3. Road Condition Data Collection Survey

3.1 Overview

The objectives of pavement condition data collection, using the pavement condition survey vehicle, are to: take pictures of road surface for crack analysis; measure the crossing road profiles for rut; measure the vertical road profiles for IRI; record locations using GPS; and take pictures of forward views.

Table 3.1 Functions and Performance of Road Condition Survey Vehicle

Functions	Performance
Distance	Accuracy to within ±0.5% for values actually measured by tape
Cracking	Accuracy to be able to detect any crack of 2 mm or more in width
Rutting	Accuracy to within ±5mm for values actually measured in the cross-sectional profile graphs
International Roughness Index, IRI	Devices to measure cross-sectional profiles satisfy the accuracy of Class 2. (complying with the "Handbook for Pavement Survey and Test Methods")
Road images	Full high-vision CCD cameras (1,920 (w) x 1,080 (h))
GPS data	Accuracy of point positioning, and measurement of longitude, latitude and altitude

3.2 Personnel

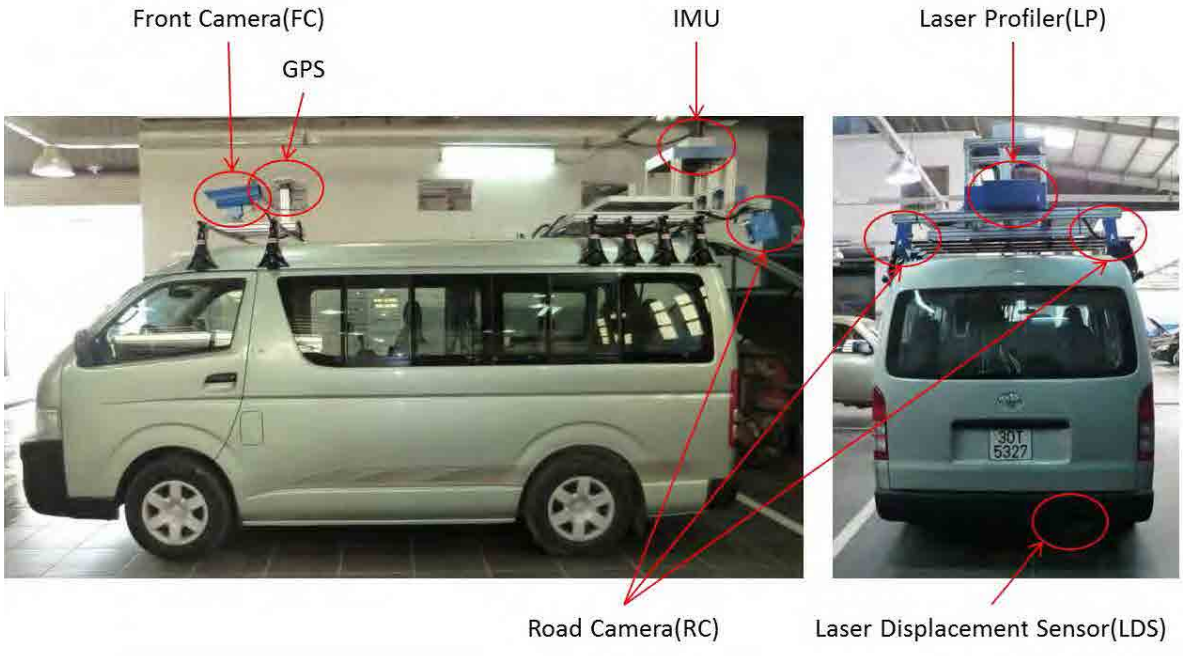
The team has: Leader; Operator 1; Operator 2; Navigator; and Driver. The leader shall have basic IT skills of Windows and MS Excel. Operator 1 handles the forward viewing; Operator 2 handles the road images; the navigator checks the routes.

3.3 Overview of the Road Condition Survey Vehicle

The road condition survey vehicle has the following sensors: front camera, GPS, IMU, Laser Profiler, road cameras, laser displacement sensors. The front camera record front images; GPS records locations; IMU and laser displacement sensor identify longitudinal profile; the road cameras record road images in black and white to identify cracks; the laser profiler 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 front camera needs to record the front view, the location of the front camera needs to be high enough not to include the front of the vehicle itself. The clearance of vehicle needs to be high enough to have sufficient space between the road surfaces to the laser displacement sensor. The vehicle needs to accommodate five persons: driver; navigator; leader; operator; and worker.

Figure 3.1 Outside of the Road Condition Survey Vehicle

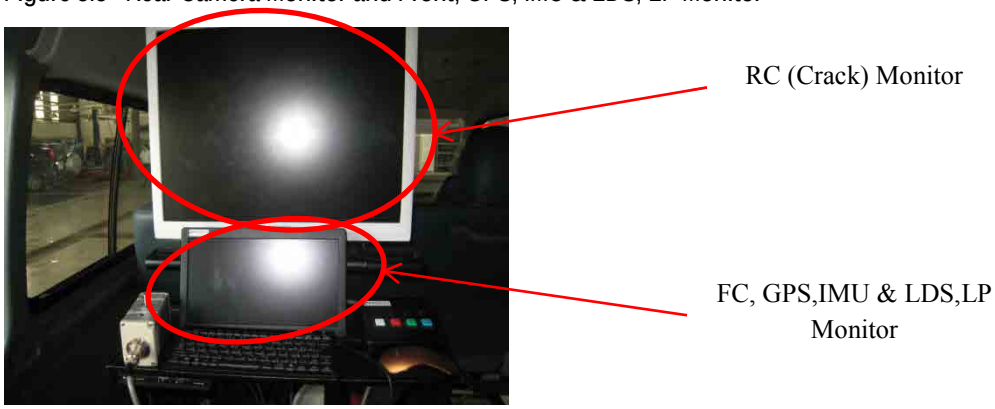


FC: Forward view images; GPS: Location of measurement point; IMU & LDS: Vertical Profiles (IRI); RC: Road surface images (Crack); LP: Crossing Profiles (Rut)

There are two computer monitors and control devices in the vehicle behind the driver seat. The bigger monitor shows the images from the road cameras. The small monitor shows the front view, data and information from GPS, IMU & LDS, and LP. The small monitor also shows the front view.

Figure 3.2 Inside of the Road Condition Survey Vehicle

Figure 3.3 Rear Camera Monitor and Front, GPS, IMU & LDS, LP Monitor



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

Figure 3.4 On-board Equipment in the Rear of the Vehicle

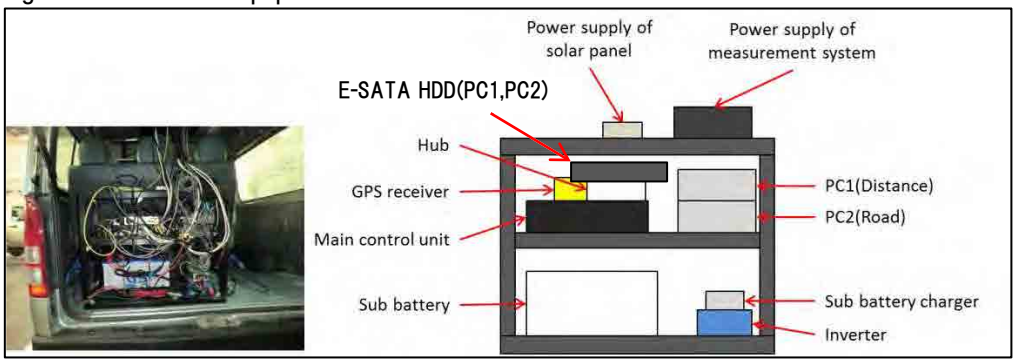


Table 3.2 On-board Equipment

Name	Explanation
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, 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.
E-SATA 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.
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.
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 (Front Camera, Laser displacement Sensor, IMU, road Camera, Laser Profiler, PCs 1 and 2). The unit calculates distances based on the pulse data to be sent to PC1 and PC2.
Sub battery	It is the power source (dc-battery) of loading equipment. The battery using the sub-battery charger, it charges automatically and prevents unexpected failure of a dc-battery from the power generation machine with which the vehicle is equipped.
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.
Sub battery charger	The device supplies the power from vehicle to sub-battery.
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 road camera displaying to the monitor and records the road camera setting such as route, aperture and gain.

3.4 Method

(1) Preparation of outside vehicle

Remove all the covers on the cameras and sensors and clean the lenses and sensors. Make sure that nuts and bolts are tightened.

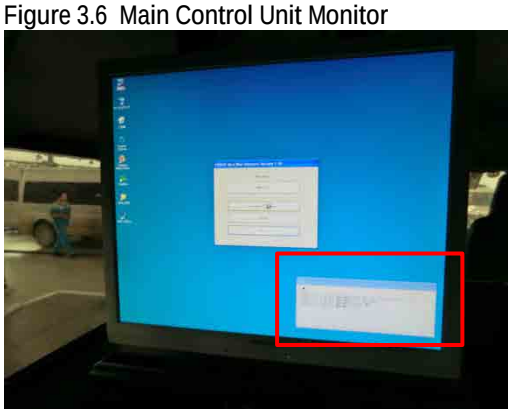
(2) Preparation of Survey System

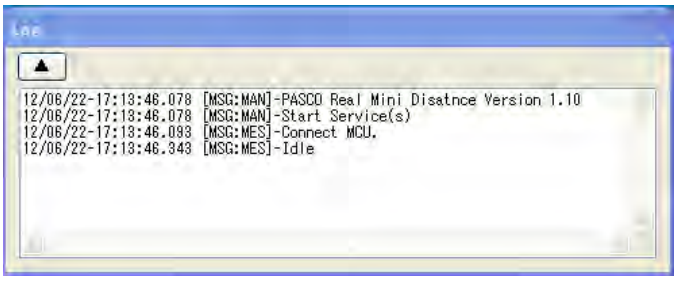
Turn on the power.

Figure 3.5 Main Control Unit Power-On

Check the activation of PC and Main Control Unit (MCU).

Figure 3.6 Main Control Unit Monitor

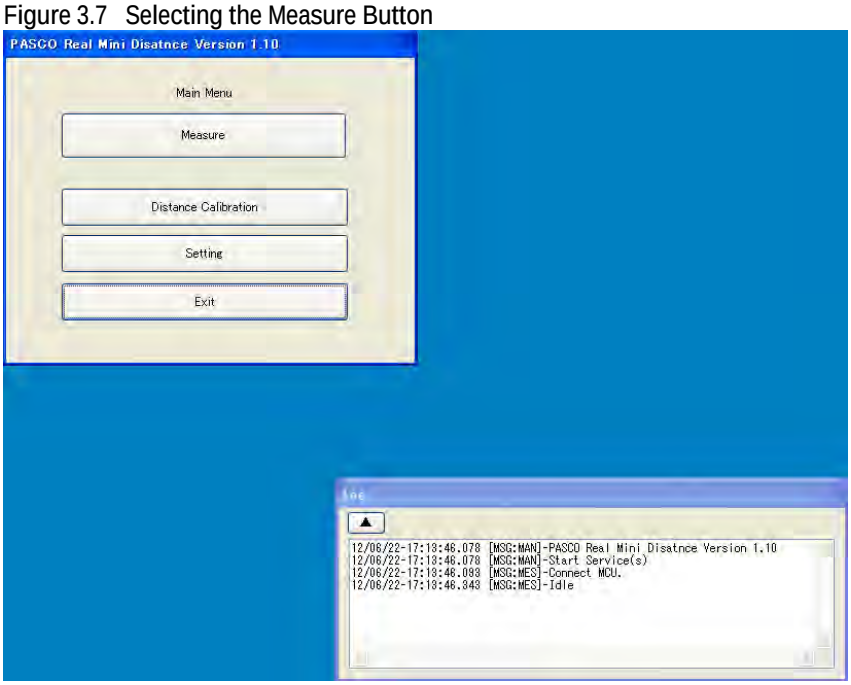




If PC and MCU is not connect, turn off power and turn on power. If the connection still cannot be confirmed, please check the slack of the wiring.

Click “Measure.”

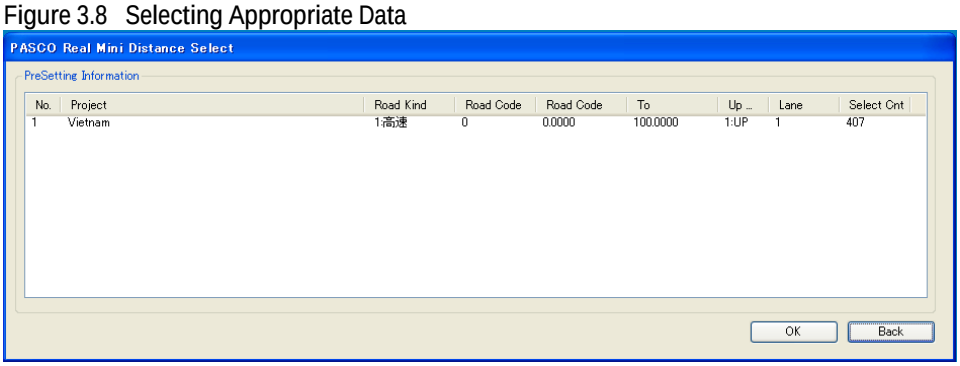
Figure 3.7 Selecting the Measure Button



Select “Vietnam" from the list.[3]

Press “OK.”

Figure 3.8 Selecting Appropriate Data



Input the route information: The form has the text boxes to enter:

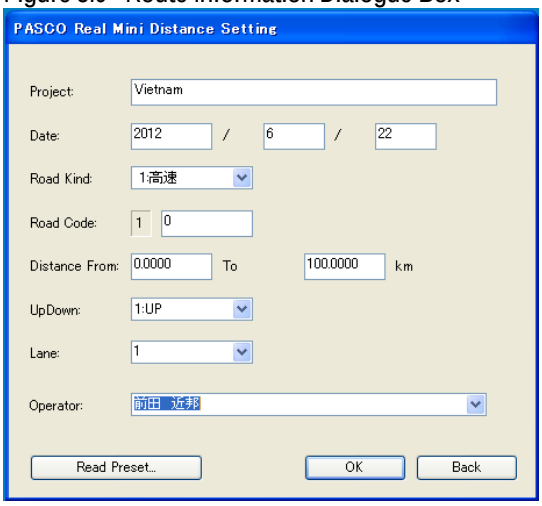
[3] It show an example from the Vietnam project.

Table 3.3 Entering the Data to Text Boxes

Text Box	Note
Project (Project name)	Automatic input
Date (Measurement date)	Automatic input
Road kind (Road kind)	Automatic input
Road Code (Code of measurement route)	Input the 5 digit number
Distance from to (KP information of measurement route)	Input KP of start and end
Up Down (Direction of route)	Select from the list (1 UP, 2 Down)
Lane (Number of lane)	Select from the list
Operator (Operator)	Select from the list

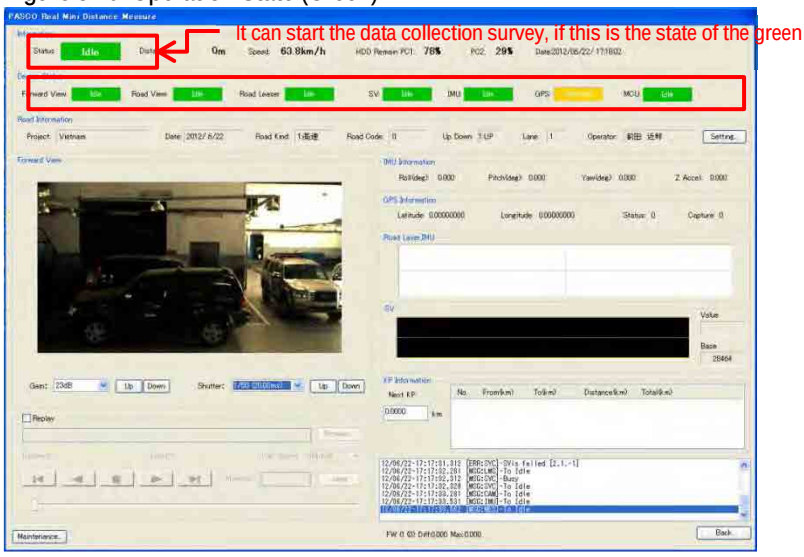
The dialogue box show like Figure 3.9

Figure 3.9 Route Information Dialogue Box



Check the connection with the road data collection devices.

Figure 3.10 Operation State (Green)



The colors indicate the connection conditions.

Table 3.4 Measurement Device Connection Status

Colour	Condition
Red (Busy)	Not connection
Yellow (Unsettled)	Search
Green (Idle)	Connection

Measurement is possible even "Search" state of the GPS
If measurement is not connect, turn off power and turn on power
If the connection still cannot be confirmed, please check the slack of the wiring

Set the shutter speed and gain of the camera.

Figure 3.11 Shutter Speed and Gain Control 1

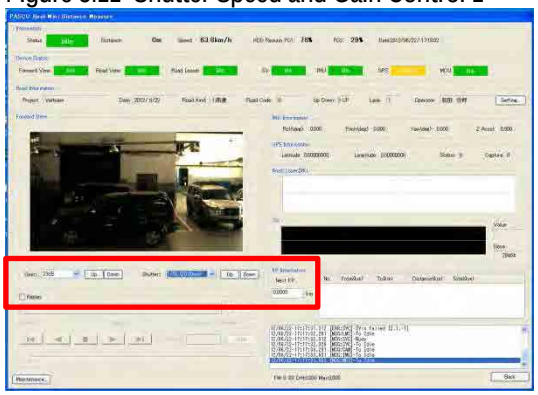


Figure 3.12 Shutter Speed and Gain Control (Enlarged 1)

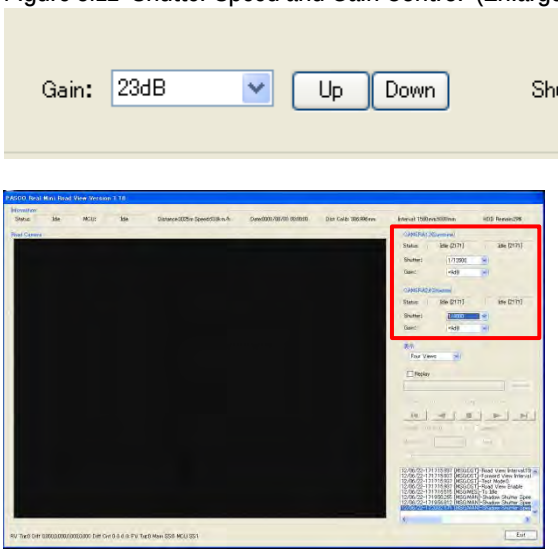
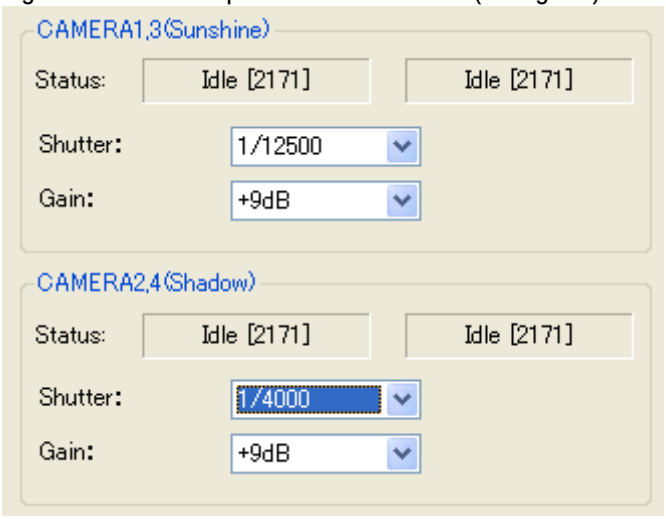


Figure 3.13 Shutter Speed and Gain Control (Enlarged 2)



Switch PC1 and PC2 using the selector when it is necessary.

Figure 3.14 Switching PC1 and PC2

(3) Road Data Collection Survey Procedure

A. Overview

Push the white button of the operation box. Check the translation to state “Ready.” Start the measurement by push the white switch of control box.

During measurement,

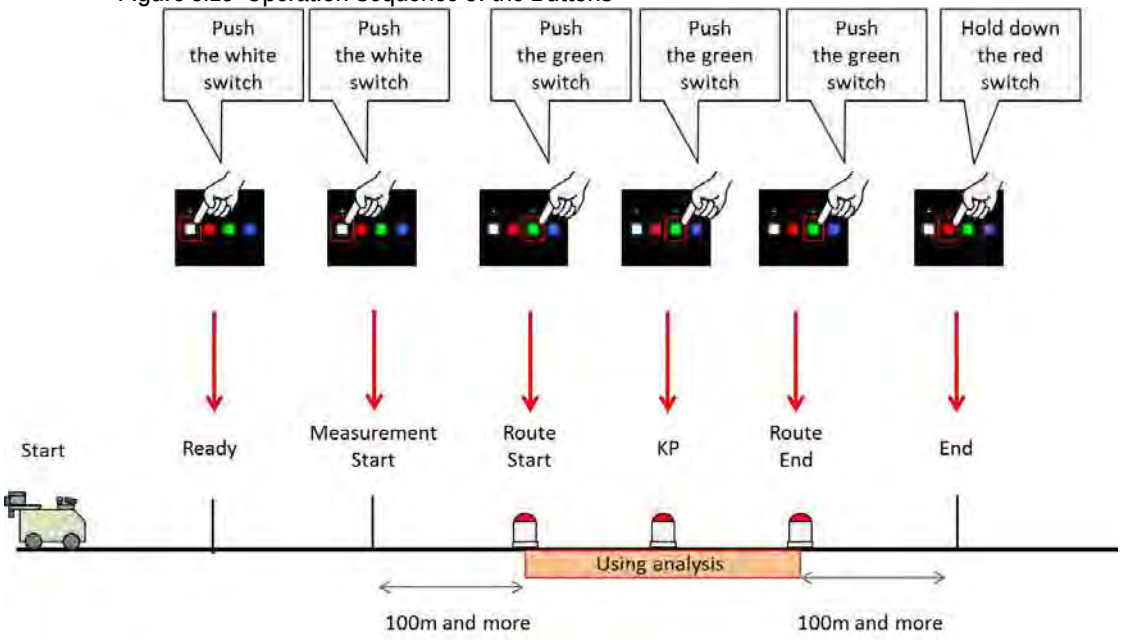
- Push the green switch of control box to register the kilometer post information.

- Change the camera settings to suit the image of state

End the measurement by hold down the red switch of control box

The road condition survey system need to start before 100m and more of route start. The road condition survey system needs to end more than 100 meters from the end point. When a capaciyt of HDD is small, the road condition data would not be collected.

Figure 3.15 Operation Sequence of the Buttons



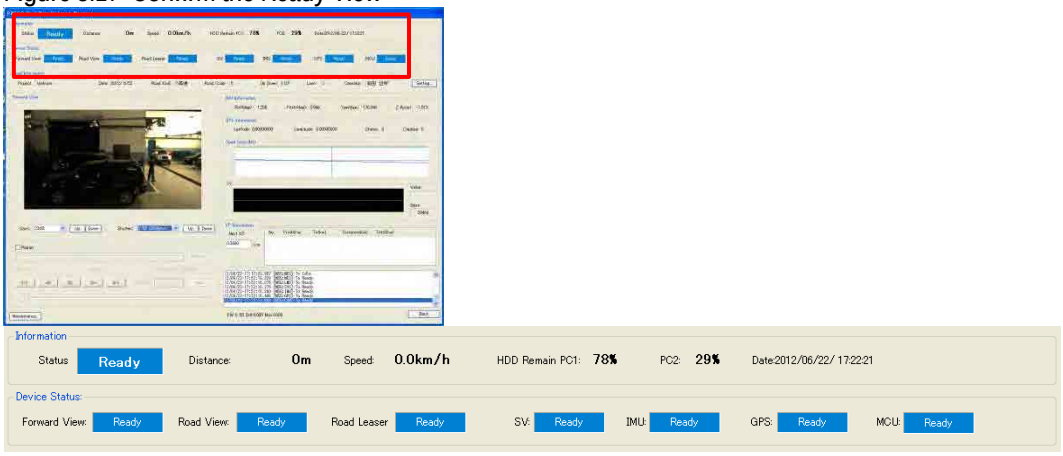
B. Steps to measure the data

Push the white switch of control box to get ready.

Figure 3.16 White Button (Ready)

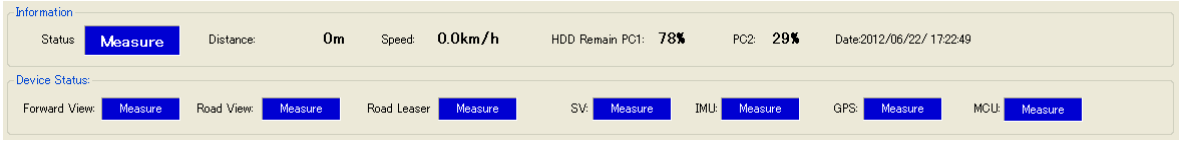
Check the translation to state “Ready”

Figure 3.17 Confirm the Ready View



Start the data collection survey by pushing the white button of the control box.

