
Measure Date	Timestamp of when the measurement was taken(year, month, date, hour and minutes).	yyyy/mm/dd hh:mm:ss
Inspect	Checks for the presence of analysis data.	
Folder	Folder name of the analysis data.	
Next	Go to the Information menu.	Made available when a data is selected from the list.
Back	Go back to the Launch menu.	

Table 10.4Features of the Data Selection Menu

<Identify the Location Window>

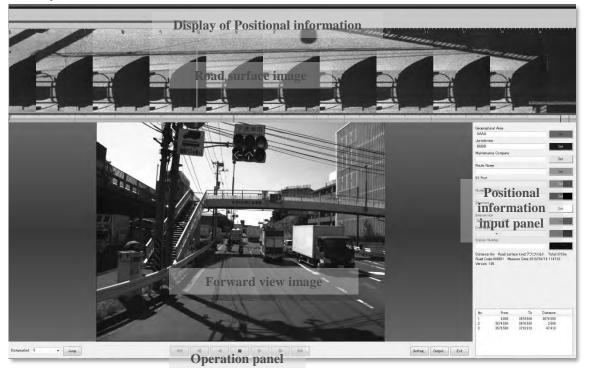


Figure 10.3 Identify Window

Item	Description	Notes
Display of positional information	Display of the configured positional information.	
Road surface image	Display of the road surface image.	
Forward view image	Display of the forward view image	
Operation panel	Allows operations including playback of images and skipping from point to point.	
Positional information input panel	Input positional information.	

Table 10.5 Features of the Identify Window

Positional Information Input Panel

RC 0 RN 0 RNS 0	RB 0	Set
Geographical Area	-	Sec.
Jurisdiction	-	-38 ¹
Carsaction	-	Set
Sub-Bureau		
	+	Set
Road Name		
Sector Sector		Sét
Kilo-Post Station		-
Number of LaGonfiguration	itoms	Set
Number of Laconingulation	items	Set
Structure		det
*	_	Set
Intersection	-	
÷		Sat
Overlapping		
Station Number Discrepancy		
Peculiar Condition		Ben
	-	-
Distance:0m Road surface type Road Code:0000 Data informa Version 1.08		al: 3253m i 1:39
No. From To	Distanc	e
Data list 2000	3487.00	-
2 3487.000 7978.976	4491.97	p.

Figure 10.4 Positional information Input Panel

Table 10.6	Features of the Positional information Input Panel
14010 10.0	reactives of the rostitional information input ranet

Item	Description	Notes
Configuration items	Items to configure the positional information.	
Data information	Display of data information regarding the	
	analysis currently in progress.	
Distance	Distance of the current screen.	
Road surface type	The road surface type category.	
Total	The total length of the entire data.	
Road Code	Road category, Road number, Road number	
	Supplement and buranch number	
Measure Date	Timestamp of when the measurement was	
	taken (in year, month, date, hour and	
	minutes).	
Version	The current application version.	
Data list	Display of the list of analysis target data.	

Operation Panel

Distance(m): 0	•	Jump	-#4	-41	-	►	11-	44	Setting	Output	Exit

Figure 10.5 Operation Panel

			_	1
Distance(m):	0		Jump	
Distance(m):	0	•	Jun	p

Figure 10.6 Jump Operation

Item	Description	Notes
Distance field	Enter the distance by selecting a reset information from the list, or, manually input the distance.	
Jump	Jump (skip) to the position specified to the Distance field.	

Table 10.7Features of the Jump Operation



Figure 10.7 Image Operation Interface

Item	Description	Notes
A	Frame backward.	
	Mesh backward.	
	Continuous backward.	
	Stop	
	Continuous forward.	
ID	Mesh forward.	
	Frame forward.	

Table 10.8	Features of	of the	Image	Operation	1

Setting	Output	Exit
---------	--------	------

Figure 10.8 Interface of Other Options

Item	Description	Notes
Setting	Open the Environment Configuration menu.	
Output	Open the Data Output menu.	
Exit	Exit from the application.	

utput Data		_				_	_	
Common Ite Road categ		ad No: 999	Berg No 6	pplement: 99	Dene	ich No: 11	Directio	n: 2
nuau catee	sory. · · · · · · · · ·	10 140. 000	NOAD NO OU	pplemento	Dian		Directio	1. 2
Lane No:	1 Lane Posi	tion: 3	Measure Date:	20161201	Operator:	TSUCHIYA	Vehicles:	Real Mini
File:								
Folder:								Browse
No.	From(Km)	To(Km)	Distance(m)	_				
1	0.000	3487.000	3487.000					
2	8487.000	7978.976	4491.976					
100								-
4 <u>E</u>						-		
							Execute	Back