Figure 3.18 Pressing the White Button to Start the Measurement

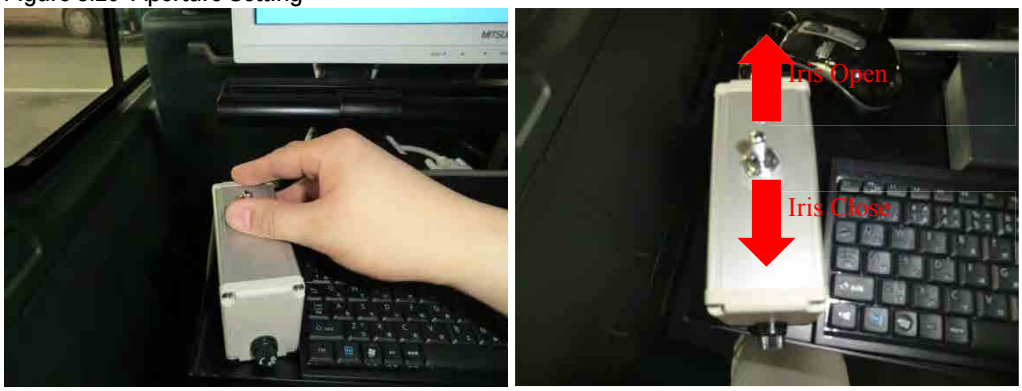


During the survey, push the green button to register the kilometer post information

Figure 3.19 Kilometer Post Recording

Change the camera settings to suit the image of state by controlling the switch as in Figure 3.20. The front camera changes the iris of the lens by lens controller.

Figure 3.20 Aperture Setting



The shutter speed and gain of the rear cameras can be changed by change the parameters of the control program.

Figure 3.21 Changing the Shutter Speed and Gain of Rear Cameras (Screen Image)

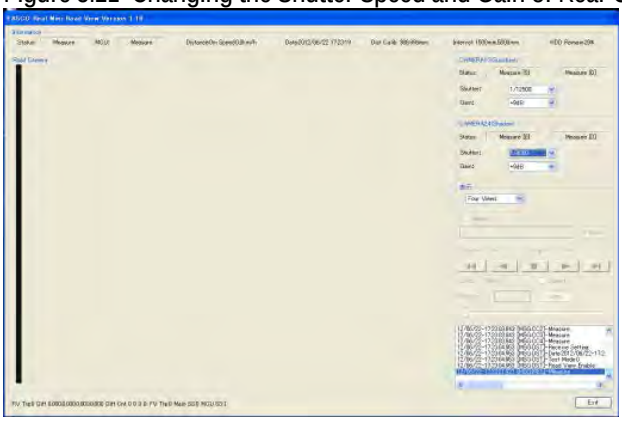
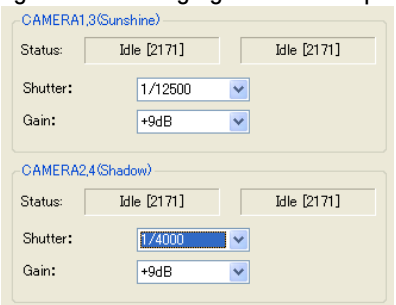


Figure 3.22 Changing the Shutter Speed and Gain of Rear Cameras (Enlarged View)



End the survey by hold down the red button.

Figure 3.23 End Road Condition Survey

(4) Check the Survey Data

Select the check box [Replay]. Select the data folder. Replay the data.

Figure 3.24 Check the Survey Data

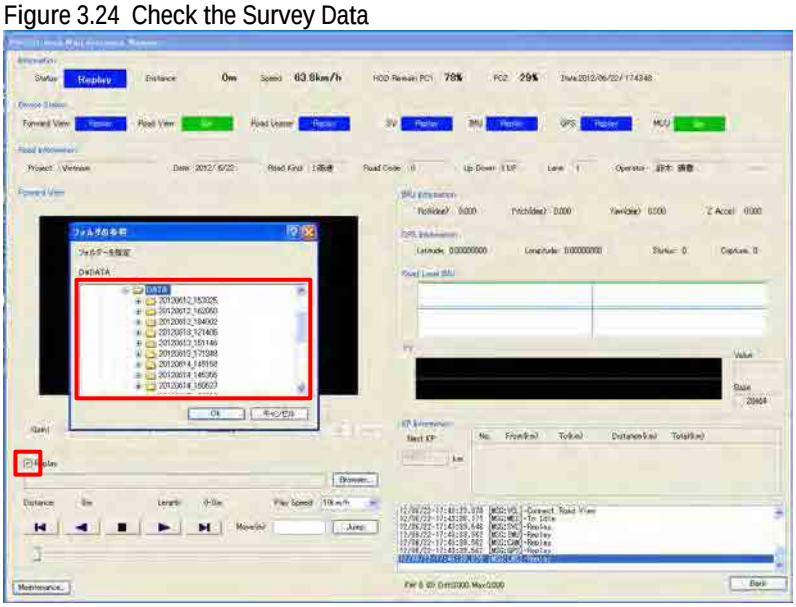
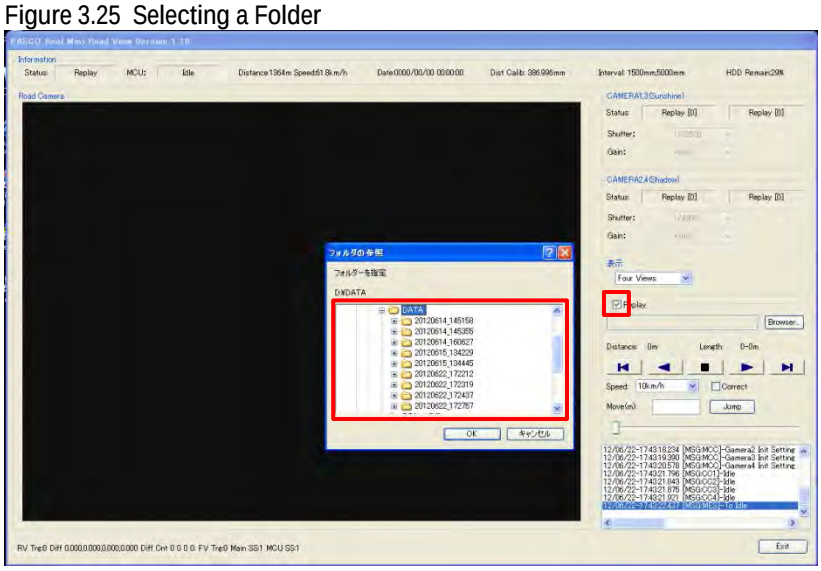


Figure 3.25 Selecting a Folder

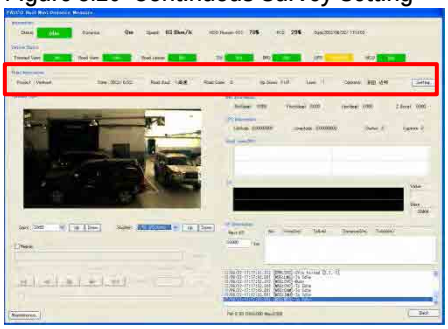


(5) After measurement

A. Continuous Survey

Click “Setting.”

Figure 3.26 Continuous Survey Setting

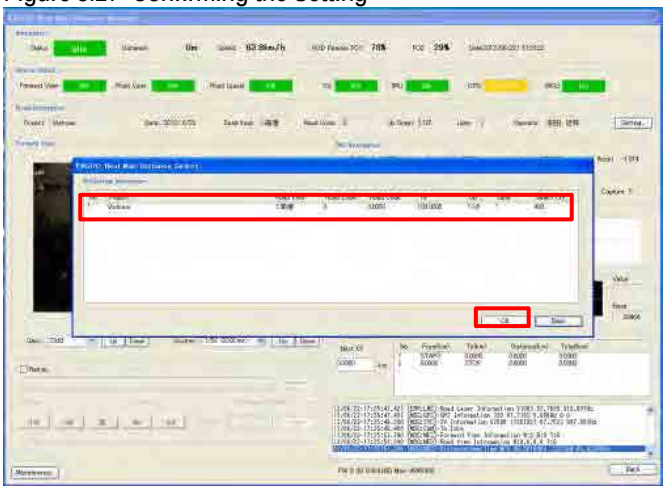


Select “Vietnam" from the list.[4]

Click “OK.”

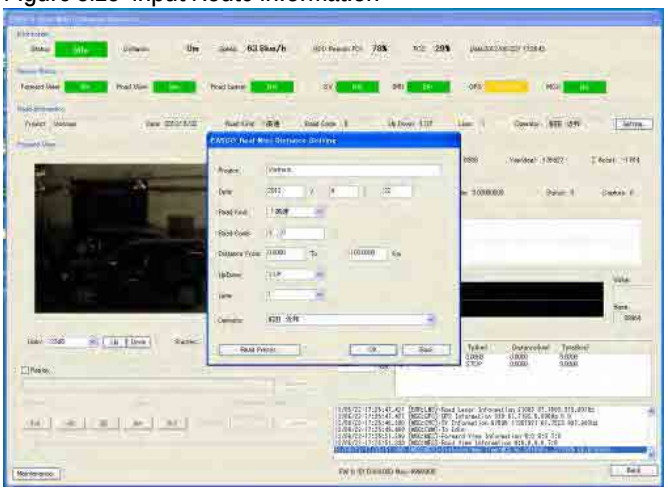
[4] An example from the Vietnam project.

Figure 3.27 Confirming the Setting



Input the route information.

Figure 3.28 Input Route Information



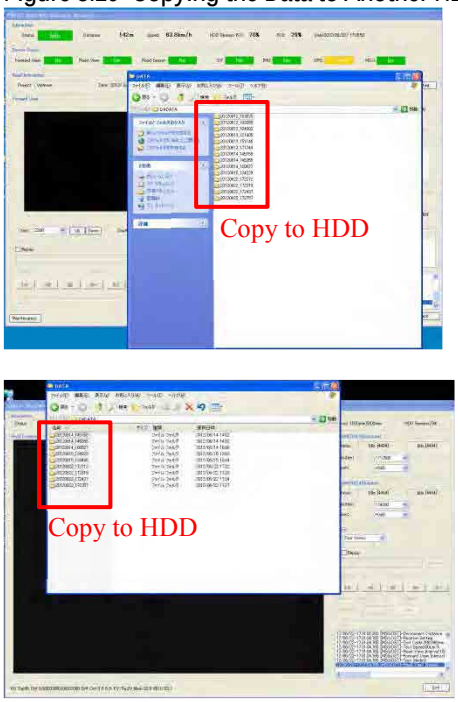
Follow the steps to end the survey.

B. Termination of Data Recording

Copy the survey data to HDD.

Data folder => D: \DATA\

Figure 3.29 Copying the Data to Another HDD.



After copying the data, shut down the system and tidy up the tools and equipment.

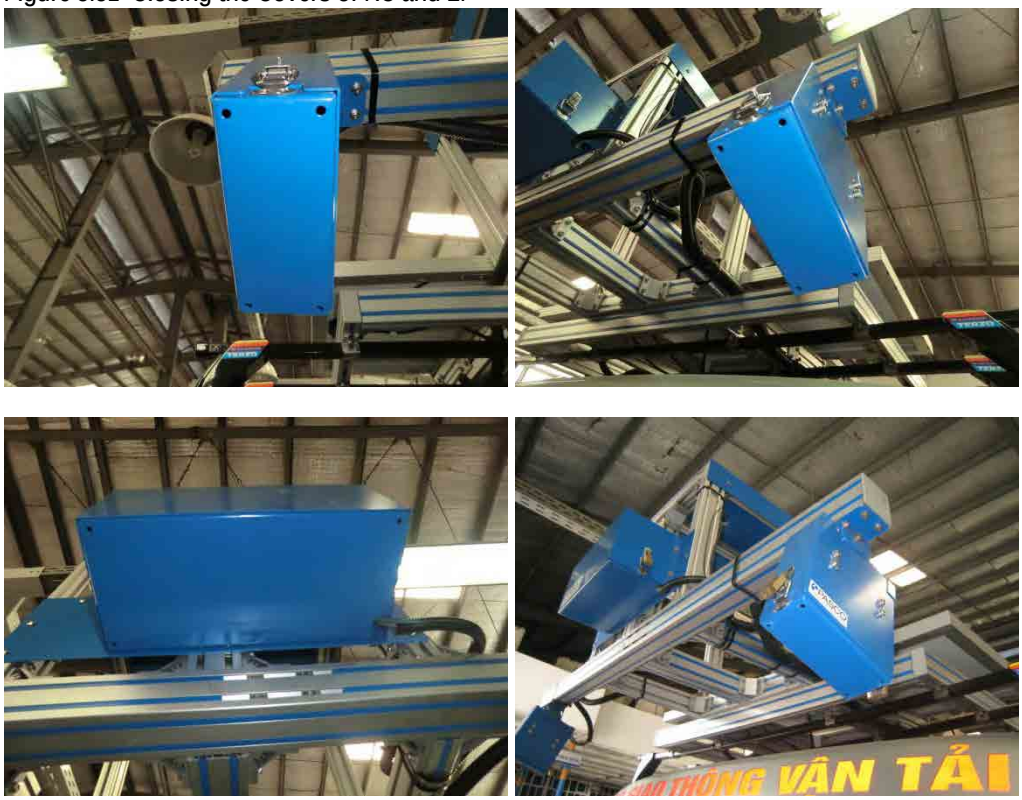
(6) Tidy up the equipment

Shut down the system.

Figure 3.30 Shutting Down the System

Put the cover to the road camera and laser profiler.

Figure 3.31 Closing the Covers of RC and LP



Close the cover of the laser displacement sensor.

Figure 3.32 Cover of the LDS

Cover the vehicle with the vehicle cover.

4. Pavement Damage Interpretation

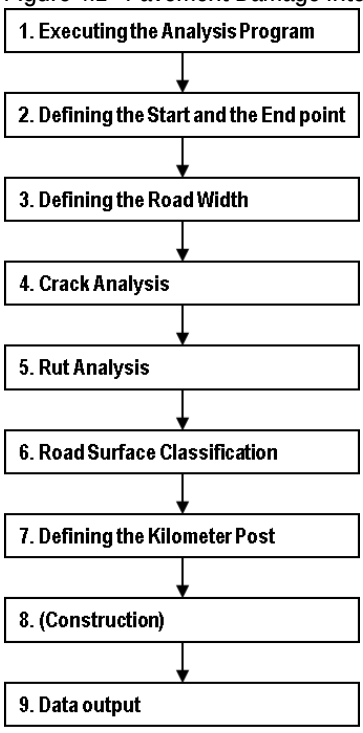
4.1 Introduction

The major objective of this process is to interpret the pavement damage conditions. Along with the damage interpretation, kilometer posts and other road structure data are registered. Road width and surface type registrations are other major activities in this process.

4.2 Work Flow

The road surface investigation analysis flow is shown below.

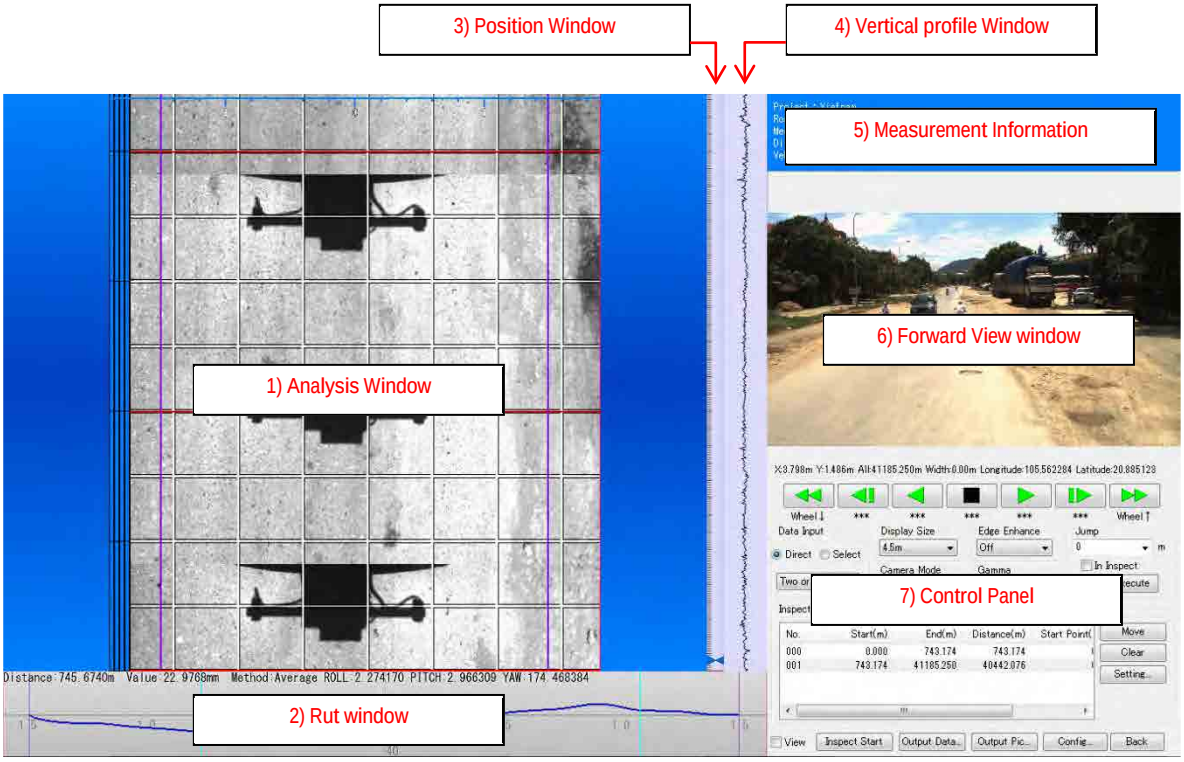
Figure 4.1 Pavement Damage Interpretation Work Flow



4.3 User Interface

The following figure shows the user interface of the system.

Figure 4.2 User Interface Windows and Control Panel



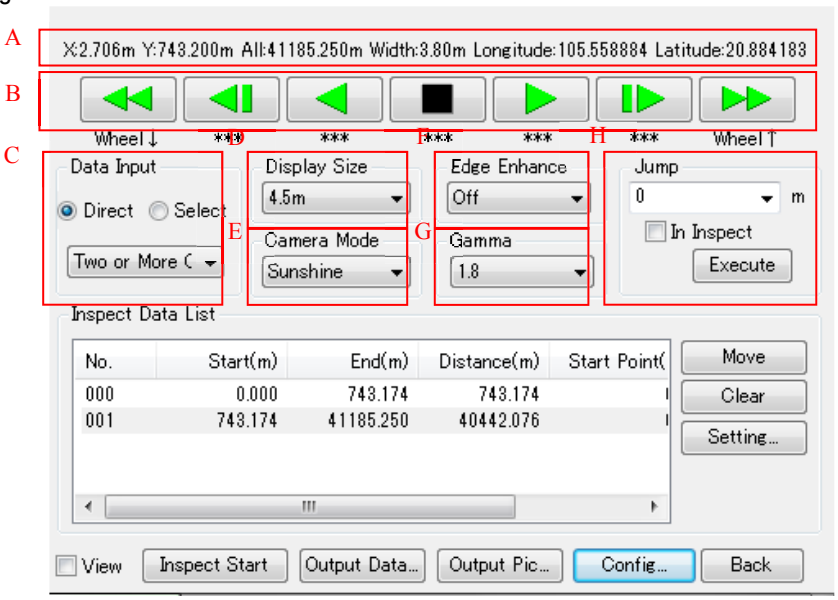
The user interface has the following windows:

Table 4.1 User Interface Windows

Window	Function
Analysis window	Display the road surface images
	To define meshes where cracks exist
Rut window	Display the rut shape
Position window	Display the position of analysis data
	Left Click position window, we can move the any position of data.
Vertical profile window	Display the vertical profile of road
Measurement Information	Display the Informaiton of measuremaent (Project name, Road kind, Measurement date, …etc)
Forward View window	Display the forward view images
	To enlarge the 'Forward View', double click the forward view window.
Control Panel	

The control panel has the informaiton section and button control section.

Figure 4.3 Control Panel in the User Interface

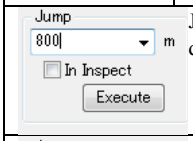
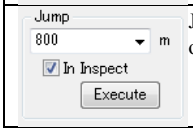
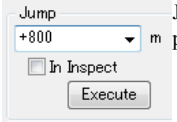
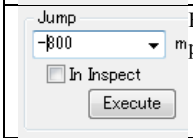
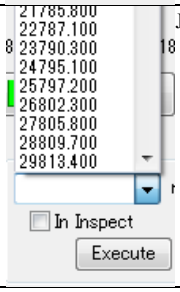


The button control controls the vising locations.

Figure 4.4 Description of Interface

Letter	Function Name	Description
A.	Information	The information section shows the X and Y position and longitude and latitude of cursor and the road width.
B.	Button Control	 [Frame Back] [Piece Back] [Back] [Stop] [Replay] [Piece Forward] [Frame Forward]
C.	Data Input	Select way of crack Classification
		- Direct : Use the mouse and keyboard
		- Select : Use the mouse only
D.	Display Size	Select the size of road surface image
E.	Camera Mode	Select the camera mode
		- sunshine : setting for sunshine
		- shade : setting for shade
		- compose : mix of sunshine and shade
F.	Edge Enhance	Setting the edge enhance of the road surface images
G.	Gamma	Setting the gamma of the road surface images

Figure 4.5 Description of Interface (Jump)

Letter	Function	Description	Explanation
H.	Jump		Jump to position of the input number
			Jump to 800m from start of data
			Jump to 800m from start point of analysis area
			Jump to 800m from this position
			Back to 800m form this position
			Jump to select list position

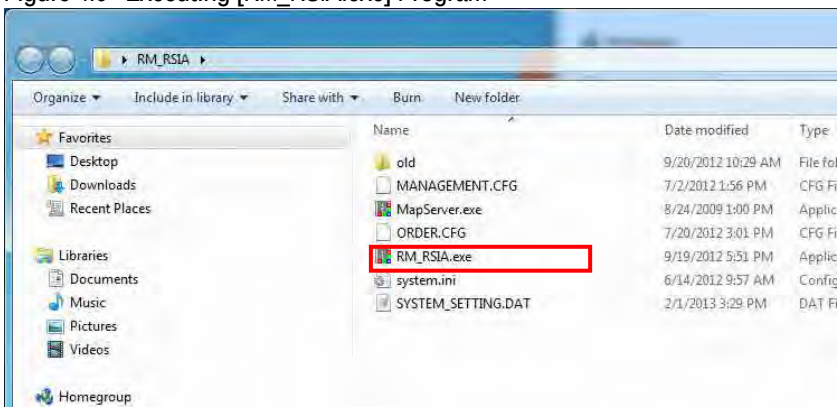
4.4 Method

(1) Execute the Interpretation Program

Execute the Analysis Program then choose the route which candidate for analysis.

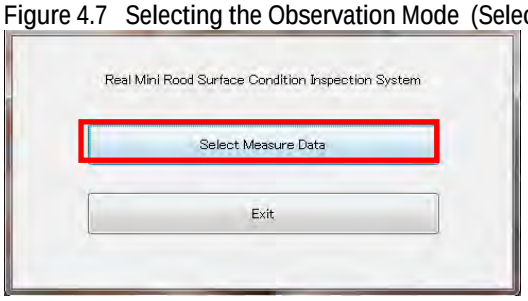
Execute the [RM_RSIA.exe].

Figure 4.6 Executing [RM_RSIA.exe] Program



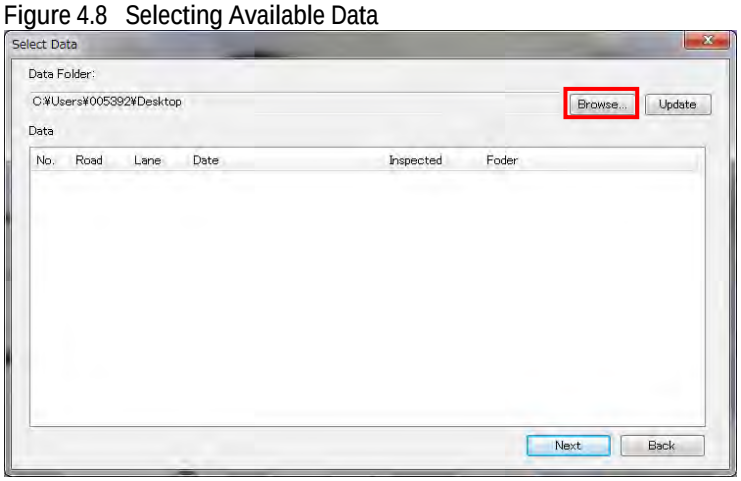
Left Click [Select Measure Data].

Figure 4.7 Selecting the Observation Mode (Select Measure Data)



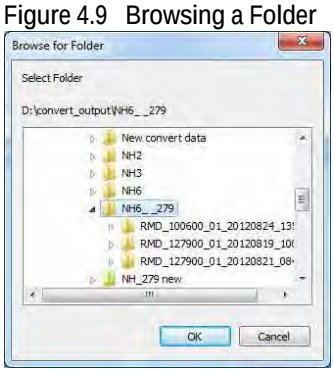
Left Click [Browse] to open the output data of the Convert program.

Figure 4.8 Selecting Available Data



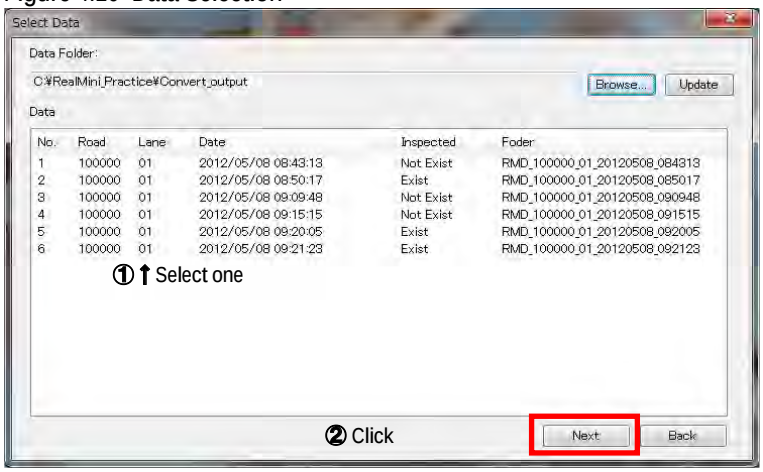
Select the folder which reserved as the export data in the convert program.

Figure 4.9 Browsing a Folder



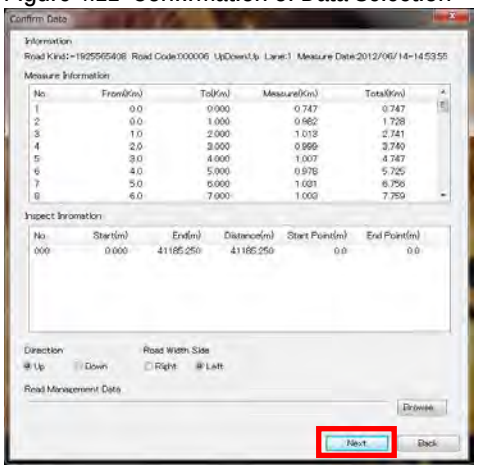
We can see the folder exported from the Convert Program. Choose one then left click [Next].

Figure 4.10 Data Selection



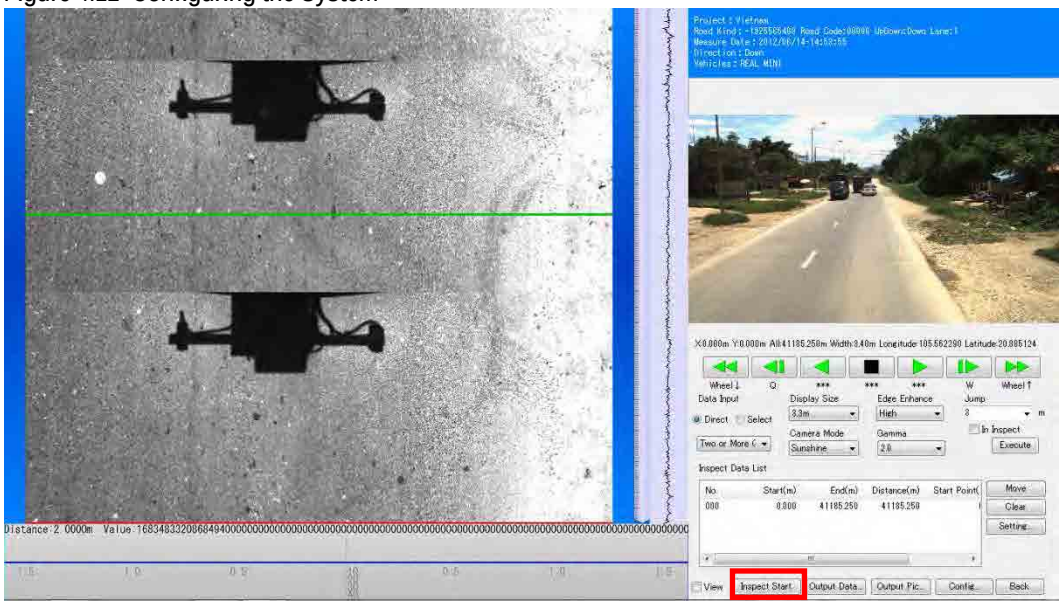
Left Click [Next].

Figure 4.11 Confirmation of Data Selection



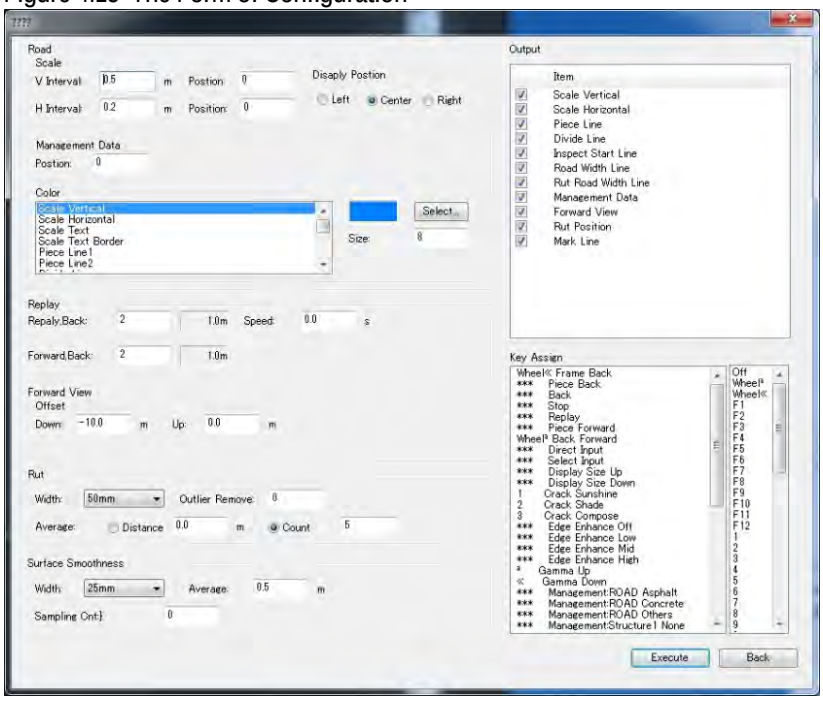
(7)Left Click [Config], we can edit the keyboard assign.

Figure 4.12 Configuring the System



Choose the item to display on the analysis window (like a 'Piece line', 'Rut Position') or edit the keyboard assign (like a 'Piece Forward', 'Piece Back').

Figure 4.13 The Form of Configuration

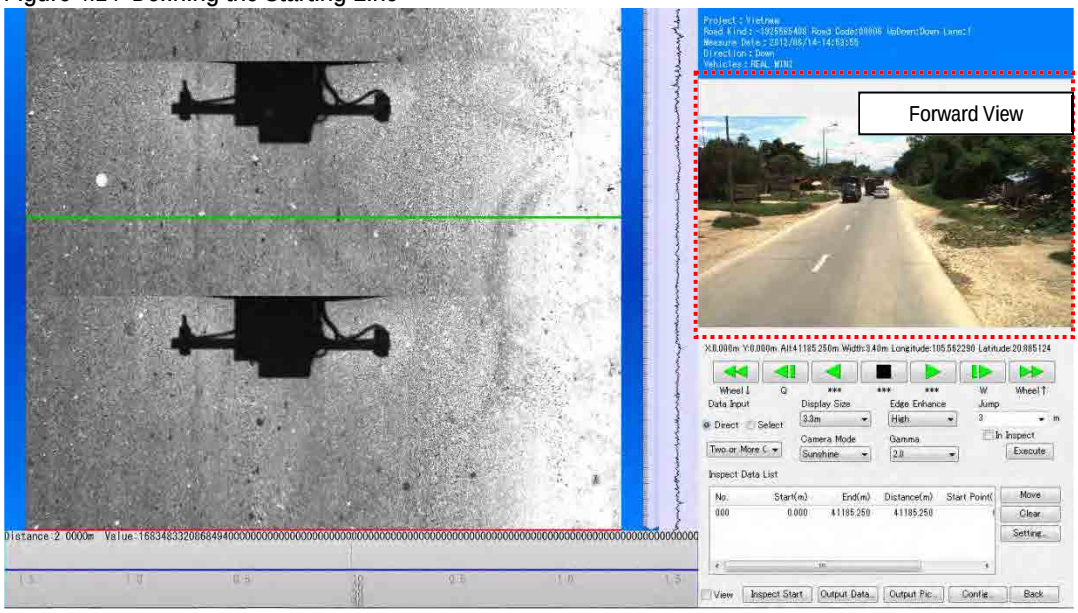


(2) Defining the Start and the End Point of Interpretation

A. Setting Start and End Positions

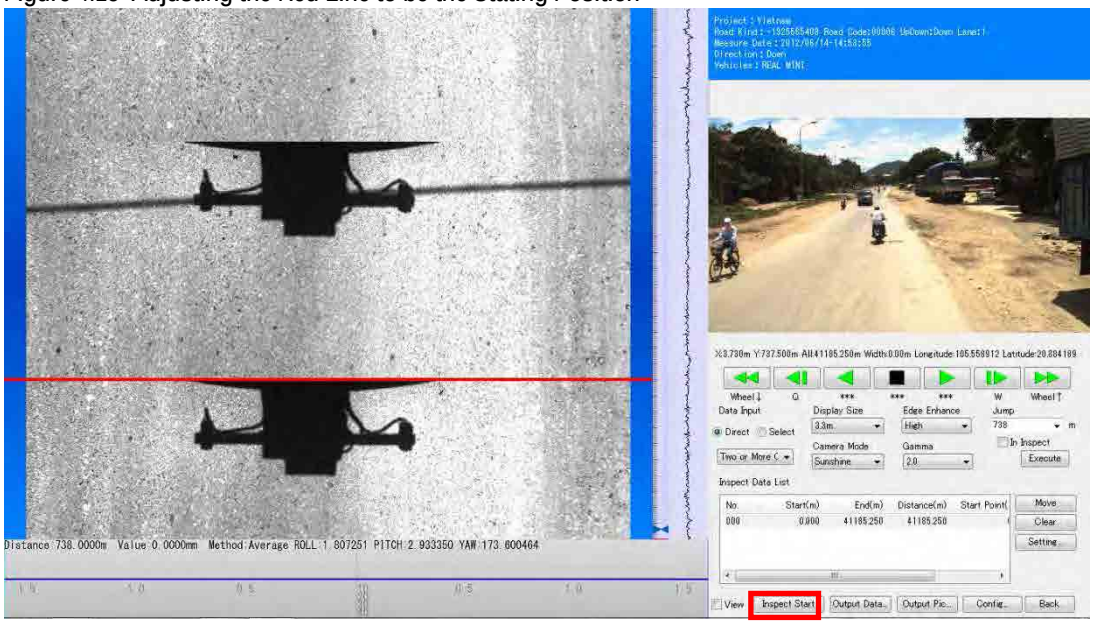
Before starting the road damage interpretation, the interpreter needs to define the start and end positions. In this example, use the shadow of the electric line.

Figure 4.14 Defining the Starting Line



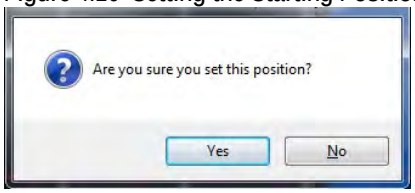
Left click [Inspect Start] and move the cursor in the analysis window, a red line appears.

Figure 4.15 Adjusting the Red Line to be the Stating Position



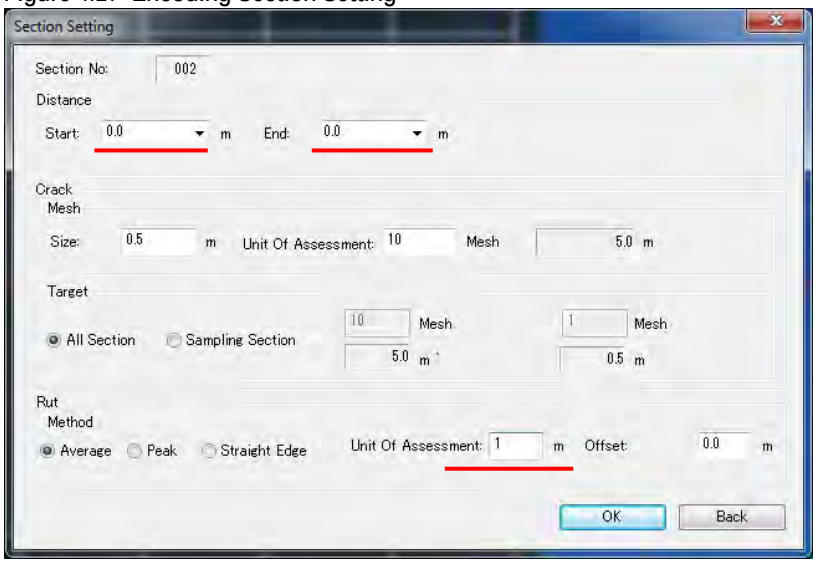
Confirm window appearing and left click [yes (Y)].

Figure 4.16 Setting the Starting Position



Check the values of red lined shown below.

Figure 4.17 Encoding Section Setting

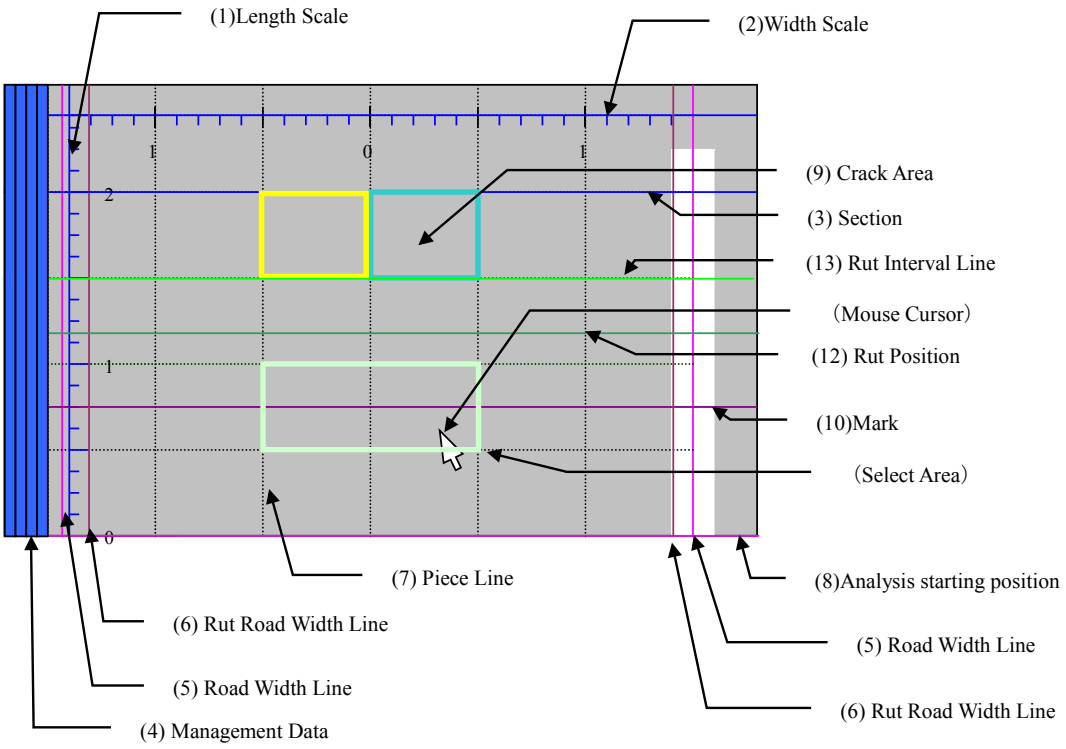


If an analysis start setup is completed, the analysis section is divided and the line of the "Inspect Data List" is increasing. If it moves to an analysis starting position, the display of a 'Rut Position', 'Management Data' and etc… will appear in an analysis window, and preparation of analysis will be completed. The method of the end position of the analysis is same method of starting position.

Figure 4.18 Starting Position Screen Image

Defining the start and the end point, these lines appear in the analysis window.

Figure 4.19 Indicators at Start-End Definition



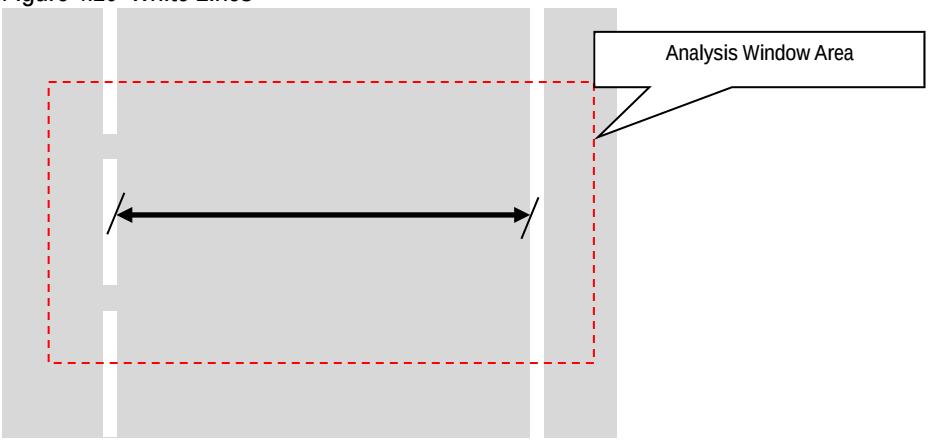
(3) Defining the Road Width

A. Examples of Road Width Setting

1) Case 1-Two white lines

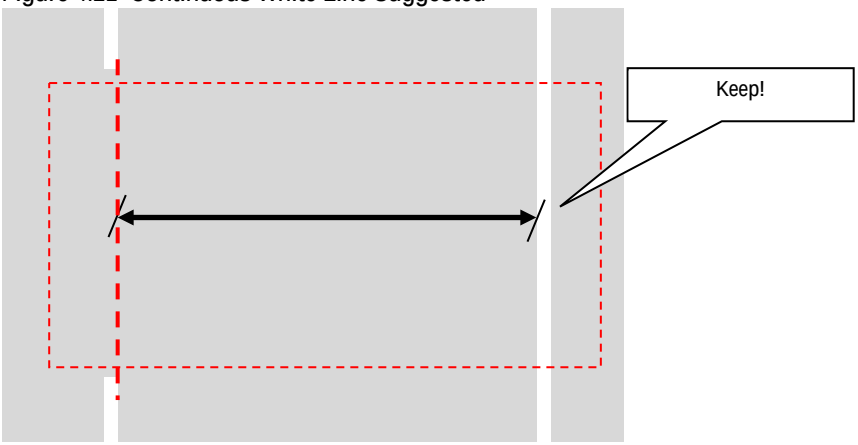
If two white lines are visible, the road width defines the inner side of a white line.

Figure 4.20 White Lines



The definition of width is not moved when the dashed line is continuing.

Figure 4.21 Continuous White Line Suggested



2) Case 2-One White Line

If one white line is visible, the road width defines from a line to the maximum width.

Figure 4.22 Road Width Determination without the Right White Line

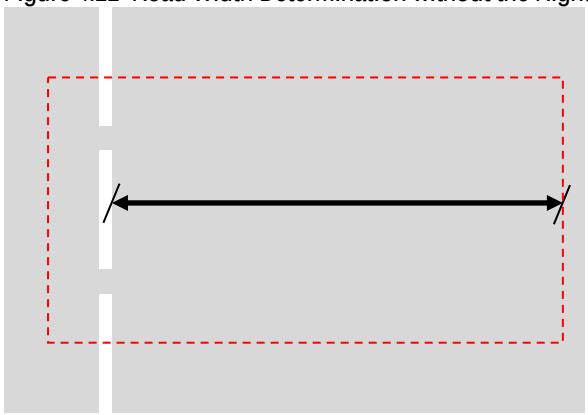
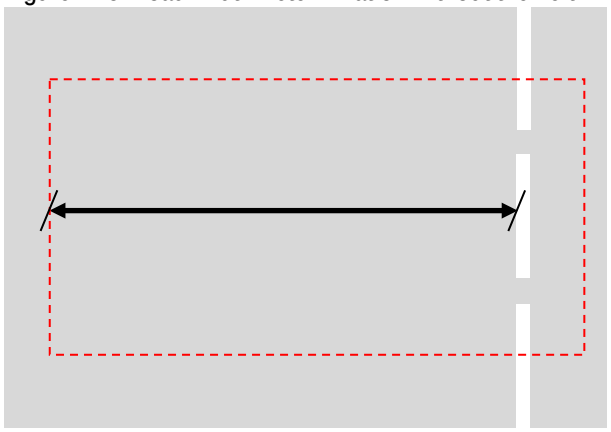


Figure 4.23 Road Width Determination without the Left White Line



If one white line is visible and another side is unpaved, the road width defines from a line to the end of pavement.

Figure 4.24 Determining the Road Width One Side Paved 1

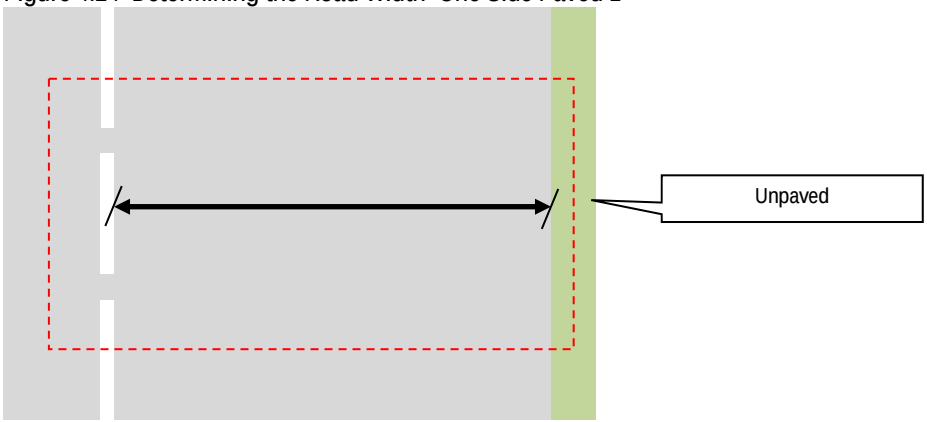
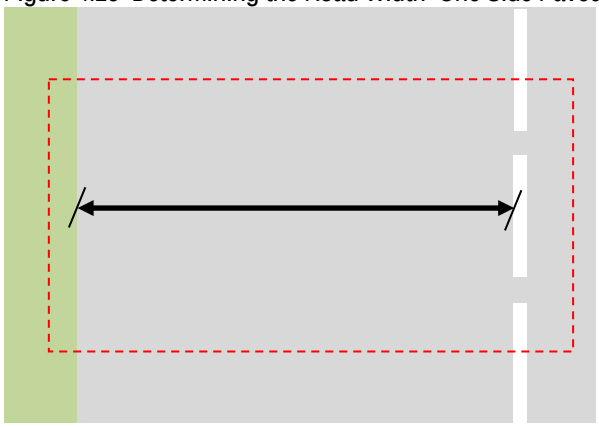


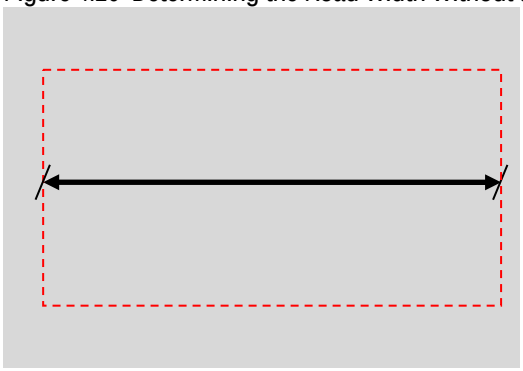
Figure 4.25 Determining the Road Width One Side Paved 2



3) Case 3-No white line

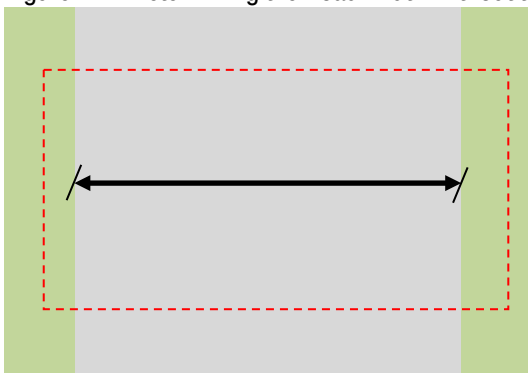
If there is no white line, the road width defines the maximum width.

Figure 4.26 Determining the Road Width Without the White Lines 1



If there is no white line and one side or both sides are unpaved, the road width defines the full width of pavement.

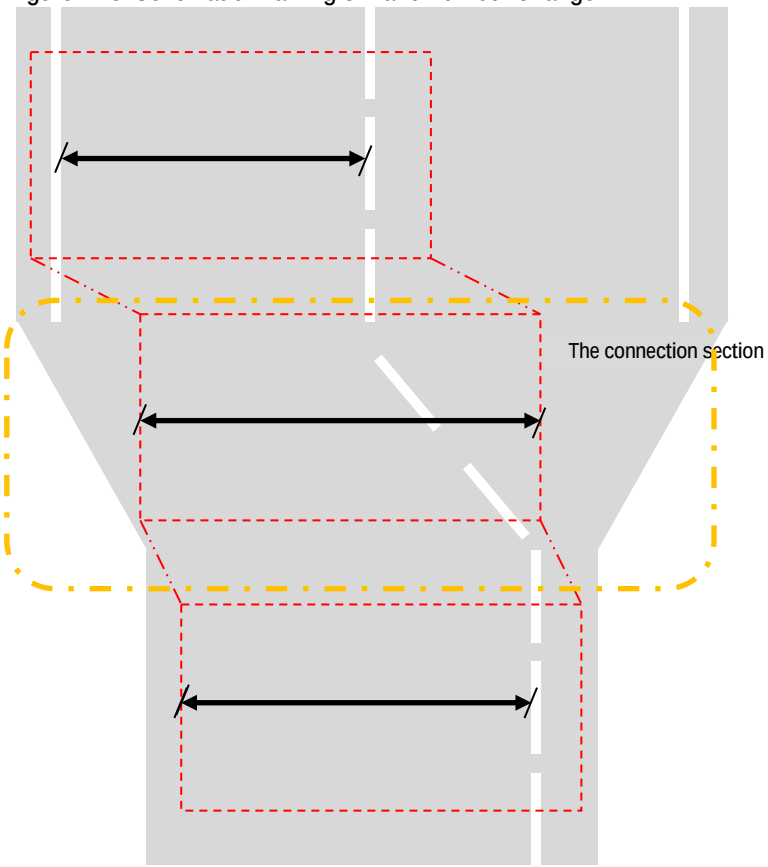
Figure 4.27 Determining the Road Width Without the White Lines 2



4) Case 4-A lane increases or decreases

If the number of lane increases or decreases, the connection sections road width defines the maximum width. However, when there is unpaved, the road width defines the full width of pavement.