Figure 10.9 Data Output Menu Interface

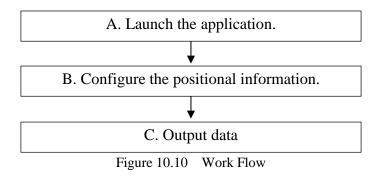
Item	Description	Notes
Common Item	Configuration of common items.	Configured at the time of measurement.
Road Category	Grade of the road	1: National Highway 2: Expressway 3: Provincial Road 4: Others Road
Road No.	Road number.	
Road No. Supplement	Supplement No. of road No.	
Branch No.	Branch number	
Left Right	Left-bound, Right-bound, Single-bound	Left: 1, Right: 2, Single: 3
Lane No.	Number of Lane	
Lane Position	Lane position	
Measure Date	Timestamp of when the measurement was taken.	YYYYMMDD
Operator	Name of the operator.	
Vehicles	Name of the measuring vehicle.	
File Name	Enter the file name of the output data.	
Brows	Specify the output folder path.	
Data list	Select the output target data	
Execute	Execute output.	
Back	Go back to the Analysis menu.	

Table 10 10	Features of the Data Output Menu
10010 10.10	i cultures of the Data Output Menu

10.5 Operation Procedure

(1) Work Flow

The work flow of the Location setting application is as described in Figure 10.10.



- (2) Identify the Location Position
 - A. Launch the Application

Double click on [RM2_RISA.exe] (this application) found on the computer to launch the application.



Figure 10.11 Icon of the Application

Click on [Location Information Setting].

	Real Mini Analysis System	
	Pavement Interpretation	
	Location Information Setting	
-	Exit	

Figure 10.12 Selecting the Application

Click on [Browse] and specify the folder path of the identify the data.

ect Data					
Data Folder:					
D:¥H25_Vie					Browse Update
Data				-	-13
No. Road	Lane	Measure Date	Inspected	Folder	
				Ne	xt Back

Figure 10.13 Selecting the Data Available for identify

Specify the folder containing the data converted using the data converter application and click [OK].

D:¥H25_Vietnam¥Check¥data	
	- 2
a check a data	^
RMD 000000 01 20130918 132250	
RMD 000000 01 20130919 143456	E
RMD_000000_01_20130919_150209	1
RMD_000000_01_20130919_171039	
RMD_000001_01_20130919_114733	
RMD_000001_01_20130919_120954	*
(<u>m</u>)	

Figure 10.14 Folder Selection

From the list, select the data to identify the location and click [Next].

):¥H2! Da	÷				Browse	Update
No. 1 2 3 4 5 6 7 S	Road 000000 000000 000000 000000 000001 000001 000001	Lane 01 01 01 01 01 01 01 01	Measure Date 2013/09/18 13:22:50 2013/09/19 14:34:56 2013/09/19 15:02:09 2013/09/19 17:10:39 2013/09/19 17:10:39 2013/09/19 12:09:54	Data Inspect/Position Not Exist Not Exist Inspect/Position Not Exist	Folder RMD_000000_01_20130918_132250 RMD_000000_01_20130919_143456 RMD_000000_01_20130919_150209 RMD_000000_01_20130919_171039 RMD_000001_01_20130919_114733 RMD_000001_01_20130919_120954	
					Next	Back

Figure 10.15 Data Selection

This will launch the Analysis menu.



Figure 10.16 Identify the Location Window

B. Configuring the Positional information

Positional information is configured for the 11 items as listed in Table 10.11 \cdot . The minimal unit accepted by this application is 5 meters. Configuration of the positional information is made by performing the operations described in Table 10.12 \cdot .

No.	Classification	Description	Data Type
1	Geographical Area	Area of the target segment.	Segment
2	Jurisdiction	Administrative authority of the target	Segment

Pavement Condition Survey

		segment.	
3	Management Agency	Sub Bureau of the target segment.	Segment
4	Road Name	Road name of the target segment.	Segment
5	Kilo-post station	Kilo-post station number	Point
6	Number of Lane	Number of traffic lanes for the target segment.	Segment
7	Structure	Bridges, tunnels, and rock sheds and their specific names.	Segment
8	Intersection	Intersections, railway crossings, tollgates and their specific names.	Point
9	Overlapping	Reasons for an overlap and the name of the overlapping road.	Segment
10	Station Number Discrepancy	The administrative Station Number when a discrepancy is present between the measurement station number and administrative station number.	Point
11	Peculiar Condition		Segment

		Configure information to the specified		
	281	position.		
		Click the button.		
		Configure information from the specified		
Input	Set Figur	position.		
method		Hold down [Shift] and click the button.		
	Distate	Delete the information of the specified position.		
		Hold down [Ctrl] and click the button.		
	Elelete From	Delete information from the specified position.		
		Hold down [Shift] + [Ctrl] and click the button.		
	Route Name National Hiefwey 1	Enter names and numbers directly.		
		Road Name		
		• Kilo-post station number		
		• Number of Lane		
		• Station Number Discrepancy		
		Select an item from the pull down list.		
Turnet		 Geographical Area Jurisdiction 		
Input		 Jurisdiction Maintenance Company 		
type		 Peculiar condition 		
		Select a code from the pull down list and enter		
	Structure Brandee Titunnel RRock shed	the specific name of the item.		
		• Structure		
		• Intersection		
	OOther	• Overlapping		

Table 10.12Operations for Positional information

Play back the image and navigate the forward view image and the road surface image to the boarder of a segment. identify the configuration starting (ending) position with the left edge of the road surface image.

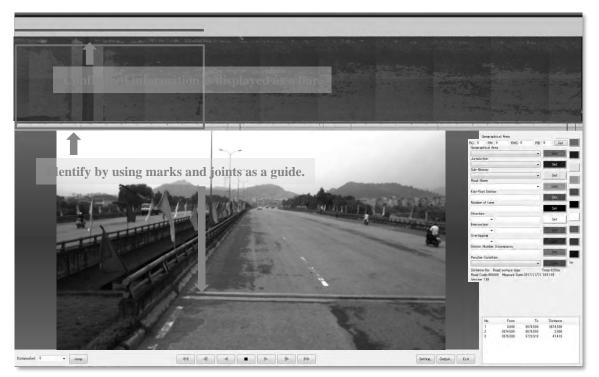


Figure 10.17 Example of Identify Position for a Bridge

Tips-1 Point and Segment Data

Table 10.11 shows that there are different kinds of data: point data and segment data. Item numbers 1 to 4, 6, 7, 9, and 11 are segment data, and because a segment is a type of data that retains lengths, the starting and ending positions must be configured.

- 1) Configuring the Geographical Area, Jurisdiction, Management Agency and Road Name Configuring the Geographical Area, Jurisdiction, Management Agency and Road Name are set their information from start to end position. The set procedure is follow.
- a) To move to the start position marking guide.
- b) For Geographical Area, to record from selecting the pull-down list of Geographical Area and to push "Shift" key and click "Shift from".
- c) For Jurisdiction, to record from selecting the pull-down list of Jurisdiction and to push "Shift" key and click "Shift from".
- d) For Management Agency, to record from selecting the pull-down list of Sub bureau to push "Shift" key and click "Shift from".
- e) Road Name is automatically indicated. If the indicated name and the target road name are same, to push "Shift" key and click "Shift from.
- f) If the indicated name and the target road name are different, operator select the road name from pull-down list and record the road name.

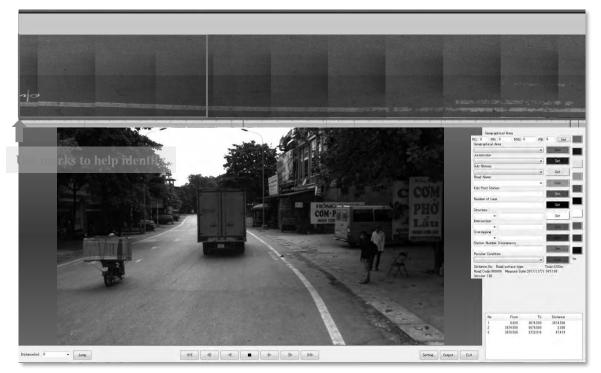


Figure 10.18 Example of Identify the Boundary Position

Select the relevant information from the pull down list, or enter the information directly. Hold down the [Shift] key and click to configure the information to the succeeding segments.