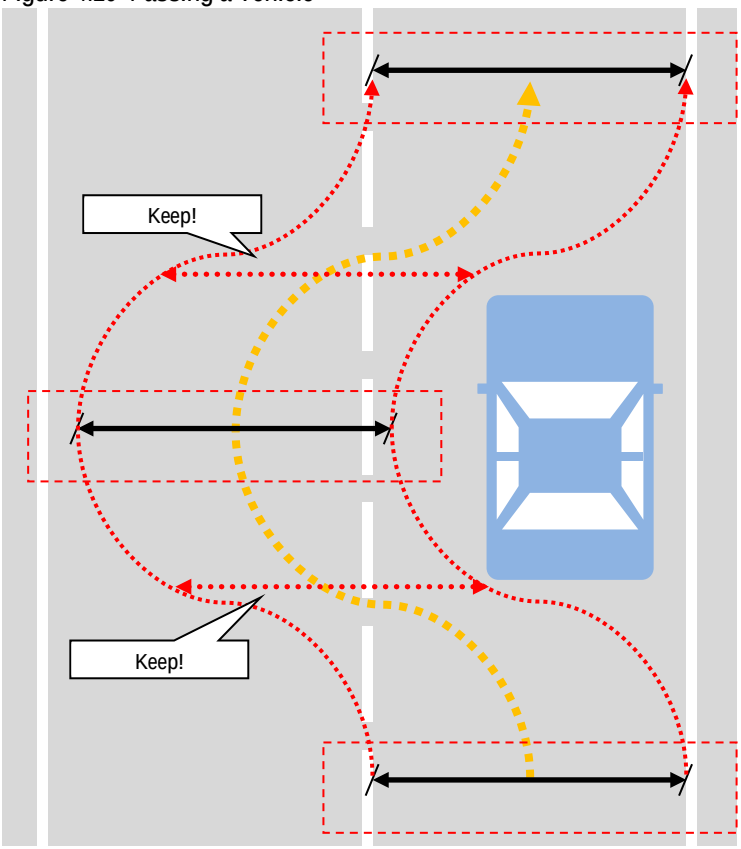
Figure 4.28 Schematic Drawing of Lane Number Change



5) Case 5- Passing a Vehicle

If the survey vehicle passes a car, the road width and rut width keep the width of the last session.

Figure 4.29 Passing a Vehicle

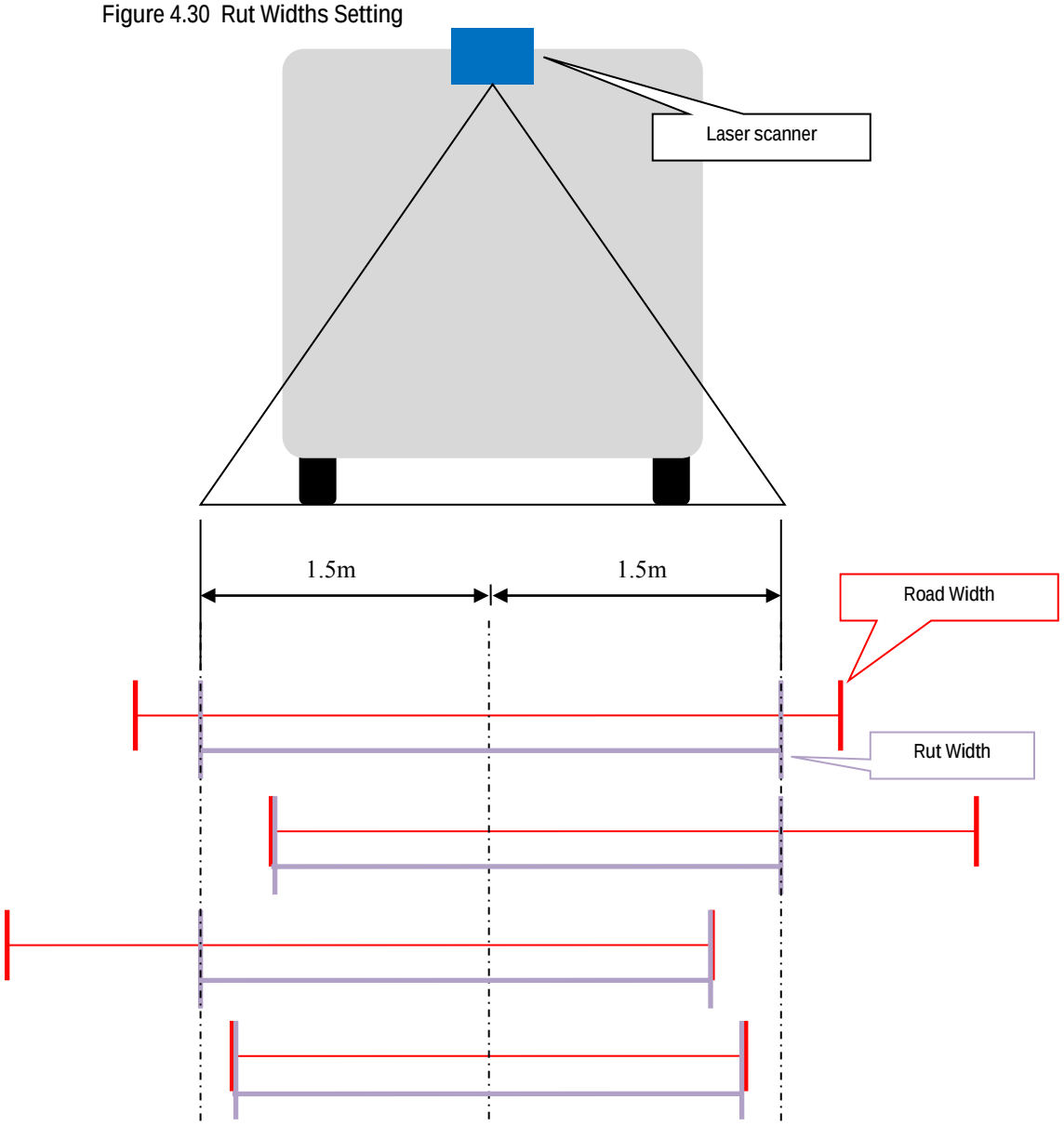


B. Setting the Rut Recording Widths

When the width of the road is wider or equal to 3.0 meters, set the rut recording width to 3.0 meter or less. If the width of the road is less than 3.0 meter, then set the rut width equal to the road width.

Road Width ≧3.0m → Rut Width ≦3.0m (One side max: 1.5m)
< 3.0m → =Road Width

Figure 4.30 Rut Widths Setting

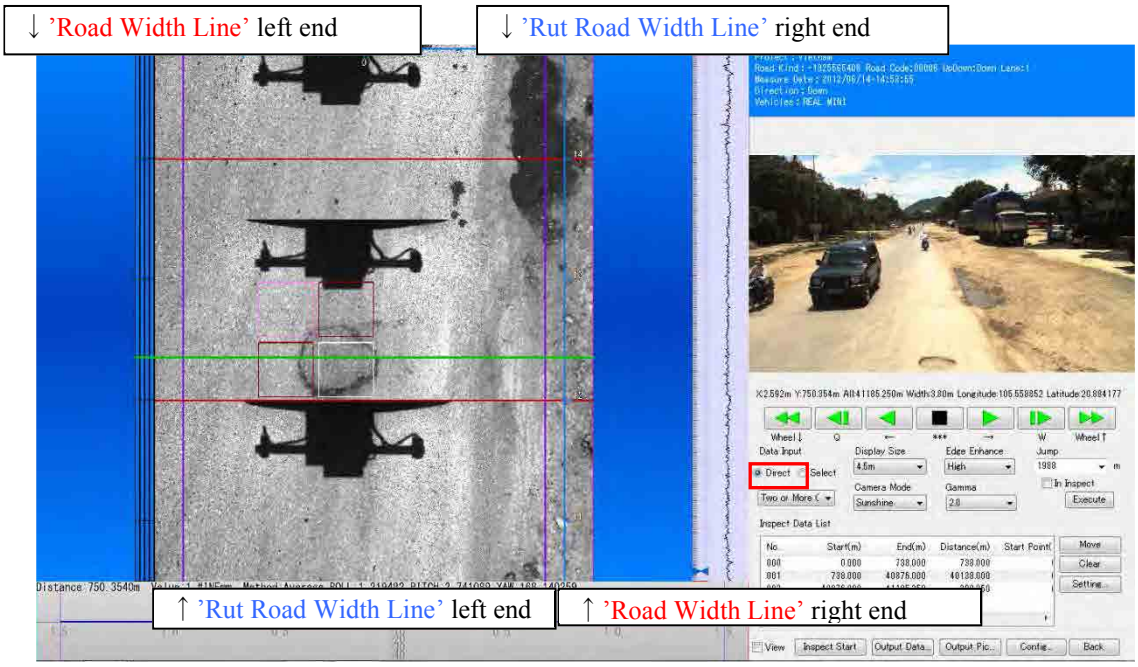


C. Road Width Setting for Interpretation

Change the [Display Size] 2.7m to 3.3m.

Figure 4.31 Road Width Setting

Defining the road width 'Road Width Line (3.8m)' and 'Rut Road Width Line (3.0m)'



Defining the road width Tips

<Crack Road Width>

Using the mouse, Ctrl and Shift keyboard input.

Table 4.2 Road Width Setting

<Crack Road Width>		When the mouse cursor looks like this, left and right side road width can change narrow or wide.
		When the mouse cursor pushing the Ctrl key looks like this, left and right side road width of 1 sector can change narrow or wide.
		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.
<Rut Road Width>		When the mouse cursor pushing the Alt key looks like this, left and right side rut road width can change narrow or wide.
		When the mouse cursor pushing Alt＋Ctrl key looks like this, left and right side rut road width of 1 sector can change narrow or wide.

(4) Crack / Patch / Pothole Interpretation

A. Examples/Cases of Crack/Patch/Pothole

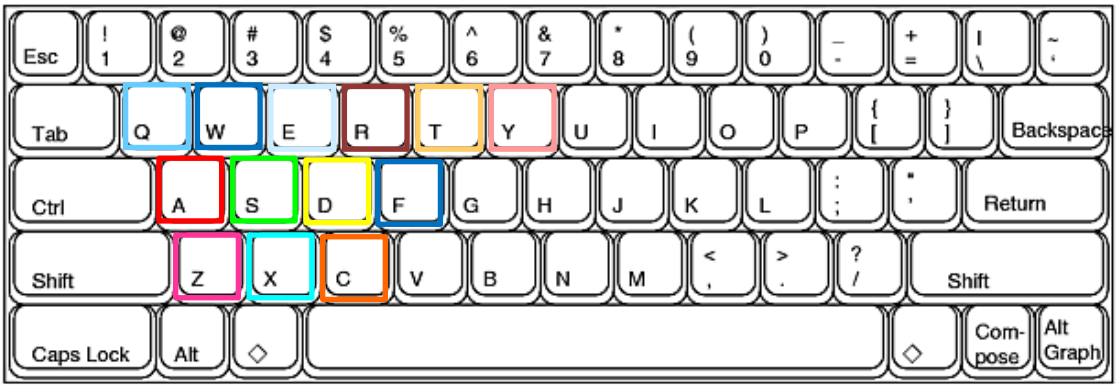
Cracks, patches and potholes are interpreted and classified into thirteen categories. To each category, one key is assigned.

Table 4.3 Key Assignment

No.	KEY	Classification	Explanations
1	A	Two or More Crack	There are two or more cracks in the mesh
2	S	One Crack	There is one crack in the mesh
3	D	Patching 75%	Patching occupies an area of more than 75% of the mesh
4	F	Patching 25%	Patching occupies an area of more than 25% to less than 75% of the mesh
5	Z	Pothole 75%	Pothole occupies an area of more than 75% of the mesh
6	X	Pothole 25%	Pothole occupies an area of more than 25% to less than 75% of the mesh
7	C	Pothole	Pothole occupies an area of greater than 0% to less than 25% of the mesh
8	Q	Concrete Crack 25cm	Total length of crack in the mesh are more than 25cm to less than 50cm
9	W	Concrete Crack 50cm	Total length of crack in the mesh are more than 50cm to less than 75cm
10	E	Concrete Crack 75cm	Total length of crack in the mesh are more than 75cm to less than 100cm
11	R	Concrete Crack 100cm	Total length of crack in the mesh are more than 100cm to less than 125cm
12	T	Concrete Crack 125cm	Total length of crack in the mesh are more than 125cm to less than 150cm
13	Y	Concrete Crack 150cm	Total length of crack in the mesh are more than 150cm

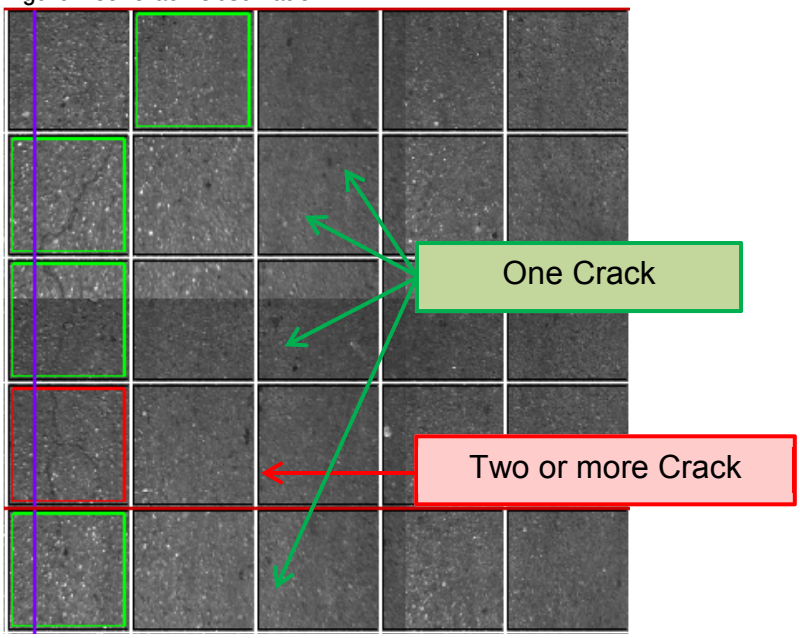
1,2 : Asphalt only
3~7 : Asphalt and Concrete
8~13 : Concrete only

Figure 4.32 Keys Assignment (Graphical Presentation)



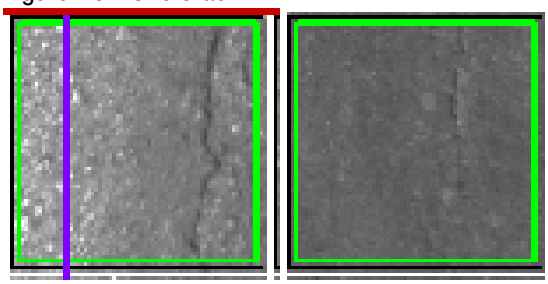
The following image show an example of one crack and two or more cracks in one mesh.

Figure 4.33 Crack Observation



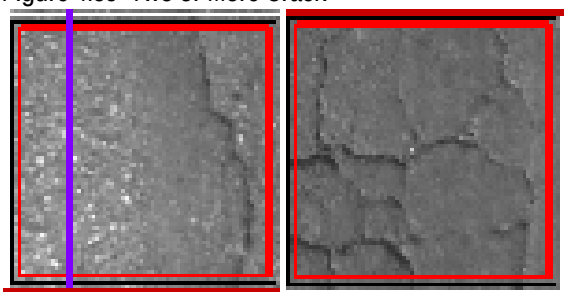
One crack is observed.

Figure 4.34 One Crack



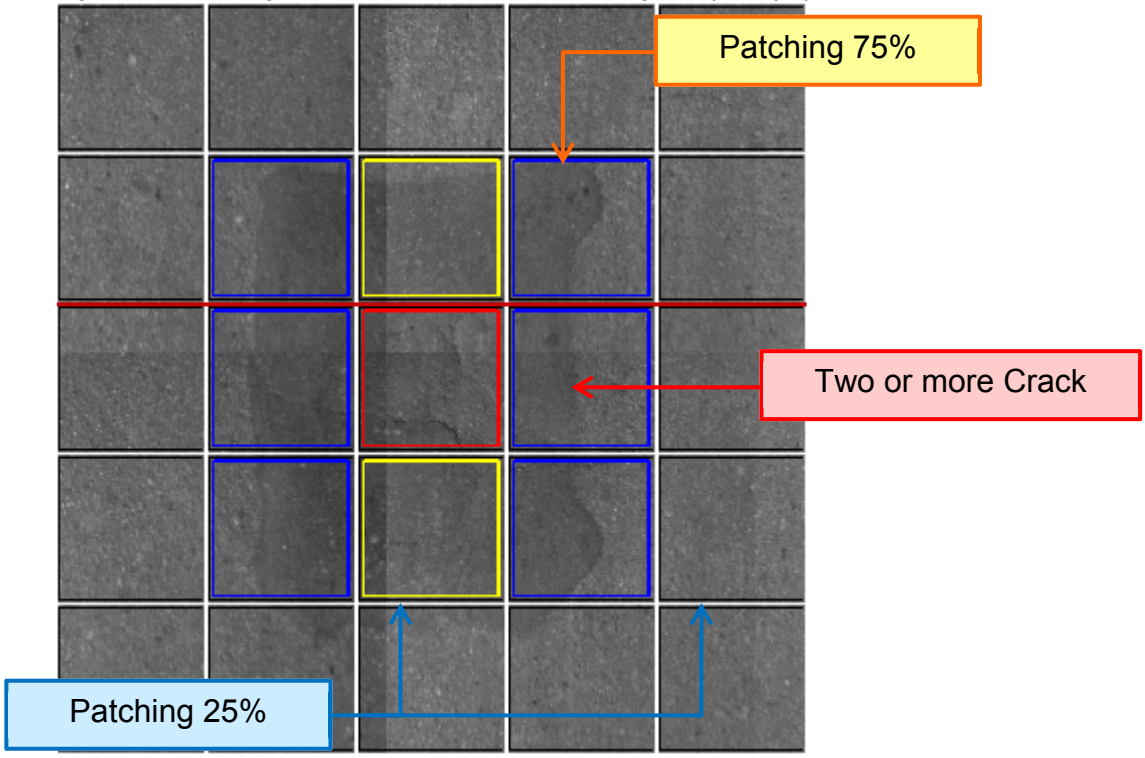
Two or more cracks are observed.

Figure 4.35 Two or More Crack



Following examples show the cases of Patching 75% and Patching 25%.

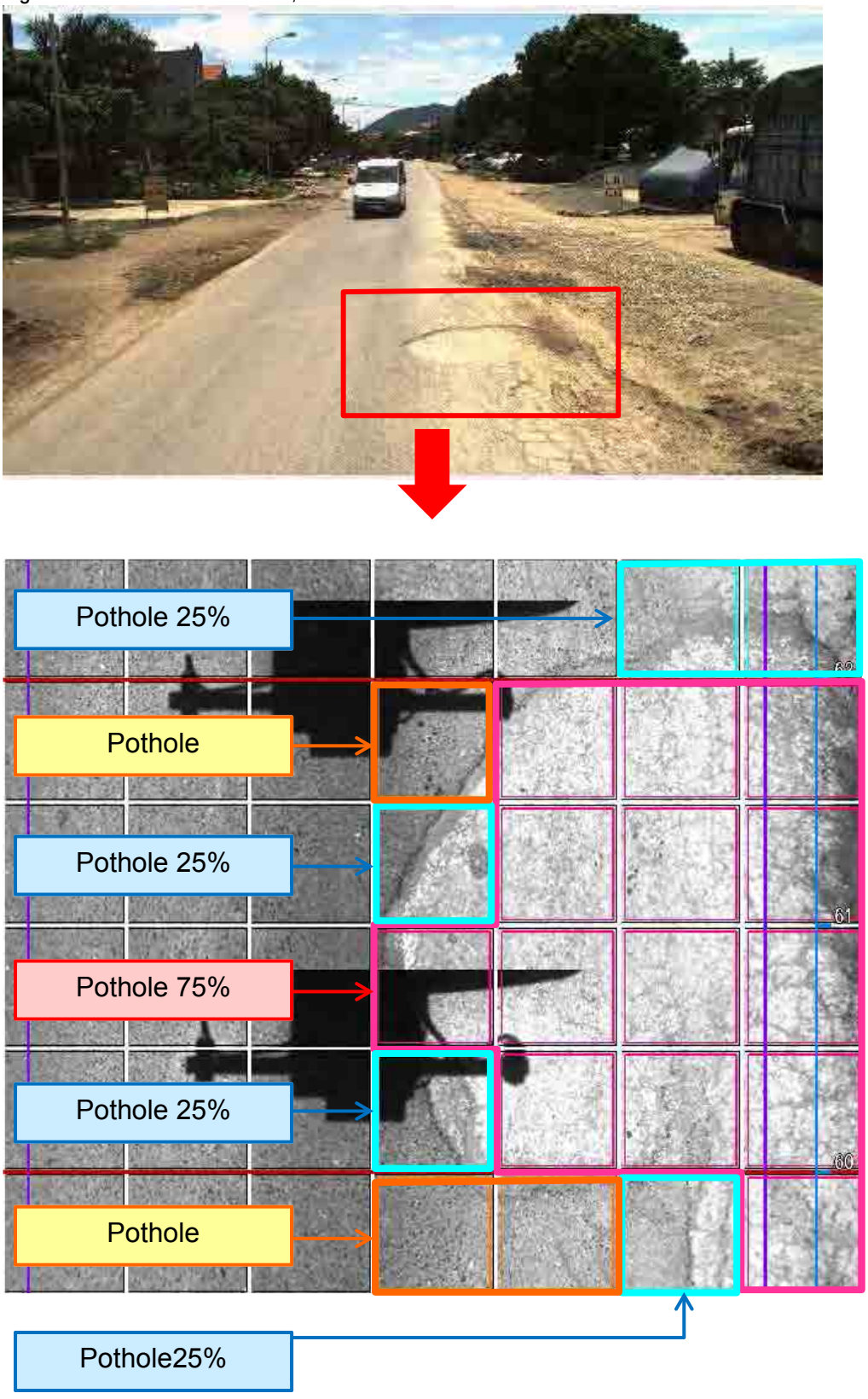
Figure 4.36 Patching 75%, Two or More Cracks, Patching 25% (Example)



If there is a crack in the patching, the classification is “One Crack” or “Two or More Crack.”.

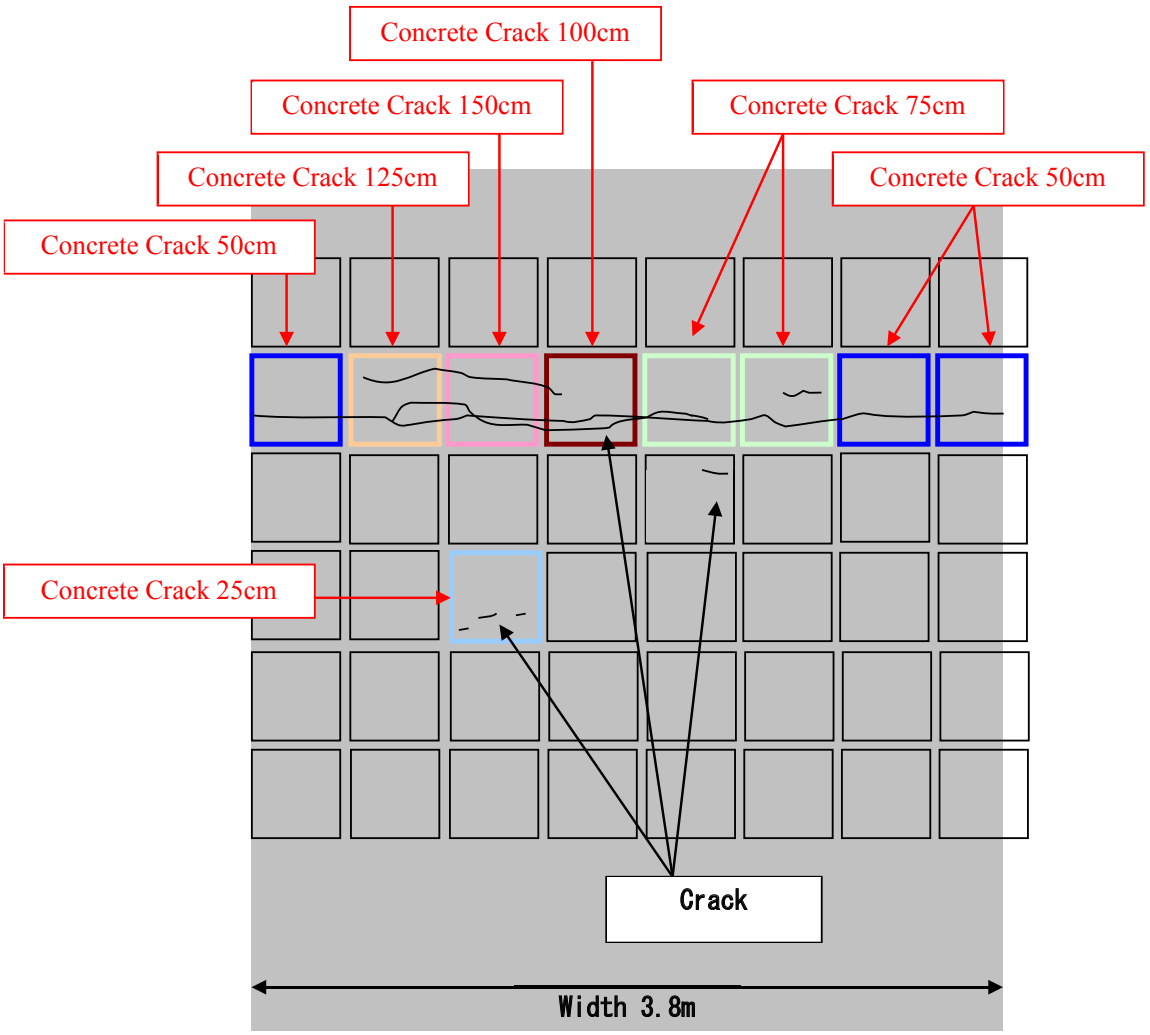
Following examples show: Pothole 75%, Pothole 25%, and Pothole.

Figure 4.37 Pothole - Front View,



The next examples show Concrete Crack 25cm, Concrete Crack 50cm, Concrete Crack 75cm, Concrete Crack 100cm, Concrete Crack 125cm, Concrete Crack 150cm.

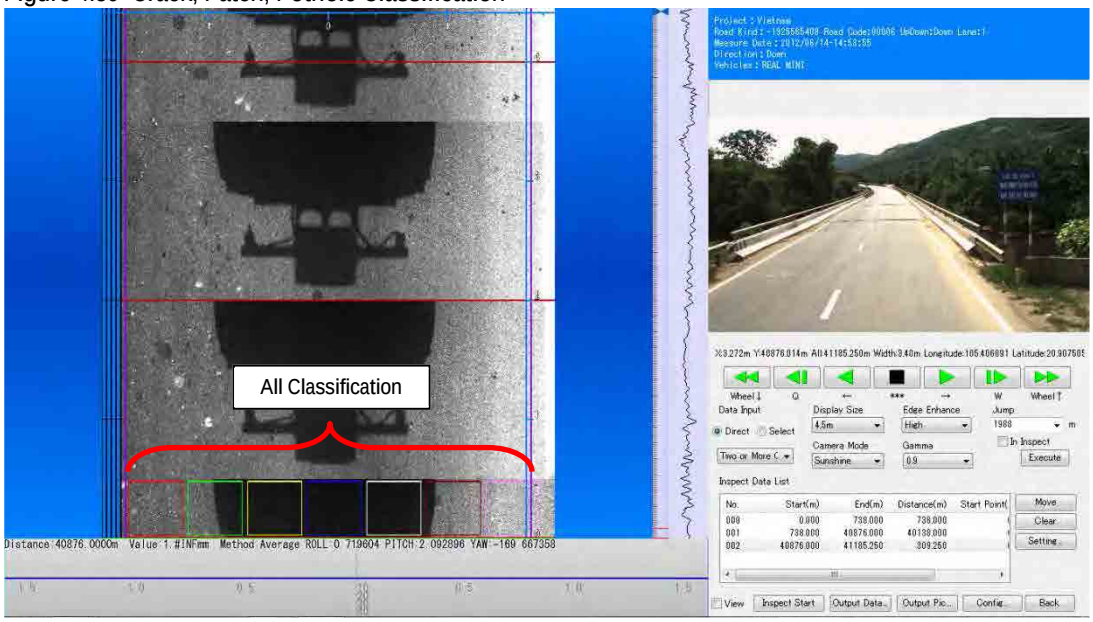
Figure 4.38 Schematic Presentation of Pavement Damage Interpretation (Cement Concrete)



B. Cracks/patch/pothole Interpretation

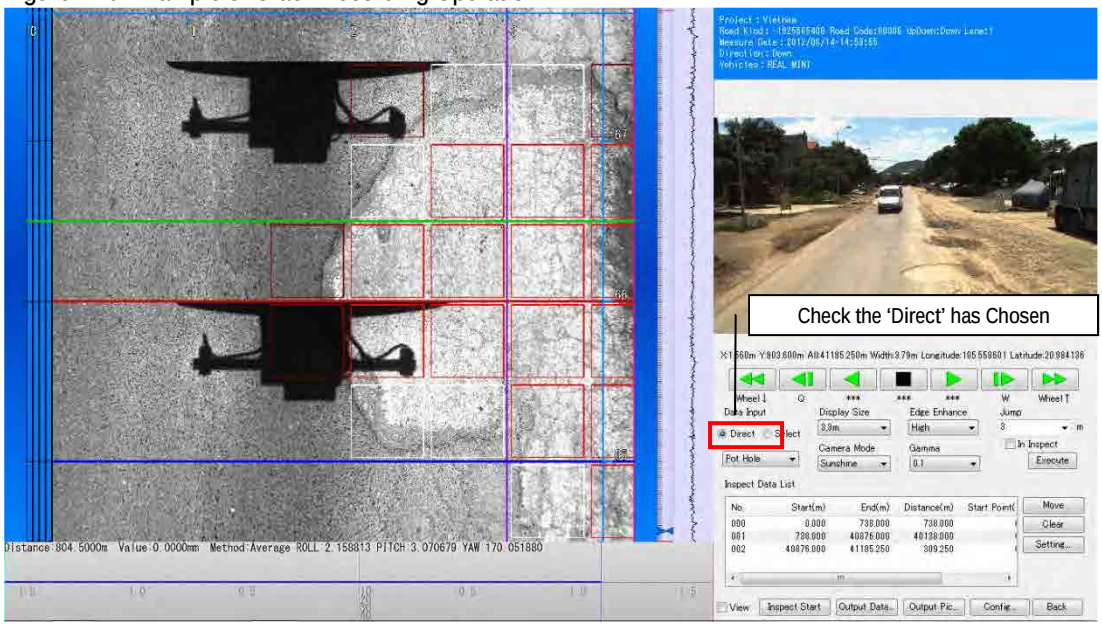
In the crack interpretation, we choose several crack classifications of the road surface. Classification are: 'Two or More Crack', 'One Crack', 'Patching 75%', 'Patching 25%', 'Pot Hole 75%', 'Pot Hole 25%' and 'Pot Hole'.

Figure 4.39 Crack, Patch, Pothole Classification



Several crack Classifications have assigned for a keyboard input. Moving the mouse cursor in the analysis window and input it from the keyboard. →Refer the Crack Reference.

Figure 4.40 Example of Crack Recording Operation

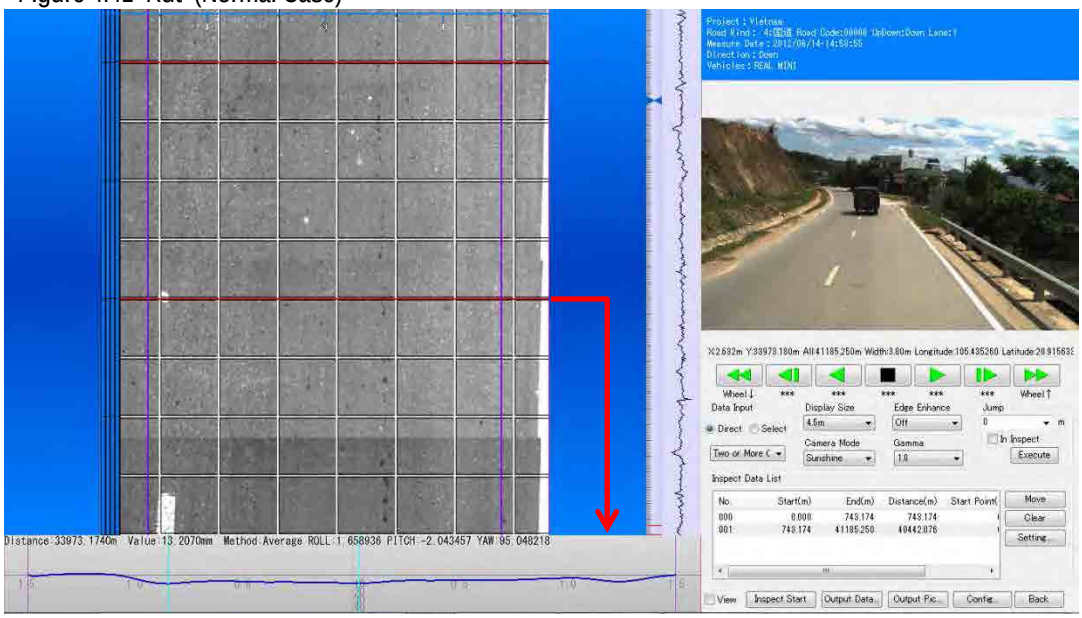


(5) Rut Analysis

A. Examples/Cases of Rut

When the road surface is dry, the sensor records the data normally.

Figure 4.41 Rut (Normal Case)

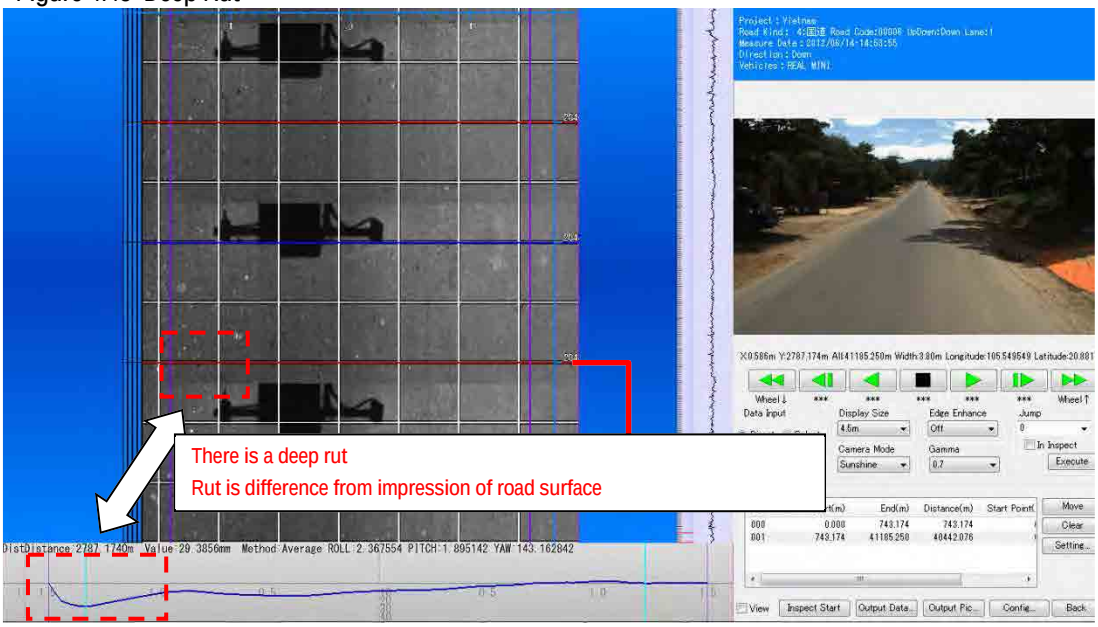


When there is puddle, the sensor does not record rut data accurately.

Figure 4.42 Rut (Abnormal Case)

The following image shows a case of deep rut.

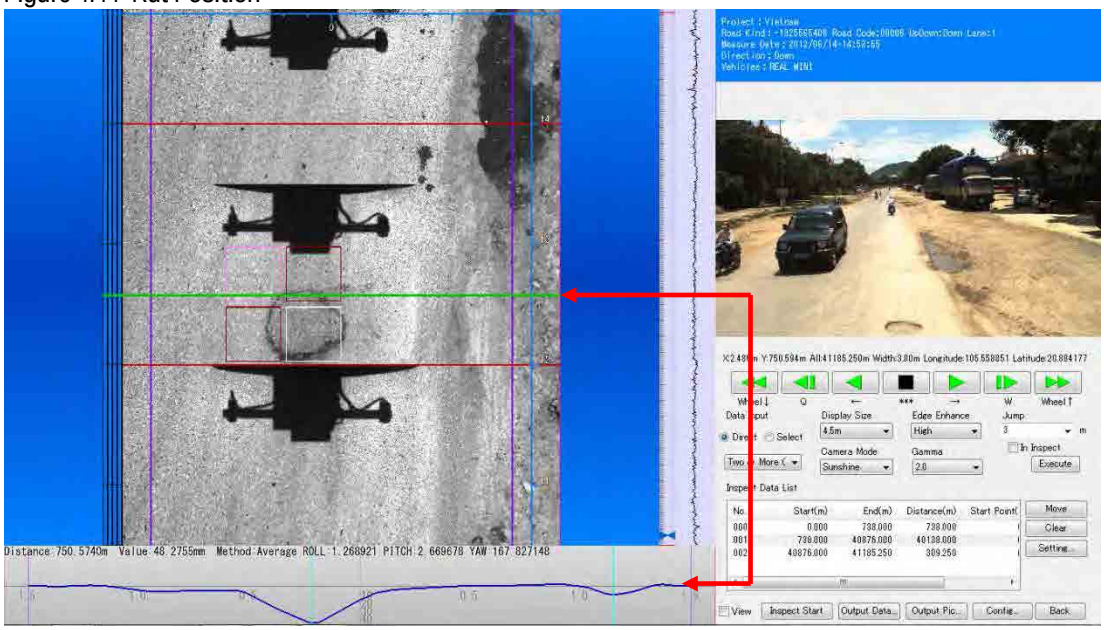
Figure 4.43 Deep Rut



B. Rut Interpretation

Green colored line 'Rut Position' in the analysis window appears in the rut window.

Figure 4.44 Rut Position



Pushing the Ctrl key and left click the mouse can check the rut shape optionally. When the rut shape has a strange feature, change the rut position to the right position.

(6) Road Surface Classification

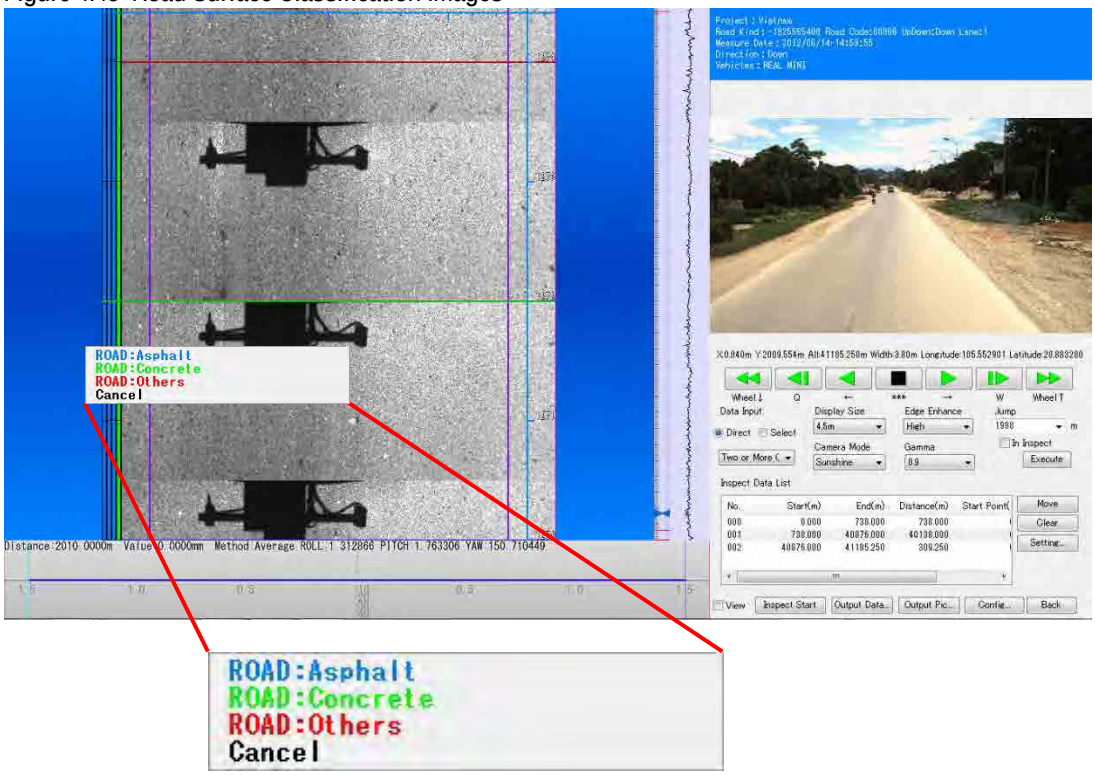
A. Examples/Cases of Road Surface Types

The following are samples of road surface types: asphalt; concrete; and others.

B. Classify road Surface Classification

Cursor the mouse to the left end of the 'Management Data' area appears "1". Then right click the mouse, appears the small window which can choose the road surface Classification. In an example shown below is Asphalt pavement so choose the 'ROAD: Asphalt'.

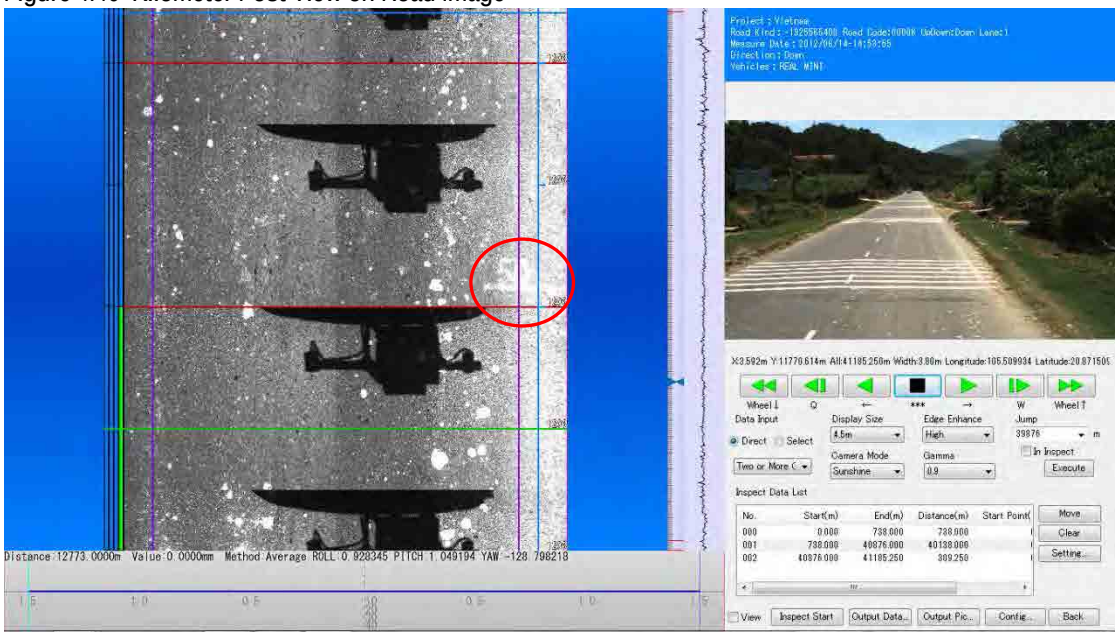
Figure 4.45 Road Surface Classification Images



(7) Identifying the Kilometer Posts

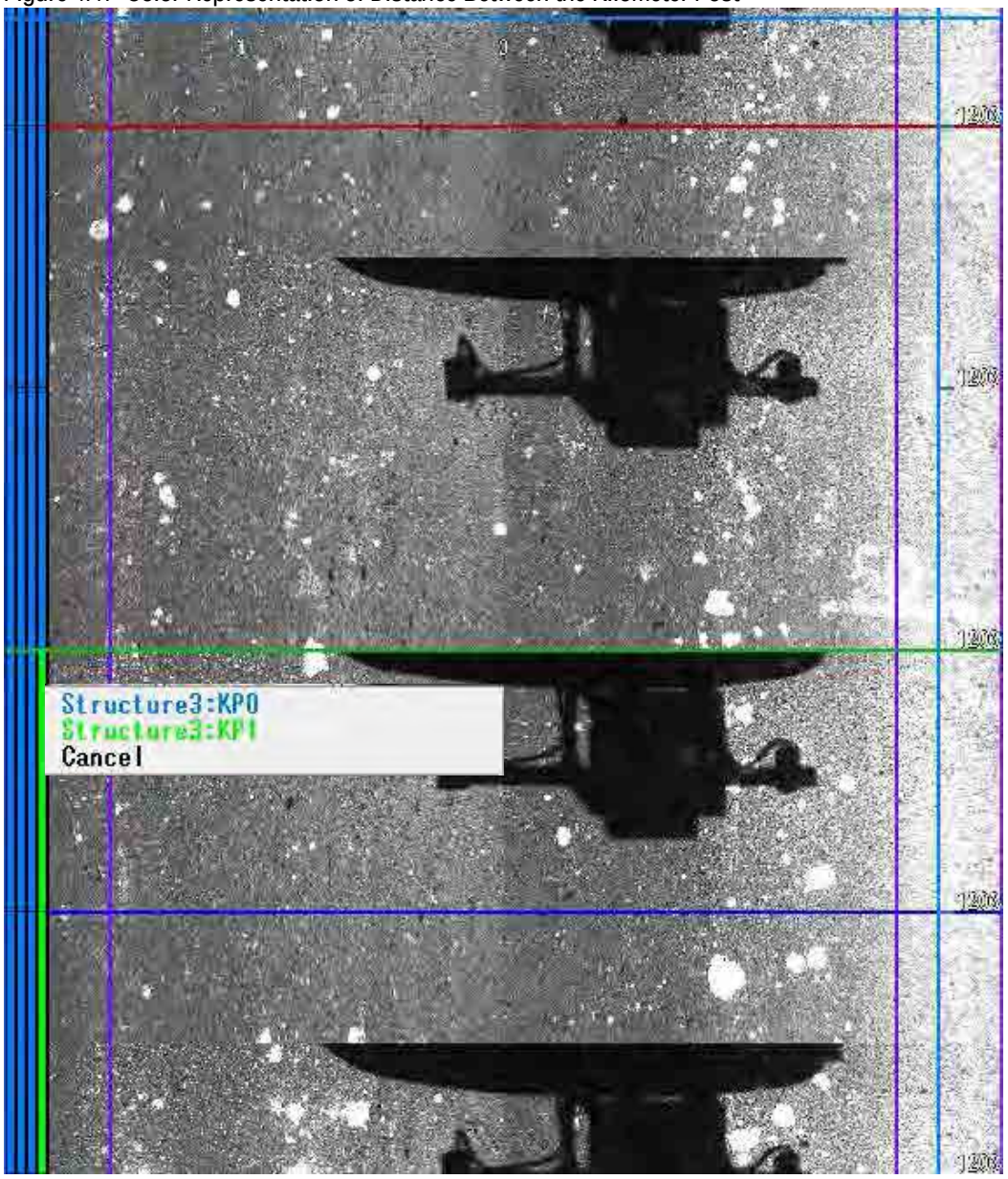
The road surface marking is seen on the road.

Figure 4.46 Kilometer Post View on Road Image



If you identified the marking on the road surface, set the kilometer post right click the right end of the 'Management Data'.

Figure 4.47 Color Representation of Distance Between the Kilometer Post



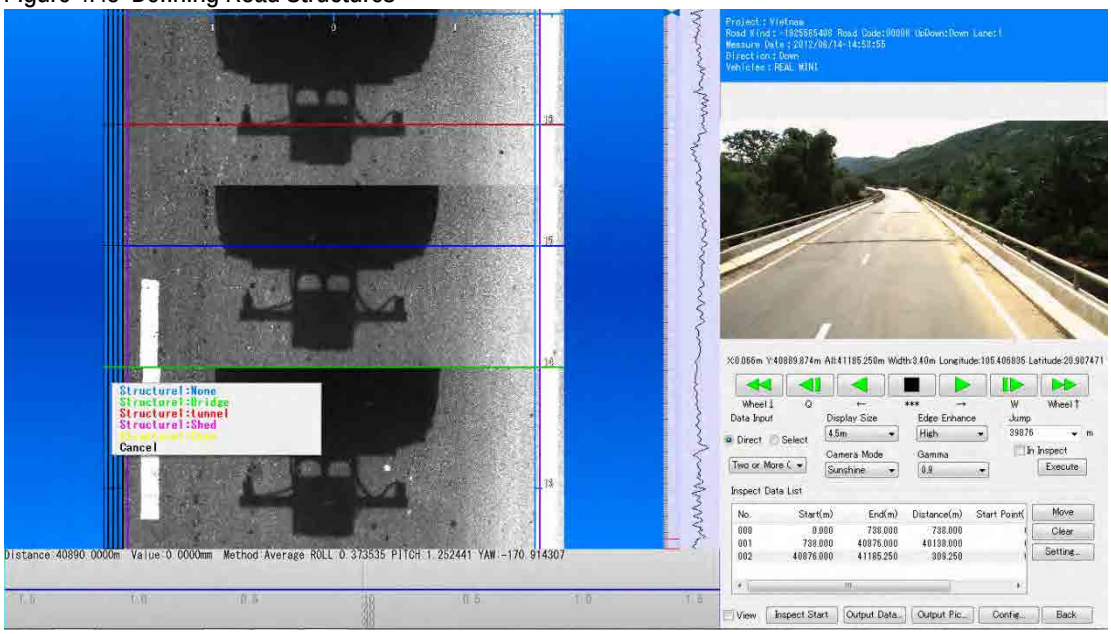
Green and blue are used alternatively to show road segments between kilometer posts. For example, the kilometer posts between 49 to 50, green is used, and from 50 to 51, blue is used.