RC: 1 RN: 4 RNS: 0 RB:	0 Set
Geographical Area	
Southern Area 🔹	Set
Northern Area Northern Middle Area Southern Middle Area Southern Area	Set
Sub-Bureau IV.7	Set

Figure 10.19 Example of Selecting and Entering Information

There are many roads in Vietnam managed by DRVN, PDOT, Expressway or etc... This application loads the road name from "Road_Name.csv". If new road is surveyed, it should add the road code and road name into the lowest line in the csv file.

	A CONTRACTOR CONT	3: 0 Se
cil mil Roll Roll In In	Geographical Area Northern Middle Area Jurisdiction	Set
 Jarah Ster (Hell 2 Sal-Bread) Sal-Mana 22 - Sar Pault None	RMB II	Set
Notional Helman Hill - Internet Calin-Petra Distance Nautional Canal 2 Sectors	Sub-Bureau II2	Set
kternetive Overlapse	National Highway 46	Set
Dation Number Classoper: Provide Contine Distorechin Road instruction 77,277-b) Real William Distorechin Road instruction 77,277-b) Real William Franciscon William		Set

Figure 10.20 Example of Selecting the road name

The file structure of the data analysis exist the csv file as below figure. The csv file also indicated in

the below figure. This file consist of "Road category", "Road Number", "Road Number Supplement", "Branch Number" and "Road Name" separated by comma.

au Name separateu by	comma.
blo 🛓	2017/12/19 19:21
ORDERCFG	2015/07/21 10:45
😰 color.ini	2015/06/26 12:28
🔃 kind.ini	2015/06/26 12:28
LOG.TXT	2017/12/14 19:10
MANAGEMENT.CFG	2015/06/26 12:28
MapServer.exe	2015/06/26 12:28
ORDER.CFG	2015/06/26 12:28
position.ini	2017/12/14 13:40
RM2_PISA.exe	2017/12/07 12:12
RM2_PISA.SUD	2017/12/14 19:13
RM2_RISA.exe	2017/12/07 12:12
Route_Name.csv	2017/11/20 13:28
S RUTPROC.dll	2015/06/26 12:28
RUTPROC.ini	2015/06/26 12:28
😰 system.ini	2017/11/17 12:38
SYSTEM_SETTING.DAT	2017/12/14 19:10
💽 window.png	2017/11/14 13:15

Figure 10.21 Folder structure



Figure 10.22 Road_Name.csv

2) Configuring the Structure, Intersection and Overlapping Structure, Intersection and Overlapping are record only the position onto the data.

<Structure>

To records the type, name, and section of structure. Following table shows the recording structure. Table 10.13 Setting item of Structure

	Туре
Bridge	
Tunnel	
Rock shed	
Others	

Recording procedure as below;

a) To move to the start position of the structure

The start position of the structure set on the left edge area of the road image in upper of the application.

- b) To select the type of structure
- c) To input the name of structure
- d) To push "Shift" key and click "Shift from" and record the structure information from the position.
- e) To move to the end position of the structure The end position of the structure set on the left edge area of the road image in upper of the application.
- f) To push "Shift" and "Ctrl" and click "Delete from", and delete the structure information from the indicated image.



Figure 10.23 Example of Identify the Position for a Road Infrastructure

1 st Sele	ct from the list.	
Structure	AAA bridge	Set
B.Bridge T:Tunnel R:Rock shed O:Other	2 nd Enter name	

Figure 10.24 Example of Entering Infrastructure Details

<Intersection>

To records the type, name of intersection. Following table shows the recording intersection. Table 10.14 Setting item of Intersection

Туре
Intersection
Roundabout

Viaduct
Railway Crossing
Toll Gate
Others

Recording procedure as below;

- a) To move to the center of intersection Move to the center position of the intersection on the left edge of the road image of the application.
- b) To select the type of intersection
- c) To input the name of intersection
- d) To click "Set" and record the information of the intersection

If there are some kinds of intersection as roundabout, railway cross, viaduct, or intersection with traffic light at the same position. Please select in the following order. roundabout \rightarrow intersection (with traffic light) \rightarrow railway cross \rightarrow viaduct

<Overlapping>

To records the type, name, and section of overlapping. Following table shows the recording overlapping

Table 10.15Setting item of Overlapping

Туре
Route overlap
Left and Right bound overlap

Recording procedure as below;

a) To move to the start position of overlapping Move to the start position of the overlapping on the left edge of the road image of the application

- b) To select the type of overlapping
- c) To input the name of overlapping road
- d) To push "Shift" key and click "Shift from" and record the overlappng information from the position.
- e) To move to the end position of the overlapping section Move to the end position of the overlapping on the left edge of the road image of the application
- f) To push "Shift" and "Ctrl" key and click "Delete from", and delete the overlapping information from the indicated image.
- Configuring the Kilo-post Station and Station Number Discrepancy To records the position of Kilo-post Station and Number of Lane.