(8) Defining Road Structure

A. Registration of Road Structures

Bridges and tunnels are examples of road structure. Classification of structures (like a bridge, tunnel, etc…) can be defined using from the right to the 2nd of the 'Management Data'. Reference the analysis window and the forward view; choose the Classification of the construction.

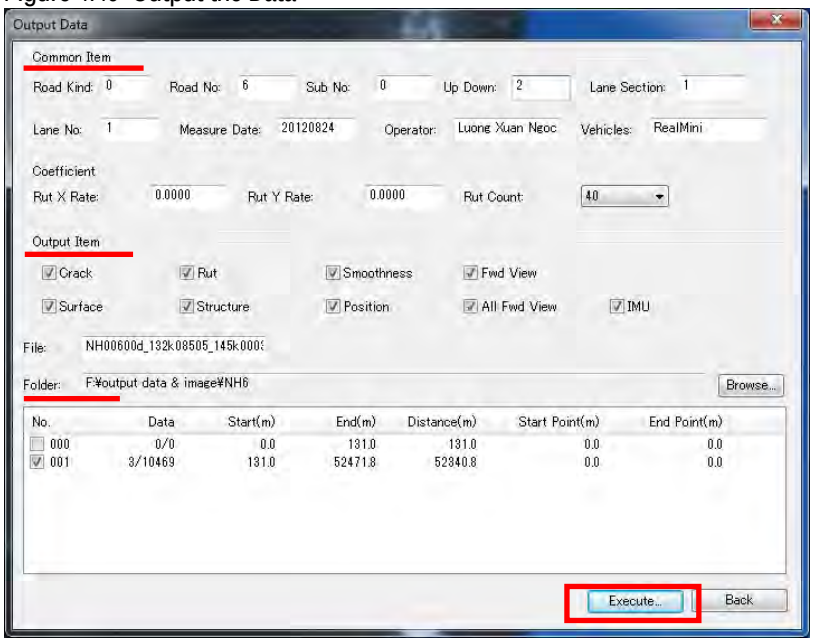
Figure 4.48 Defining Road Structures



(9) Output the Data

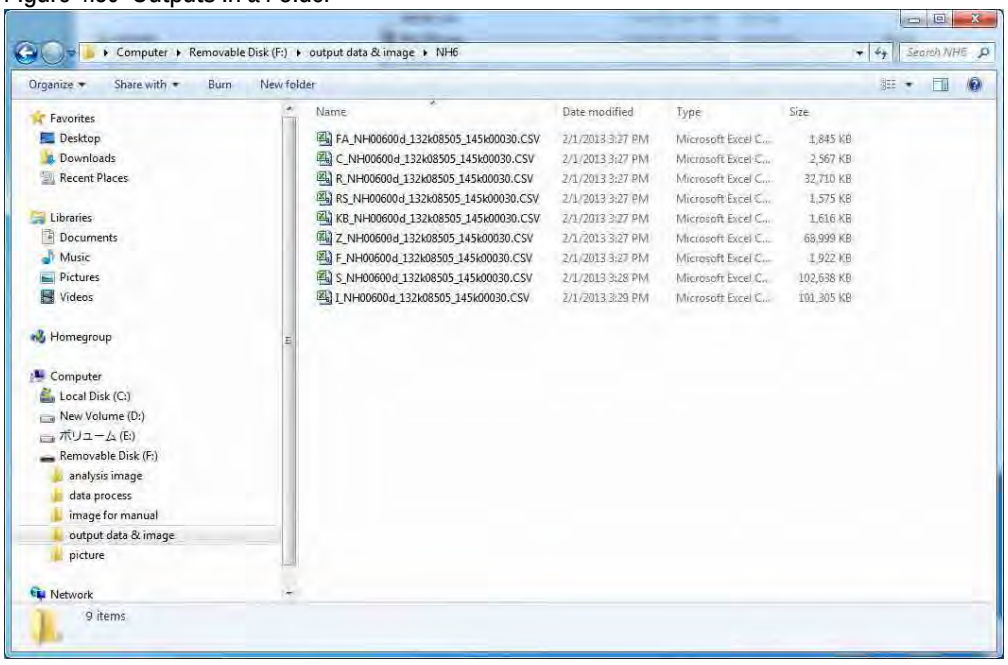
Input several pieces of information (like a 'Road Kind', 'Road No', 'Sub No', 'Up Down', etc…) in the 'Common Item.'

Figure 4.49 Output the Data



Check the 'Output Item' and 'Folder', left click [Execute]. Output data will be created to the folder reserved.

Figure 4.50 Outputs in a Folder

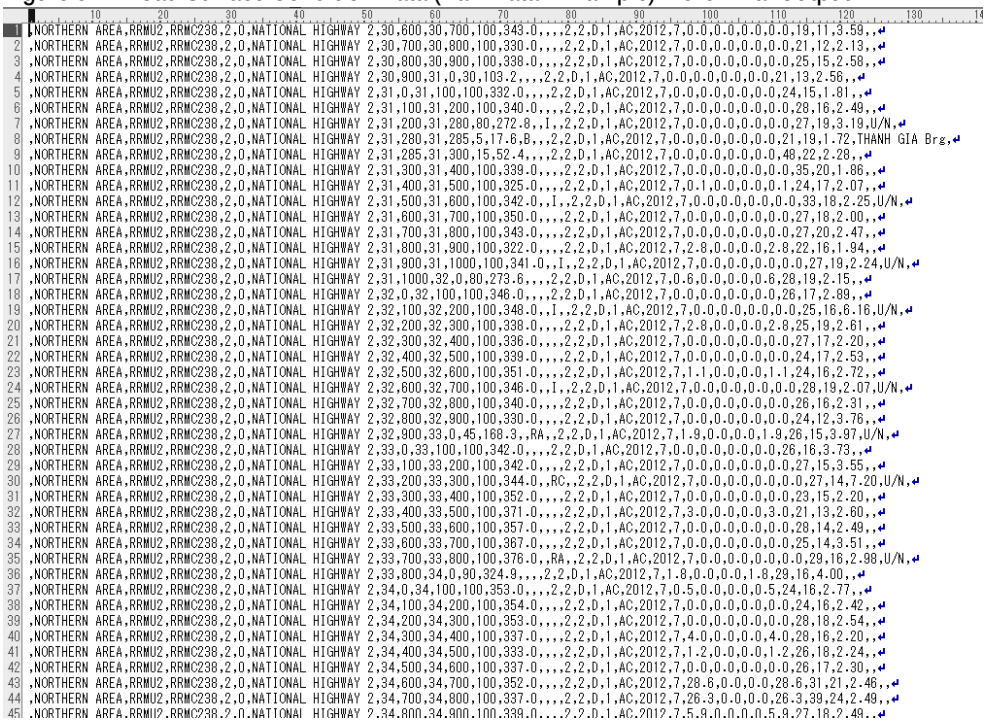


5. Road Condition Data Integration System

5.1 Final Output

The road condition data processing system is a semi-automatic system to produce the final output of the road condition survey--road surface condition data. Both raw data (csv format) and Excel data (formatted) data will be created.

Figure 5.1 Road Surface Condition Data (Raw Data - Example) -- the Final Output



```
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,30,600,30,700,100,343.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,19,11,3.59,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,30,700,30,800,100,330.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,21,12,2.13,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,30,800,30,900,100,338.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,25,15,2.58,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,30,900,31,0,30,103.2,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,21,13,2.56,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,0,31,100,100,332.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,24,15,1.81,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,100,31,200,100,340.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,28,16,2.49,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,200,31,280,80,272.8,,I,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,19,3.19,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,280,31,285,5,17.6,B,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,21,19,1.72,THANH GIA Brg,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,285,31,300,15,52.4,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,48,22,2.28,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,300,31,400,100,339.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,35,20,1.86,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,400,31,500,100,325.0,,,,2,2,D,1,AC,2012,7,0.1,0.0,0.0,0.0,0.1,24,17,2.07,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,500,31,600,100,342.0,,I,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,33,18,2.25,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,600,31,700,100,350.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,18,2.00,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,700,31,800,100,343.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,20,2.47,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,800,31,900,100,322.0,,,,2,2,D,1,AC,2012,7,2.8,0.0,0.0,0.0,2.8,22,16,1.94,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,900,31,1000,100,341.0,,I,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,19,2.24,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,31,1000,32,0,80,273.6,,,,2,2,D,1,AC,2012,7,0.6,0.0,0.0,0.0,0.6,28,19,2.15,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,0,32,100,100,346.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,26,17,2.89,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,100,32,200,100,348.0,,I,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,25,16,6.16,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,200,32,300,100,338.0,,,,2,2,D,1,AC,2012,7,2.8,0.0,0.0,0.0,2.8,25,19,2.61,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,300,32,400,100,336.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,17,2.20,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,400,32,500,100,339.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,24,17,2.53,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,500,32,600,100,351.0,,,,2,2,D,1,AC,2012,7,1.1,0.0,0.0,0.0,1.1,24,16,2.72,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,600,32,700,100,346.0,,I,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,28,19,2.07,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,700,32,800,100,340.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,26,16,2.31,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,800,32,900,100,330.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,24,12,3.76,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,32,900,33,0,45,168.3,,RA,,2,2,D,1,AC,2012,7,1.9,0.0,0.0,0.0,1.9,26,15,3.97,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,0,33,100,100,342.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,26,16,3.73,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,100,33,200,100,342.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,15,3.55,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,200,33,300,100,344.0,,RC,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,27,14,7.20,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,300,33,400,100,352.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,23,15,2.20,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,400,33,500,100,371.0,,,,2,2,D,1,AC,2012,7,3.0,0.0,0.0,0.0,3.0,21,13,2.60,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,500,33,600,100,357.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,28,14,2.49,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,600,33,700,100,367.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,25,14,3.51,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,700,33,800,100,376.0,,RA,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,29,16,2.98,U/N,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,33,800,34,0,90,324.9,,,,2,2,D,1,AC,2012,7,1.8,0.0,0.0,0.0,1.8,29,16,4.00,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,0,34,100,100,353.0,,,,2,2,D,1,AC,2012,7,0.5,0.0,0.0,0.0,0.5,24,16,2.77,,
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,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,200,34,300,100,353.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,28,18,2.54,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,300,34,400,100,337.0,,,,2,2,D,1,AC,2012,7,4.0,0.0,0.0,0.0,4.0,28,16,2.20,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,400,34,500,100,333.0,,,,2,2,D,1,AC,2012,7,1.2,0.0,0.0,0.0,1.2,26,18,2.24,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,500,34,600,100,337.0,,,,2,2,D,1,AC,2012,7,0.0,0.0,0.0,0.0,0.0,0.0,26,17,2.30,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,600,34,700,100,352.0,,,,2,2,D,1,AC,2012,7,28.6,0.0,0.0,0.0,28.6,31,21,2.46,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,700,34,800,100,337.0,,,,2,2,D,1,AC,2012,7,26.3,0.0,0.0,0.0,26.3,39,24,2.49,,
,NORTHERN AREA,RRMU2,RRMC238,2,0,NATIONAL HIGHWAY 2,34,800,34,900,100,339.0,,,,2,2,D,1,AC,2012,7,5.9,0.0,0.0,0.0,5.9,27,18,2.49,,
```

5.2 Data Used

To create the final outputs, following data are necessary:

Table 5.1 Data Required to Produce Road Surface Condition Data

File Name	Type	Process Produced	Description	Note
0001	Road Management Data	Field Reconnaissance	Jurisdiction and Corporation	
0003	Road Management Data	Field Reconnaissance	Distances between kilometer posts	
0004E	Road Management Data	Field Reconnaissance	Overlapping management	English
0004VN	Road Management Data	Field Reconnaissance	Overlapping management	Vietnamese
0005	Road Management Data	Field Reconnaissance	Station Number note	
0101	Road Management Data	Field Reconnaissance	Lane structure	
0104E	Road Management Data	Field Reconnaissance	Road structure	English
0104VN	Road Management Data	Field Reconnaissance	Road structure	Vietnamese
0105E	Road Management Data	Field Reconnaissance	Intersection	English
0105VN	Road Management Data	Field Reconnaissance	Intersection	Vietnamese
0201E	Road Management Data	Field Reconnaissance	Impassable segment	
0201VN	Road Management Data	Field Reconnaissance	Impassable segment	
commonE	Common Data	Data Processing		English
commonVN	Common Data	Data Processing		Vietnamese
C_NH00100D_000k00010_051k00000.CSV	Crack Data	Analysis		This data use for data process
R_NH00100D_000k00010_051k00000.CSV	Rut volume Data	Analysis		This data use for data process
S_NH00100D_000k00010_051k00000.CSV	Profile Data	Analysis		This data use for data process

Data to be used are from the processes of Field Reconnaissance and Pavement Damage Interpretation. The common data are prepared in this process of data integration.

(1) Common Data

The common data has two data codes: 02 and 03. The data structures of data codes 02 and 03 are expressed in Table 5.2 and Table 5.3.

Table 5.2 Geographical Area, Jurisdiction, Management Company (Data Code 02)

Data Code	Geographical Area	Jurisdiction	Management Company	Description
1	3	5	7	10 ... 59
02	01	00	0000	NOTHERN AREA
02	01	10	0000	RRMU2
02	01	10	2222	RRMC222

Table 5.3 Route Number, Branch Number, Route Name (Data Code 03)

Data Code	Geographical Area	Blank	Route Number	Branch Number	Description
1	3		6	9	11 ... 110
03	01		001	00	NATIONAL HIGHWAY 1
03	01		001	01	SOUTHERN RING ROAD 3 TO CAU DAC
03	01		002	00	RRMC222

Use the codes in Table 5.4 to express the geographical areas.

Table 5.4 Geographical Area

Geographical Area	Code
Northern Area	01
Northern Middle Area	02
Southern Middle Area	03
Southern Area	04

The common data are created from the two tables. The codes used in the common data come from the following two tables. The jurisdiction code shall be selected and encoded from the following list.

Table 5.5 Jurisdiction Classification

Jurisdiction	Code
RRMU2	10
RRMU4	20
RRMU5	30
RRMU7	40
Province	50
Company	60
Under construction	70

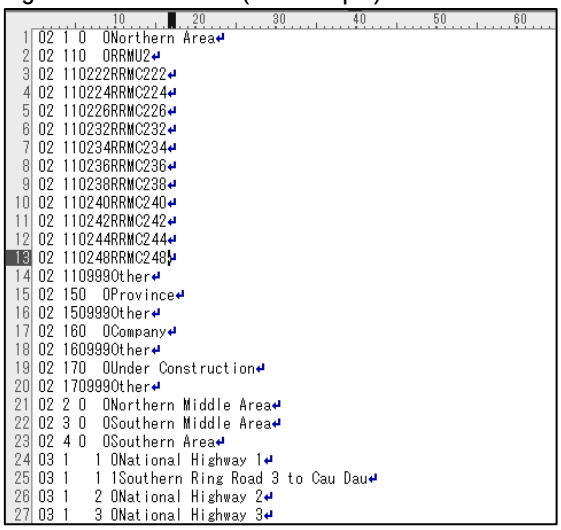
The three-digit codes are entered from the following list.

Table 5.6 Management Corporation Codes

Management Company	Code
RRMC222	222
RRMC224	224
RRMC226	226
RRMC232	232
RRMC234	234
RRMC236	236
RRMC238	238
RRMC240	240
RRMC242	242
RRMC244	244
RRMC248	248
Other	999

A commonE file is created as in the following example.

Figure 5.2 commonE (An Example)



(2) Field Reconnaissance Data

The outputs of the management data have been discussed in 2.5(6)Preparation of Road Management Data . The files required are summarized in Table 5.7.[5]

Table 5.7 Management Data Files

File Name	Description	Note
0001	Jurisdiction and Corporation	
0003	Distances between kilometer posts	
0004E	Overlap	English
0004VN	Overlap	Vietnamese
0005	Station No note	
0101	Lane structure	
0104E	Road structure	English
0104VN	Road structure	Vietnamese
0105E	Intersection	English
0105VN	Intersection	Vietnamese
0201E	Impassable segment	
0201VN	Impassable segment	

(3) Analysis Data

The following three csv files are data examples of IRI, rut depths and cracks.

Table 5.8 Profile Data, IRI Data Structure

No	Field	No	Field	No	Field
1	Road Classification	12	Road Surface Type	23	Vehicle
2	Route Number	13	Structure1	24	Name of Leader
3	Branch Number	14	Structure2	25	Longitude (from)
4	Inbound, Outbound	15	Structure3	26	Latitude (from)
5	Lane Classification	16	Displacement meter 1	27	Altitude (from)
6	Lane Number	17	Displacement meter 2	28	Longitude (to)
7	Analysis (from)	18	Displacement meter 3	29	Latitude (to)
8	Analysis (to)	19	Flatness	30	Altitude (to)
9	Length (from)	20	Displacement Volume	31	GPS Flag
10	Length (to)	21	Profile	32	Managed Station Number
11	Surveyed Year, Month, Day	22	Analysis Segment Length	33	Management Number

[5] Vietnamese files are included, since this manual is based on an Vietnamese project.

Figure 5.3 IRI Data (from Road Surface Condition Data Interpretation and Encoding)

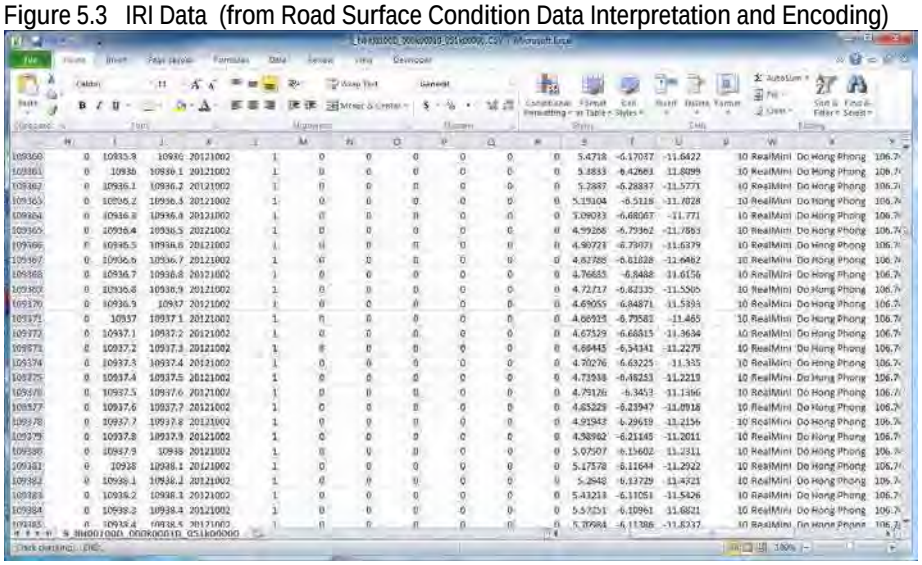


Table 5.9 shows the rut depth data structure.

Table 5.9 Rut Depth Data Structure

No	Field	No	Field	No	Field
1	Road Classification	26	Y5	51	Y17
2	Route Number	27	X6	52	X18
3	Branch Number	28	Y6	53	Y18
4	Inbound Outbound	29	X7	54	X19
5	Lane Classification	30	Y7	55	Y19
6	Lane Number	31	X8	56	X20
7	Analysis (from)	32	Y8	57	Y20
8	Analysis (to)	33	X8	-	-
9	Length (from)	34	X9	-	-
10	Length (to)	35	Y9	-	-
11	Surveyed Year Month Date	36	X10	175	X80
12	Surface Classification	37	Y10	176	Y80
13	Structure 1	38	X11	177	Analysis Method
14	Structure 2	39	Y11	178	Analysis Segment Distance
15	Structure 3	40	X12	179	Vehicle
16	Rut depth	41	Y12	180	Leader
17	X1	42	X13	181	Longitude (from)
18	Y1	43	Y13	182	Latitude (from)
19	X2	44	X14	183	Altitude (from)
20	Y2	45	Y14	184	Longitude (to)
21	X3	46	X15	185	Latitude (to)
22	Y3	47	Y15	186	Altitude (to)
23	X4	48	X16	187	GPS Flag
24	Y4	49	Y16	188	Management Kilometer Post
25	X5	50	X17	189	Management number

An example of rut depth data is shown in Figure 5.4.

Figure 5.4 Rut Depth Data (from Road Data Analysis)

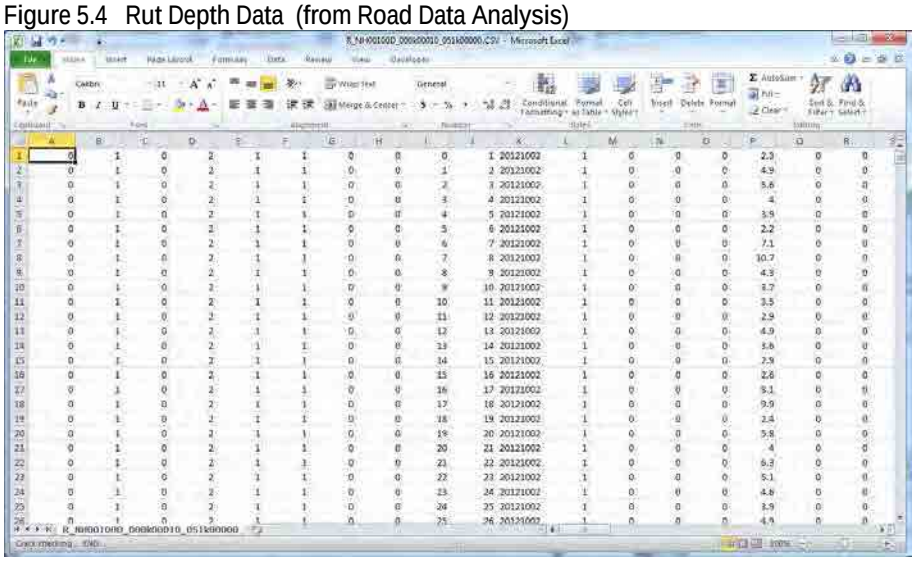


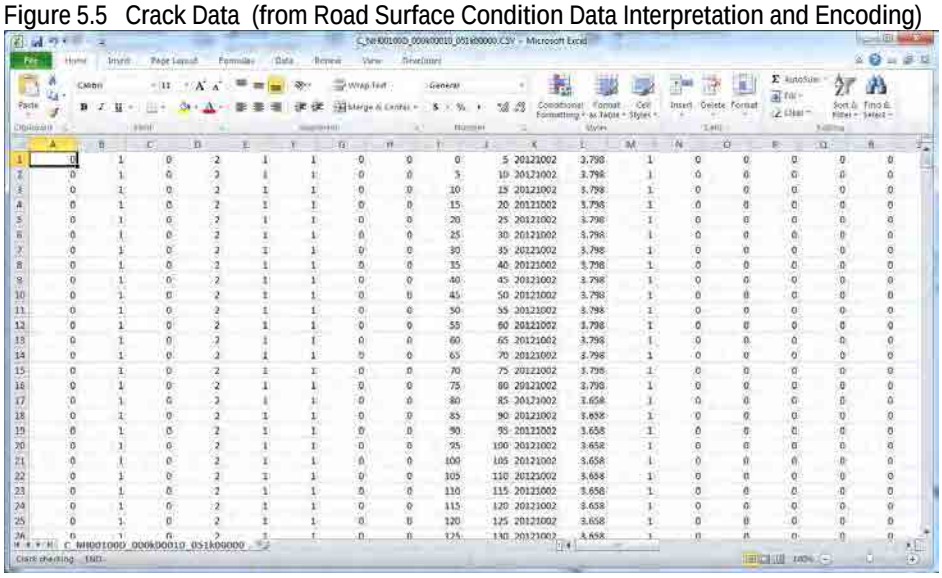
Table 5.10 shows the crack data structure.

Table 5.10 Crack Data Structure

No	Field	No	Field
1	Road Classification	36	Reserve
2	Route Number	37	Residual Acquisition Unit: Pothole 75-100%
3	Branch Number	38	Residual Acquisition Unit: Pothole 25-75%
4	Inbound, Outbound	39	Residual Acquisition Unit: Pothole 0-25%
5	Lane Classification	40	Residual Acquisition Unit: Asphalt Two or more cracks
6	Lane Number	41	Residual Acquisition Unit: Asphalt Linear Crack
7	Analysis (from)	42	Residual Acquisition Unit: Concrete Crack Length 150cm
8	Analysis (to)	43	Residual Acquisition Unit: Concrete Crack Length 125cm
9	Length (from)	44	Residual Acquisition Unit: Concrete Crack Length 100cm
10	Length (to)	45	Residual Acquisition Unit: Concrete Crack Length 75cm
11	Survey Year, Month, Date	46	Residual Acquisition Unit: Concrete Crack Length 50cm
12	Analysis Lane Width	47	Residual Acquisition Unit: Concrete Crack Length25cm
13	Road Surface Classification	48	Residual Acquisition Unit: Patching 75-100%
14	Structure1	49	Residual Acquisition Unit: Patching 25-75%
15	Structure2	50	Reserve
16	Structure3	51	Reserve
17	Pothole 75-100%	52	Reserve
18	Pothole 25-75%	53	Reserve
19	Pothole 0-25%	54	Reserve
20	Asphalt: Two or More Cracks	55	Reserve
21	Asphalt: Linear Crack	56	Reserve
22	Concrete: Crack Length150cm	57	Mesh size
23	Concrete: Crack Length125cm	58	Analysis Segment Length
24	Concrete: Crack Length100cm	59	Survey Vehicle
25	Concrete: Crack Length75cm	60	Name of Leader (Road Condition Survey)
26	Concrete: Crack Length50cm	61	Longitude (from)
27	Concrete: Crack Length25cm	62	Latitude (from)
28	Patching 75-100%	63	Altitude (from)
29	Patching 25-75%	64	Longitude (to)
30	Reserve	65	Latitude (to)
31	Reserve	66	Altitude (to)
32	Reserve	67	GPS Flag
33	Reserve	68	Management Kilometer Post
34	Reserve	69	Management Number
35	Reserve		

An example crack data from the results of the road data analysis is shown Figure 5.5.

Figure 5.5 Crack Data (from Road Surface Condition Data Interpretation and Encoding)



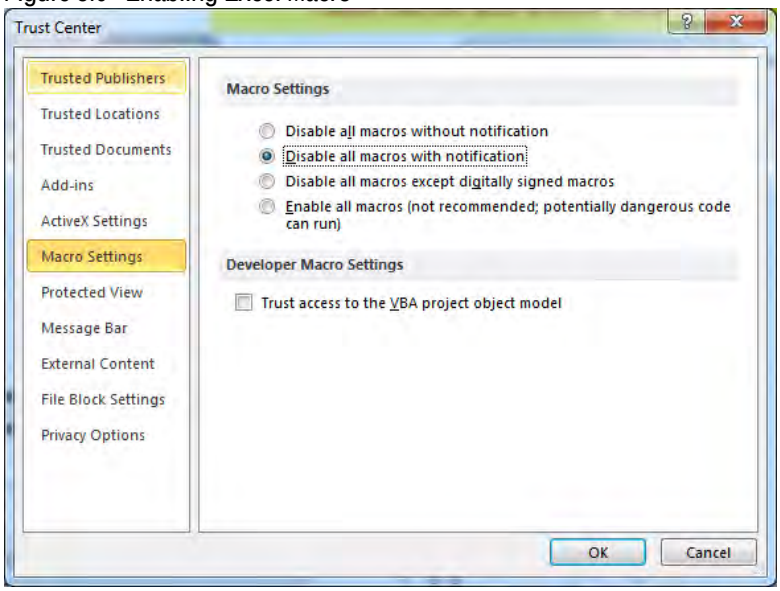
5.3 Preparatory Work

(1) Enabling the Macro Function in Excel

The system requires the MACRO function of MS-Excel. It is necessary to enable MACRO.

Set the Macro Setting to "Disable all macros with notification." If Excel 2003 is used, go to the menu bar. Select Tools, Macro, Security.

Figure 5.6 Enabling Excel Macro

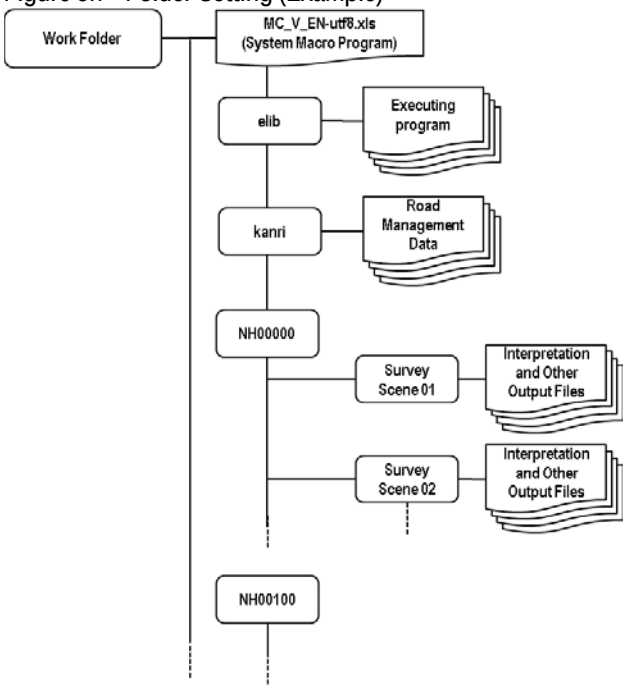


(2) Folder Setting

An folder setting example is shown in Figure 5.7. Create a work folder with an appropriate project name. Copy the MC_V_EN-utf8.xls file directly under the work folder. Copy provided elib folder directly under the work folder. Store the road management data from field

reconnaissance to the kanri folder. The pavement damage interpretation data and other recorded data are stored by scene.

Figure 5.7 Folder Setting (Example)



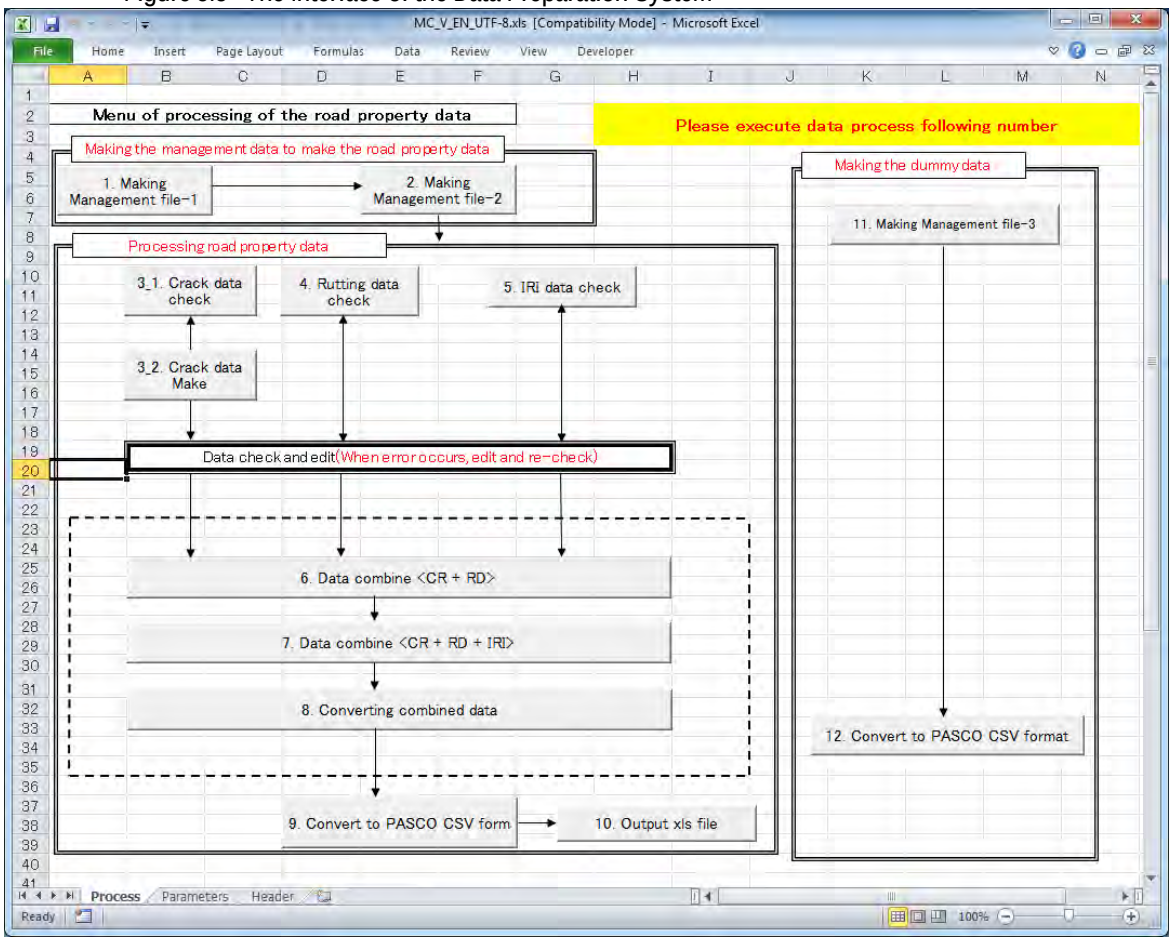
5.4 Method (Program Used)

The system uses the Notepad application to show dialogues. In order to continue, end the Notepad application.

(1) Program Interface

The Process sheet of MC_V_EN-utf8.xls looks like the following figure. The buttons are linked to the

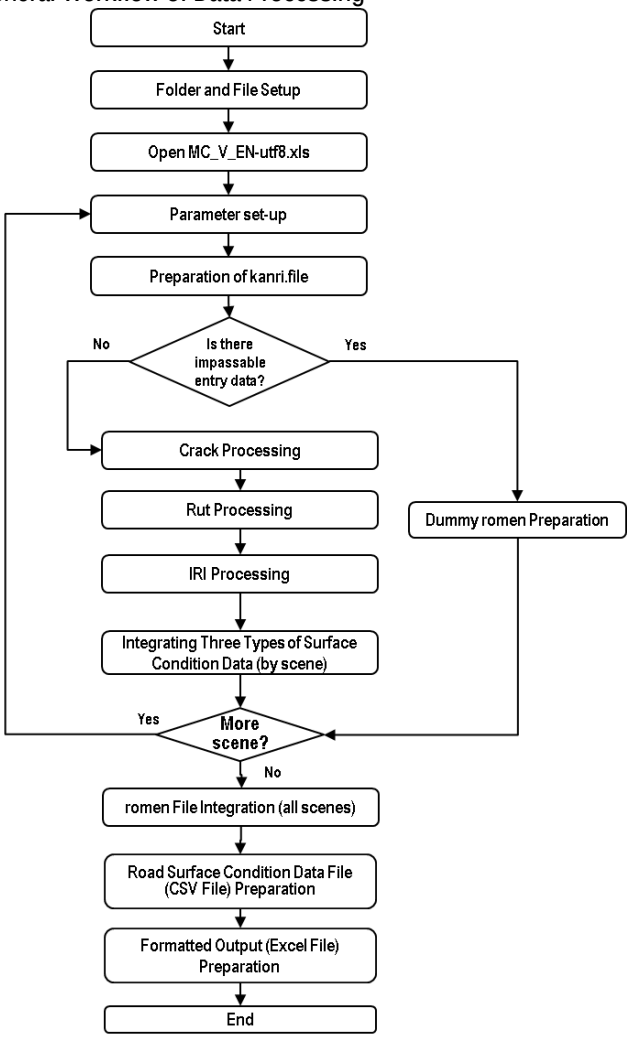
Figure 5.8 The Interface of the Data Preparation System



(2) Operation Flow

The general sequence of operation is as in the following flow chart.

Figure 5.9 General Workflow of Data Processing



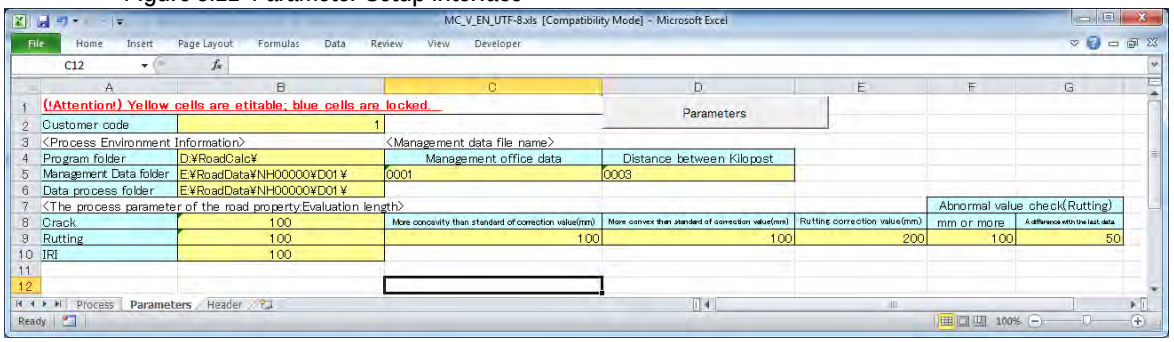
(3) Parameter Setting

The program starts by opening the MC_V_EN-utf8.xls file. The system shows the following dialogue.

Figure 5.10 Initial Dialogue Box

Click OK and continue.

Figure 5.11 Parameter Setup Interface



The enlarged view with corresponding number for explanation is shown in the following table.

Table 5.11 The Interface (Enlarged View)

[1] Customer code	1

[2]<Process Environment Information>

[3]<Management data file name>

[2-1]Program folder	D: \RoadCalc\	[3-1] Management office data	[3-2] Distance between Kilopost
[2-1] Management Data folder	E: \RoadData\NH00000\D01\	0001	0003
[2-3] Data process folder	E: \RoadData\NH00000\D01\		

[4]<The process parameter of the road property: Evaluation length>

					Abnormal value check (Rutting)	
[4-1]Crack	100	[5-1] More concavity than standard of correction value(mm)	[5-2]More convex than standard of correction value(mm)	[5-3]Rutting correction value(mm)	mm or more	A difference with the last data
[4-2] Rutting	100	100	100	200	100	50
[4-3] IRI	100					

The program would run with the default parameter setting. If it is necessary, the values can be adjusted.

[1] Customer code

The customer code can be set according to a customer management system of an organization.

[2] Process Environment Information

Prepare the working environment, and parameters are entered. According to the work environment, following folders shall be specified.

[2-1] Program folder: Set a path of working folder.

[2-2] Management Data folder: Set a path of the management data folder. Intermediate working files are stored.

[2-3] Data process folder: Set a path where the Analysis Output files are stored. Intermediate working files are stored.

[3] Management data file name

The following two road management data need to correspond to the survey segments of the analysis output files.

[3-1] Management Office data file: Set the road management data "0001" –the file name- targeted for processing. [3-2] Distance between Kilopost: Set the road management data "0003" – the file name- targeted for processing.

[4] The process parameter of the road property: Setting the Evaluation length

The evaluation lengths of surface condition data for [4-1] Crack, [4-2] Rut depth, [4-3] IRI are set based on the requirement of the pavement surface condition data to be prepared. The unit shall be the same for all conditions. In the example, the values are 100 meter.

[5] Adjustment condition setting (Setting the automatic adjustment processing conditions)

The adjustment value for setting abnormal value of rut depth volume can be set by setting the following three values: [5-1] More concavity than standard of correction value (mm); [5-2] More convex than standard of correction value (mm); and [5-3] Rutting correction value (mm). If the more strict condition needs to be applied, smaller values need to be set. In this example values 100 mm, 100 mm and 200 mm are set for the three adjustment (correction) values.

[6] Rut depth abnormal value check condition setting

Two values are set to identify abnormal rut depth values. When the conditions set are satisfied, the values are identified as abnormal. When more strict conditions are needed, smaller values need to be set. The example shows 100 mm and 50 mm for the rut depth value and the value of difference, respectively.

[6-1] mm or more: A rut depth value at some location

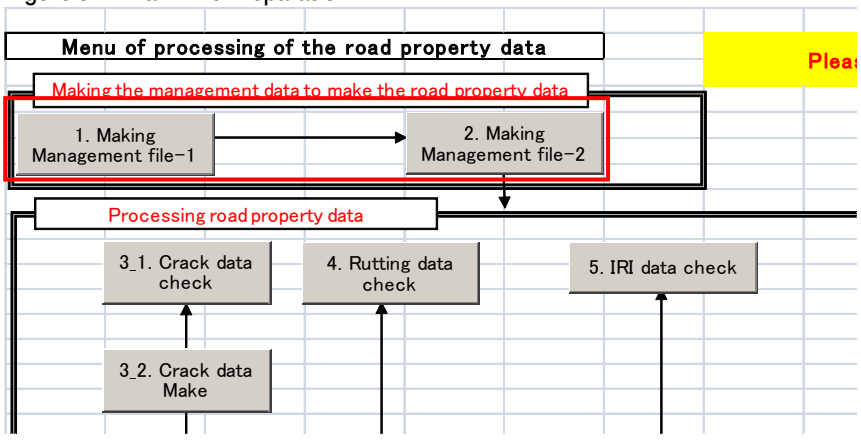
[6-2] A difference with last data: A difference of the rut depths between the one and one before.

[7] After setting all the parameters, press the Parameter button. The view is changed to the Processing sheet.

(4) kanri.file Preparation

The road management data (0001, 0003, 0004, 0005, 0101, 0102, 0104) are integrated to prepare kanri.file. To prepare the kanri.file, use “1. Making Management file-1.”

Figure 5.12 kanri.file Preparation

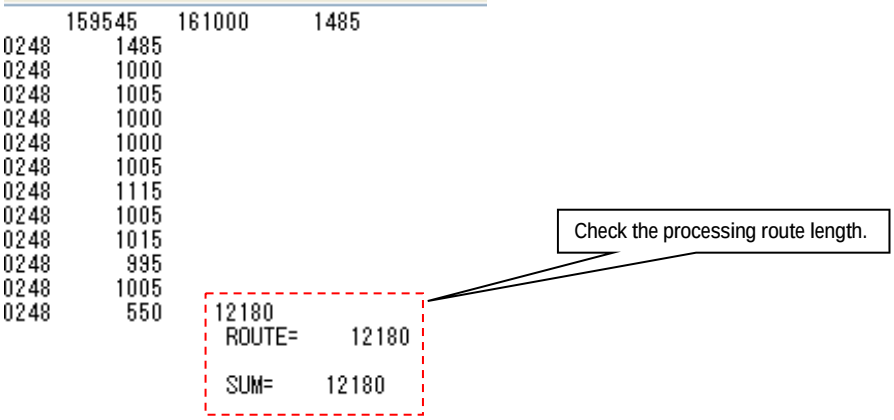


The following message box appears. A dialogue box appears, and ask if the process is to be proceeded. Click yes.

Run “2.Making Management file-2” by pressing the button.

The following output appears. Check if the length is equal to the processing route length.

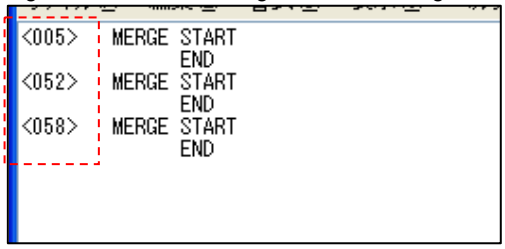
Figure 5.13 Check the Survey Route Length



After confirming the length, close Notepad.

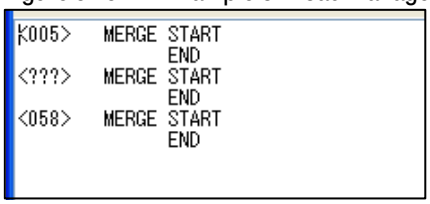
Check if each file is merged. The following case is OK.

Figure 5.14 Road Management Data Merged



The following output is an example of an error. Check the original road management data, if an error is found.

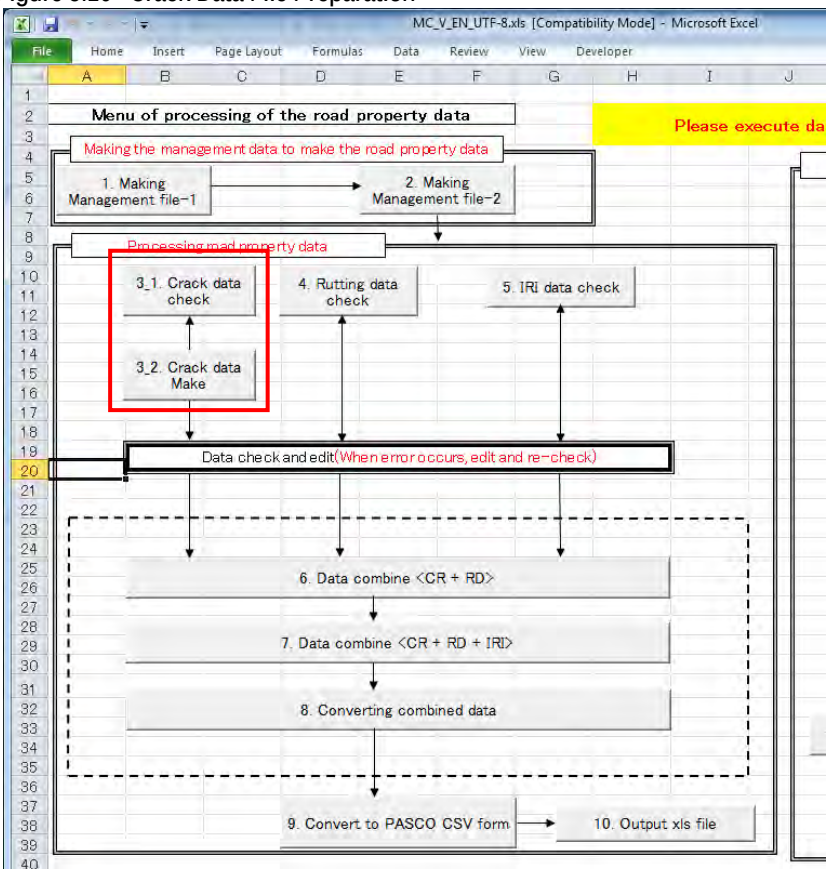
Figure 5.15 An Example of Road Management Data Not Merged



(5) Crack File Preparation

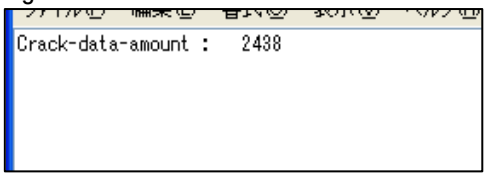
Create a crack file from the analysis output by pressing the buttons 3.1 and 3.2.

Figure 5.16 Crack Data File Preparation



Press the "3_1. Crack data check" button. The following case does not have an error.

Figure 5.17 Confirmation of Error



Following dialogue appears.

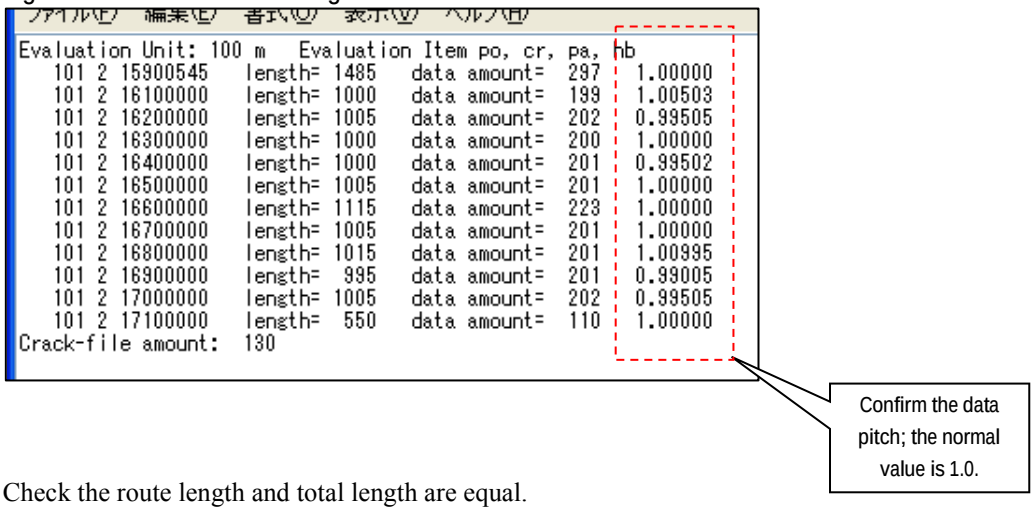
Figure 5.18 Checking 062

Click "OK" and continue.

Consistencies between the road-surface-classification file "062" created and the road structure files (0101, 0104, 0105) shall be checked.

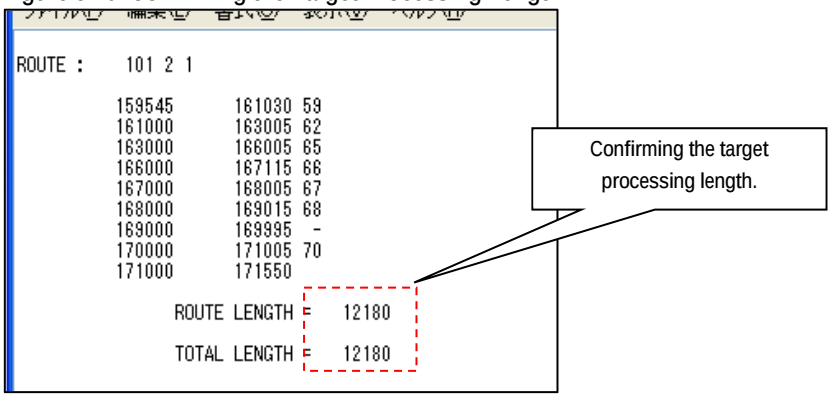
Press "3_2. Crack data make" after the consistency checking.

Figure 5.19 vrmcr2-- Confirming the Data Pitch



Check the route length and total length are equal.

Figure 5.20 Confirming the Target Processing Length



==========

An Example of an Error

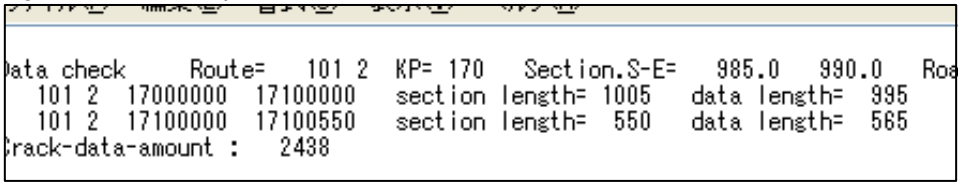
==========

The following case is an example of an error on the crack data preparation.