< Kilo-post Station >

To record the number of Kilo-post Station. The recording procedure as follows;

a) To move to Kilo-post Station

Move to the KP position on the left edge of the road image of the application

- b) To input the number of Kilo-post Station
- c) To push "Set" and record the information of Kilo-post Station



Figure 10.25 Example of Identify the Kilo-post Position



Figure 10.26 Kilo-post station (3 kilo-post station)

(ilo Post	
44	Set

Figure 10.27 Example of Input of Details

< Number of Lane >

To records the number of lane. The recording procedure as follows;

- a) To move to the position change number of lane The position change number of lane check at the forward view image. From the forward view image and road image, operator identifies the position change number of lane.
- b) To input the number of lane
- c) To push "Shift" key and click "Shift from" and record the number of lane

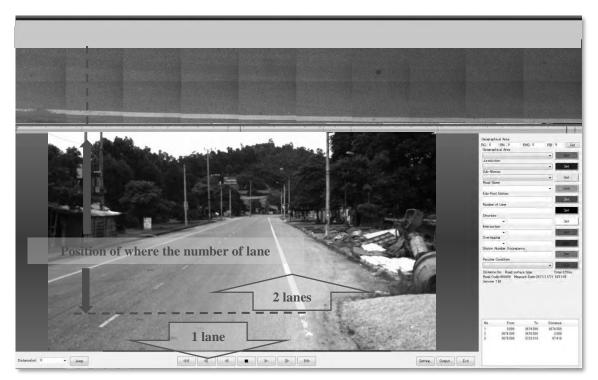


Figure 10.28 Example of Change in Number of Traffic Lanes

Number of Lane	
2	Set

Figure 10.29 Example of an Input for Number of Lanes

4) Peculiar Condition

Operator records the type, name and section of peculiar condition. Peculiar condition such as broken, wet condition and other condition could not be evaluated by Crack. The pavement condition data file should make clarify the position of such condition. The peculiar condition which operator record as follow table.

Item	Discription	Image	
1.Broken	It was once paved. There is serious damaged section due to which damage cannot be quantified.		
2.Unpaved or unidentified Pav. Type	Unpaved : It has never been paved. Unidentified Pav. Type : Pavement type other than AC, CC and BST. (Gravel, Rock)		

Table 10.16 Definition of peculiar condition

3.Wet Condition	The lane is covered with water and the whole is wet.	
4.Other damage	Other type damage that can not be judged as cracking.(such as Raveling, Scratch)	
5.Invisible	Can not see the surface due to coverage of pavement surface by other object such as sand, soil, construction material, etc.	
6.Under construction	There is ongoing construction work on the survey lane.	A CONTRACT

The recording procedure as follow;

a) To move to the start position of peculiar condition The start position of the peculiar condition set on the left edge of the road image in upper of the application.

- b) To select the type of peculiar condition
- c) To push "Shift" and click "Shift from" and record the information of peculiar condition from the indicated image.
- d) To move to the end position of peculiar condition The end position of the peculiar condition set on the left edge of the road image in upper of the application.
- e) To push "Shift" and "Ctrl" keys and click "Delete from" to delete the information of peculiar condition from indicated image

Peculiar Condition		
		Set

Figure 10.30 Example of an Input for Peculiar Condition

C. Data Output

Click on [Output].



Figure 10.31 Data Output

Enter the details under the [Common Item] section.

Common Ite Road catee Lane No:		ad No: 999	Road No Supplement Measure Date: 2016120	neh No: 11 TSUCHIYA	Direction: Vehicles: Re	2 al Mini
ile. older:						Browse
No. 1 2	From(Km) 0.000 8487.000	To(Km) 3487.000 7978.976	Distance(m) 3487.000 4491.976			
¥ 🗌						

Figure 10.32 Output Configuration 1

To the [File] field, enter the output file name. Normally, the format should be in [road code+R/L+lane_origin distance_desitnation distance] format. Example) NH100100000R1_000k00000_023k00250 (National Highway 1, Right, Lane 1, From:0k0 To 23k250)

Common Ite Road categ		ad No: 999	Road No Su	pplement: 99	Bran	ich No: 11	 Direction	к <u>2</u>
Lane No:	Lane Posi	ition: 3	Measure Date:	20161201	Operator:	TSUCHIYA	Vehicles.	Real Mini
File: te	st							_
Folder:								Browse
No.	From(Km)	To(Km)	Distance(m)					
1	0.000 3487.000	3487,000 7978,976	3487.000 4491.976					
¥ 🔲								7

Figure 10.33 Output Configuration 2

Click on [Browse] and specify the output folder path.

Commor	Item							
Road ca	tegory: 1	Road No: 999	Road No Su	ipplement: 99	Bran	ich No: 11	Direction: 2	-
Lane No	: Lane	Position: 3	Measure Date:	20161201	Operator:	TSUCHIYA	Vehicles: Real M	lini
ile:	test							
older:	G¥Vietnam Surve	ved Data					[Browse
No.	From(Km)	To(Km)	Distance(m)					N
1	0.000 3437.000		3487.000 4491.975	-				
۲ <u> </u>								

Figure 10.34 Output Configuration 3

Click on [Execute] to execute the data output.

Common It	em					_			
Road cate	ory: 1	Road No	; 999	Road No Su	ipplement: 99	Bran	ich No: 11	Direction	n: 2
Lane No:		Lane Position:	3	Measure Date:	20161201	Operator:	TSUCHIYA	Vehicles:	Real Mini
ile: te	st								
Folder: G	¥Vietnan	n Surveyed Data							Browse
No.	Fre	om(Km)	To(Km)	Distance(m)					
E1		- K - K K K	3487.000	3487.000					
2	3	487.000	7978978	2891975					and the second
4 🗐									

Figure 10.35 Output Configuration 4

The data is output in a CSV format to the specified folder path.

Organize 🕶 Share with 🖛 Burn I	New folder				i≡ • ⊡	1 6
Favorites	* Name	Date modified	Туре	Size		
Desktop	A NH00600d 132k08505 145k00030.C	V 2/1/2013 3:27 PM	Microsoft Excel C	1,845 KB		
. Downloads	马) C NH00600d 132k08505 145k00030.CS		Microsoft Excel C	2.567 KB		
Recent Places	R NH00600d 132k08505 145k00030.CS		Microsoft Excel C	32,710 KB		
	RS_NH00600d_132k08505_145k00030.C		Microsoft Excel C.	1,575 KB		
Libraries	KB_NH00600d 132k08505 145k00030.C		Microsoft Excel C	1.616 KB		
Documents	Z_NH00600d_132k08505_145k00030.C5		Microsoft Excel C	68,999 KB		
Music	F_NH00600d_132k08505_145k00030.CS		Microsoft Excel C	1,922 KB		
Pictures	国 S NH00600d 132k08505 145k00030.CS		Microsoft Excel C	102,638 KB		
Videos	副 I_NH00600d_132k08505_145k00030.CSV	2/1/2013 3:29 PM	Microsoft Excel G	101,305 KB		
🕹 Homegroup	E					
Computer						
🚢 Local Disk (C:)						
📖 New Volume (D:)						
👝 ボリューム (E:)						
Removable Disk (F:)						
analysis image						
data process						
image for manual						
🍌 output data & image						
ji picture						
Network	+					

Figure 10.36 Confirmation of Output

(3) Data check

The Location setting application check the data about KP number and direction. If same KP number input, Error messege is displayed in window when output the data. And if the order of KP don't matches the road direction, Error messege is displayed in window when output the data. These error information record in "Error2.txt".

(4) Delivery Flow

"P_*****.csv " output by this application is used for the data processing. Other data file is used for the confirmination of the setting information. Operator is confirmed whether the set information is the same for the right direction and the left direction.

	Table 10.17 Delivery Data						
No.	Data	Notes					
1	P_*****.csv	Positional information data					
2	0001-0.CSV	List of Jurisdiction					
3	0001-1.CSV	List of Sub-Bureau					
4	0005.CSV	List of KP					
5	0101.CSV	List of Number of Lane					
6	0104.CSV	List of Structure					
7	0105.CSV	List of Intersection					
8	9998.CSV	List of Peculiar Condition					

Table 10.17 Delivery Data