The line 2: The surface is recorded as concrete is interpreted as asphalt.

The lines 3 and 4: The survey length in the analysis has more than ±1% discrepancy against the road management data. If this is the case the data on distances between kilometer posts or the analysis data need to be reviewed and corrected.

Figure 5.21 An Example of Error in Crack Data - the vrmcr1

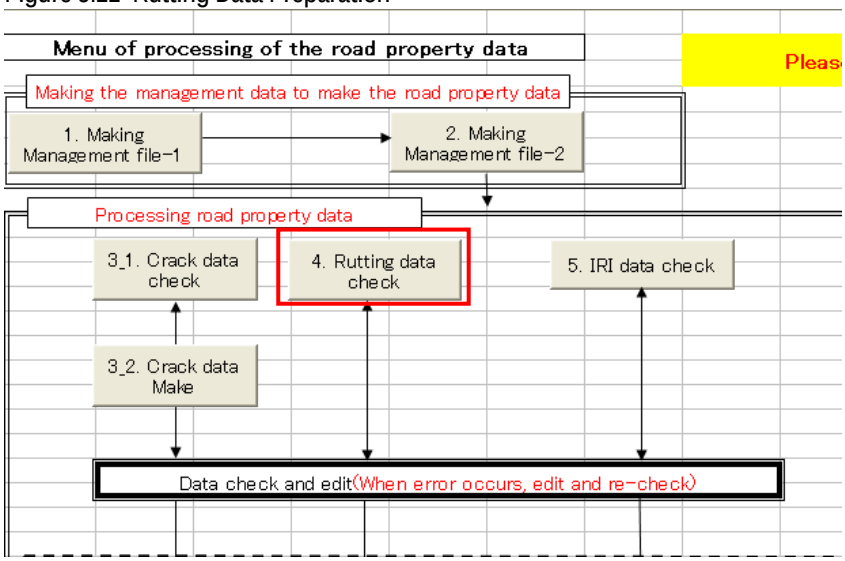


==========

(6) Rutting Data File Preparation

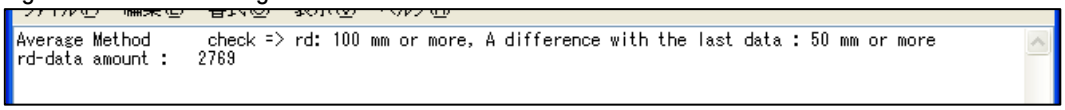
Press the 4. Rutting data check button to prepare the rutting data file.

Figure 5.22 Rutting Data Preparation



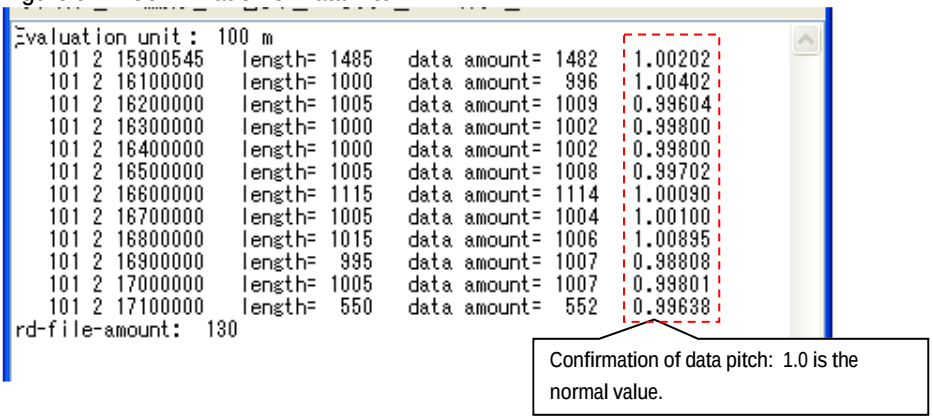
Confirm that there is no error in the process.

Figure 5.23 Error Message



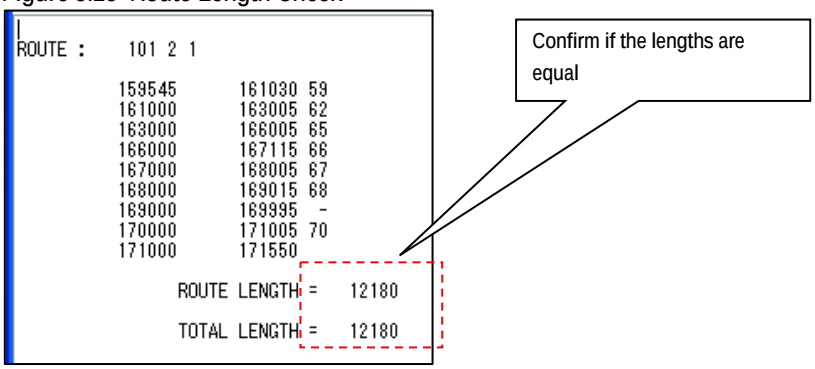
Confirm the data pitch for every segment between kilometer posts. If the pitches are significantly different, check the analysis data or the data on the kilometer post distances, and make necessary correction.

Figure 5.24 Confirmation of Data Pitch



Confirm that the processing length is right.

Figure 5.25 Route Length Check



==========

An Example of an Error

==========

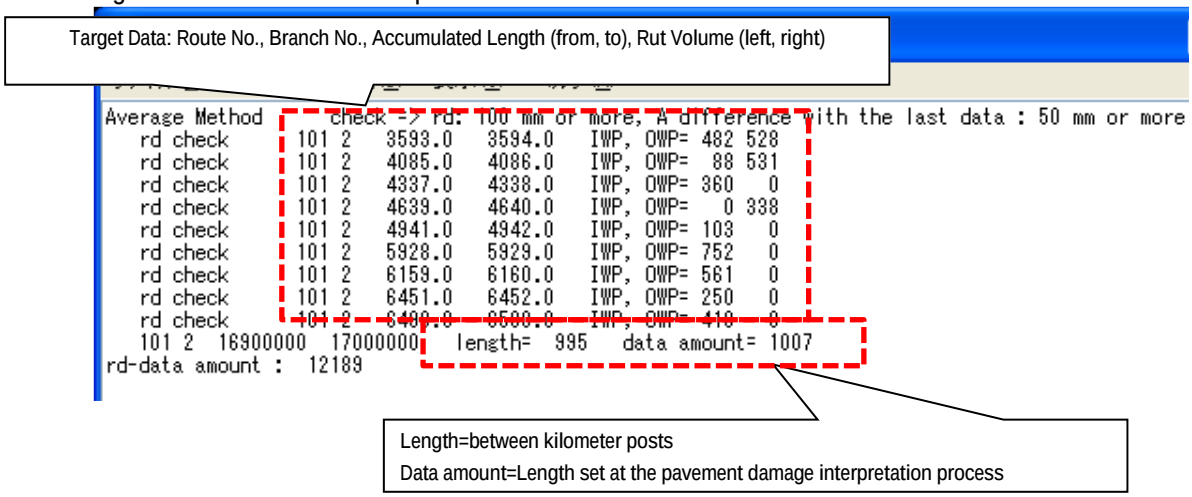
The following example is a case of error in the rutting data.

The lines from 2 to 10: An independent crack volume is more than 100 mm and the depth is 50 mm or more than the rutting depth locating before.

The line 11: The survey length in the analysis has more than ±1% discrepancy against the road management data. If this is the case the data on distances between kilometer posts or the analysis data need to be reviewed and corrected.

==========

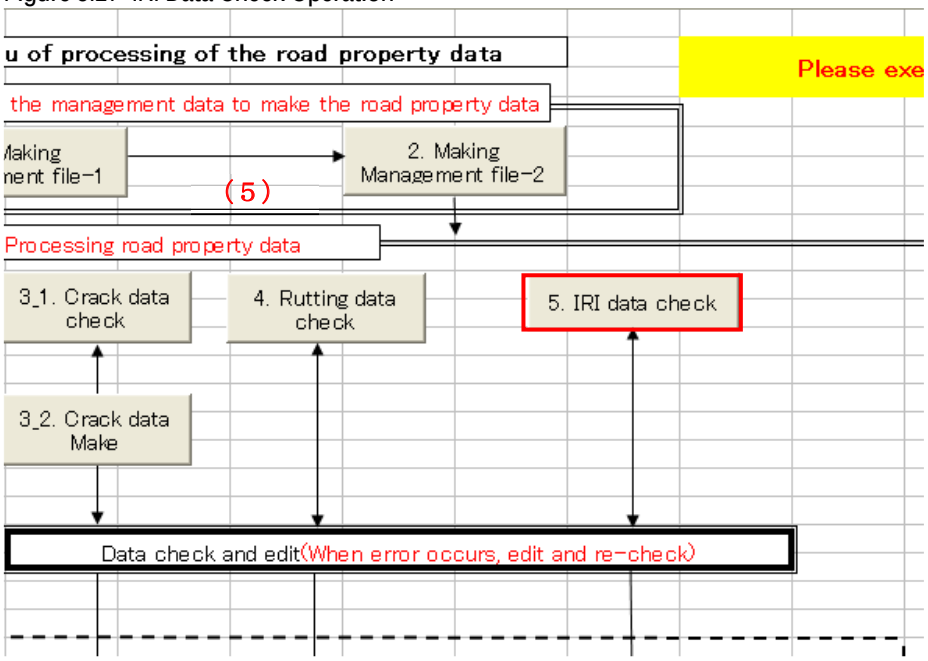
Figure 5.26 Error in the Rut Depth File



(7) IRI Preparation

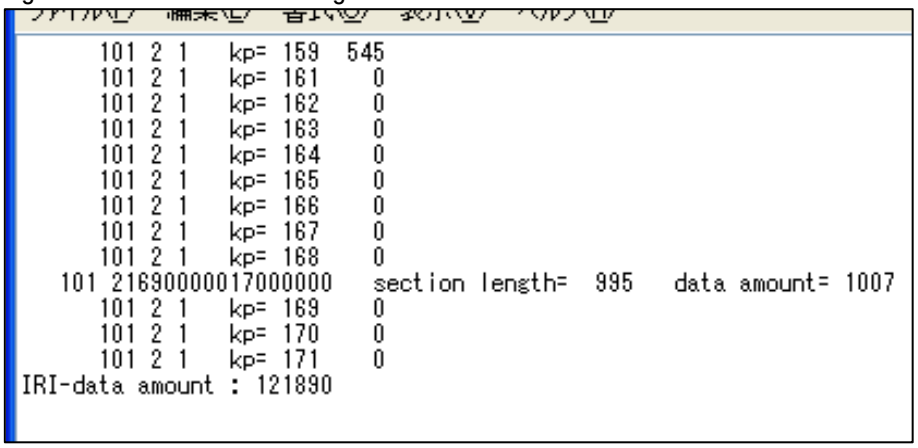
IRI file is prepared from the analysis outputs. Press “5.IRI data check” and run the program.

Figure 5.27 IRI Data Check Operation



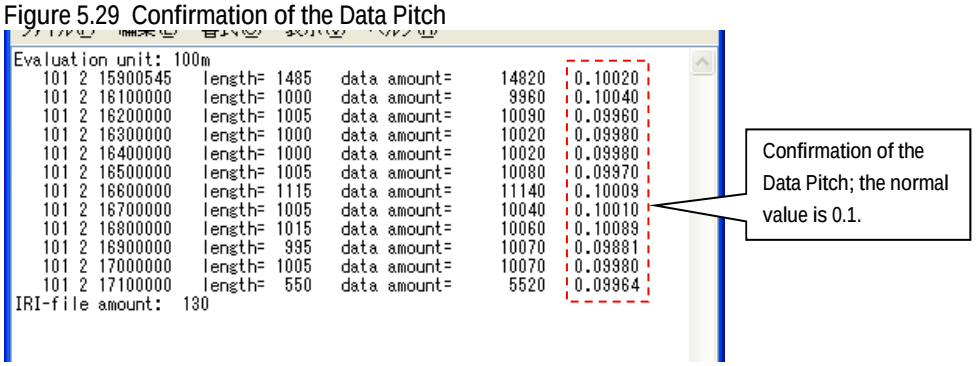
Press "5.IRI data check" and run the program. The Notepad shows the following data.

Figure 5.28 IRI Data Check Image



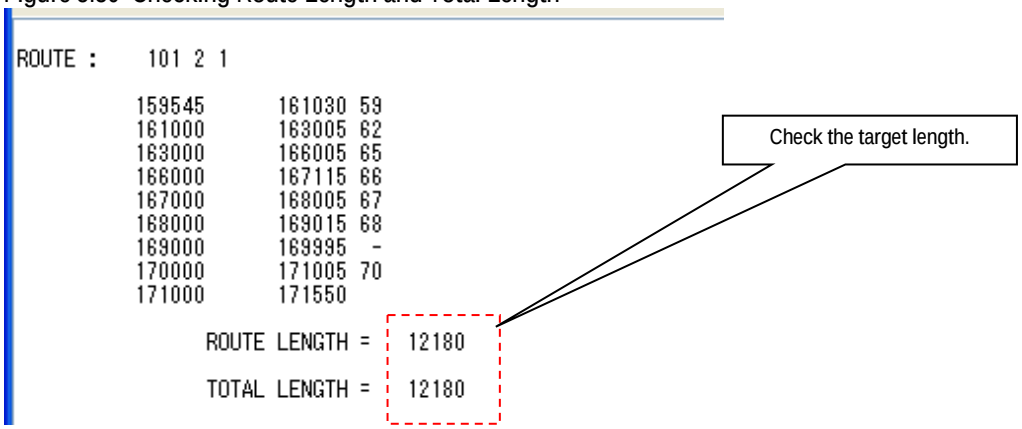
Confirm the pitch of IRI in every distance between the kilometer posts. When the pitch is significantly different, the analysis data or the distance data between the kilometer posts shall be corrected.

Figure 5.29 Confirmation of the Data Pitch



Confirm the length of processing.

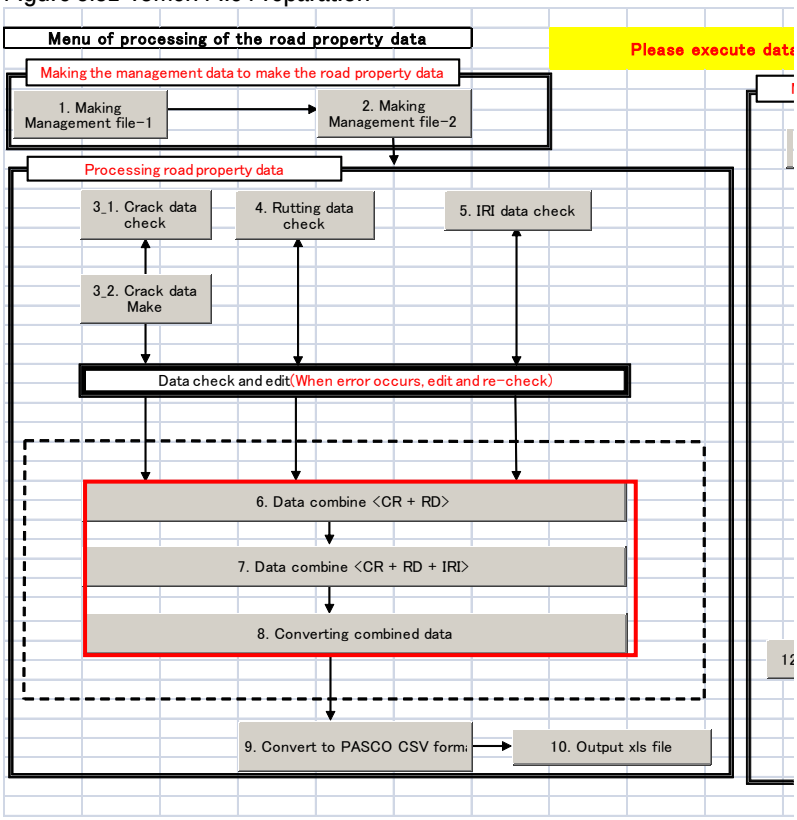
Figure 5.30 Checking Route Length and Total Length



(8) Integrating the Three Files

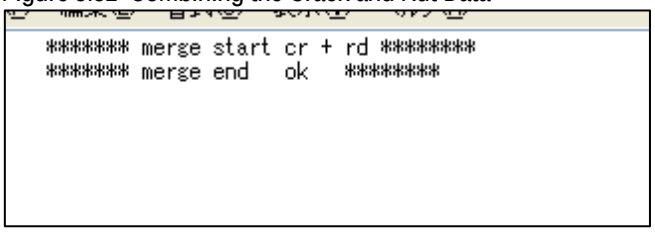
Integrate the three files prepared in the processes (4), (5) and (6) to prepare the romen file.

Figure 5.31 romen File Preparation



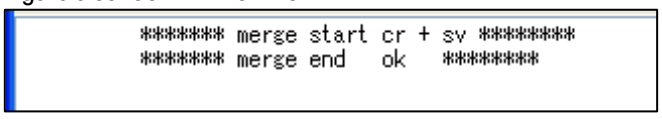
Press "6.Data combine <CR+RD>" and run the program to combine the crack and rutting data. Check the text file message to confirm there is no error.

Figure 5.32 Combining the Crack and Rut Data



Press "7.Data combine <CR+RD+SV>" to combine the combined data, crack and rut, and IRI. Check the text message to confirm there is no error.

Figure 5.33 Confirm No Error



Press the "8.Converting combine data" to run the program. To the combined file with the three types of road condition data--crack, rut and IRI data--the basic data (geographical areas etc.) are combined.

Figure 5.34 Adding the Management Data to the Combined File

```
route      101 2 1
    16      161000 5   161030 5  --->  161000
    37      163000 6   163005 6  --->  163000
    68      166000 6   166005 6  --->  166000
    80      167100 6   167115 6  --->  167000
    91      168000 6   168005 6  --->  168000
   102      169000 6   169015 6  --->  169000
   112      169900     169995    --->  170000
   124      171000 7   171005 7  --->  171000
```

An Example of an Error

Following is an example of data integration error.

There are road segment data errors between: the data elements of crack and rut depth; or crack + rut depth and IRI. When this type or error occurred, the road management data or road structure data need to be reviewed and the data need to be corrected if necessary.

Figure 5.35 An Example of Data Integration

```
        ******* merge start cr + sv ********
i    101 2 1    164300 164400     16400300  16400400
j    101 2 1    164300 164350     16400300  16400350
i    101 2 1    164600 164700     16400600  16400700
j    101 2 1    164600 164620     16400600  16400620
        ******* merge end   ok     *******
```

The segment CR+RD is expressed [164kp+300]-[164kp+400], but the target road segment is from 164kp+300-164kp+350.

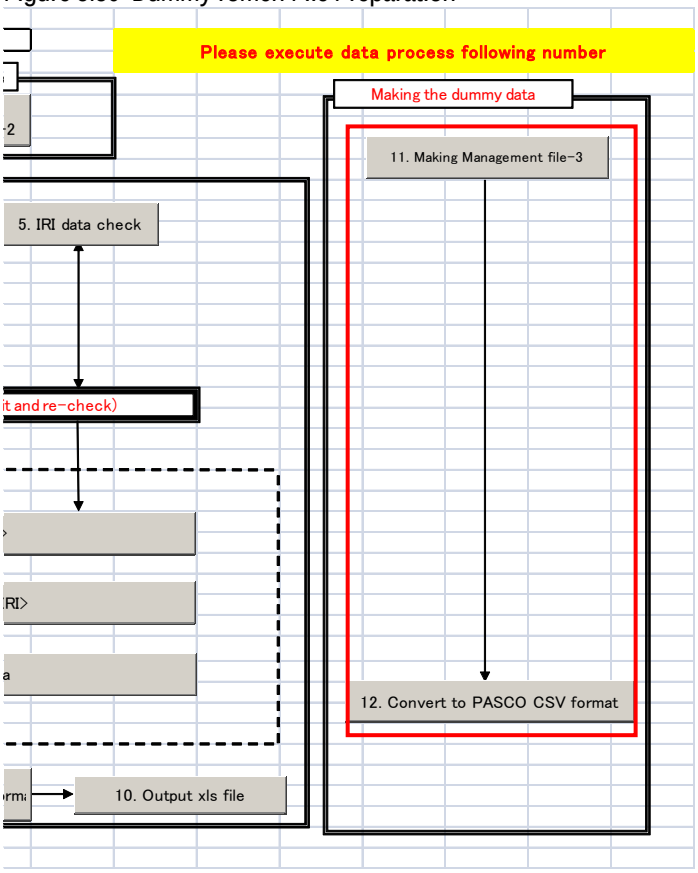
This is the end of processing one-scene. The process from the parameter setting shall be repeated and applied to all the scenes for all the routes.

(9) Dummy romen File Processing

When there is a segment that does not have the digital data or where the survey vehicle could not enter to capture the digital data, special treatment will be necessary. If this is the case, create dummy-romen data. If there is no such segment, skip this process of "Dummy romen File Processing."

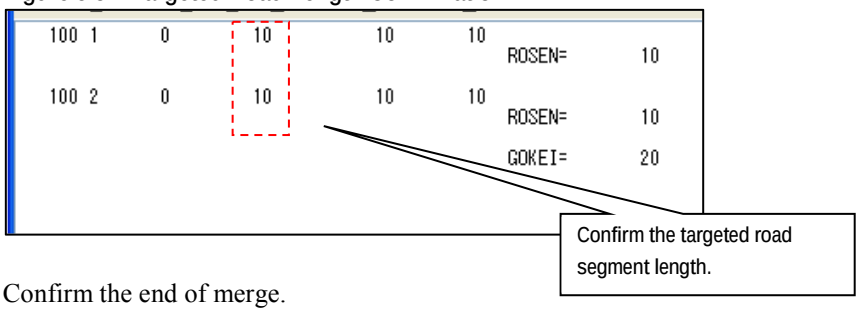
Go back to the parameter setting and set necessary parameters and prepare a kanri.file. After the kanri.file is prepared, create the Dummy romen file by pressing 11. Making Management file-3."

Figure 5.36 Dummy romen File Preparation



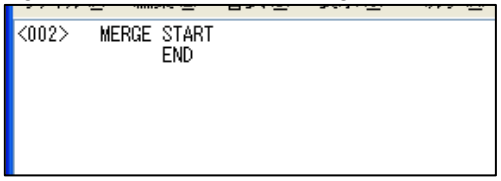
As in the other operation, the parameters need to be set up. The kanri.file needs to be prepared, also. Press the button, 11.Making Management File-3. Check the correct length.

Figure 5.37 Targeted Road Length Confirmation



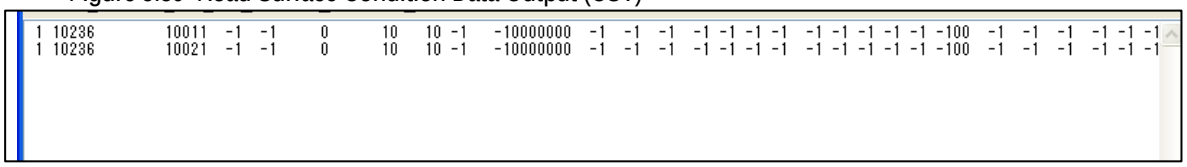
Confirm the end of merge.

Figure 5.38 Confirmation of Merge



Press “12.Convert to PASCO CSV format” to generate the csv file for the road segments that has not no digital data.

Figure 5.39 Road Surface Condition Data Output (CSV)

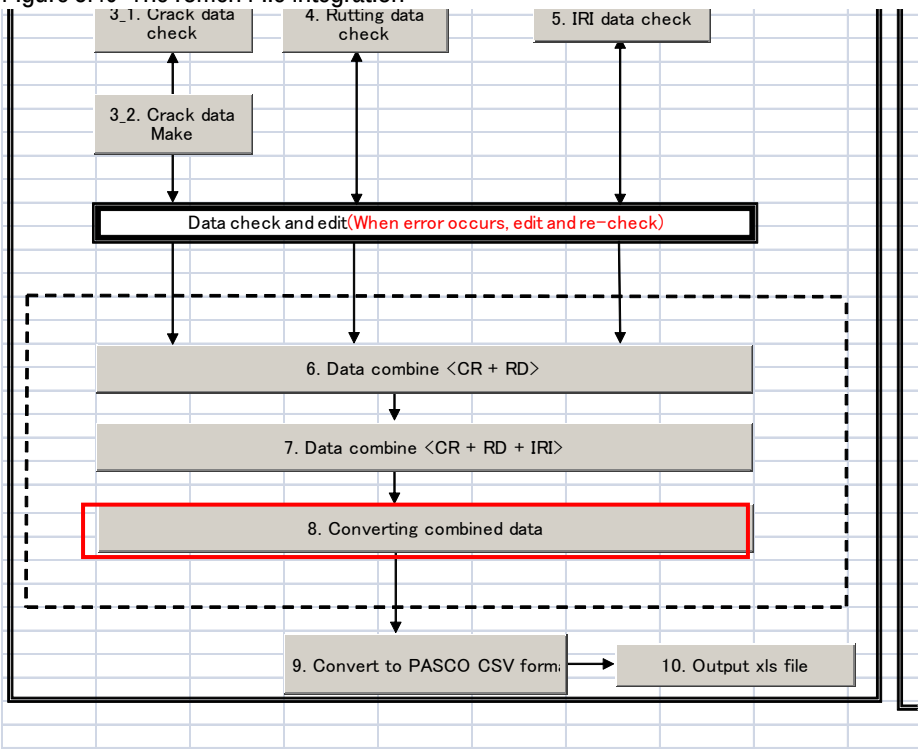


```
1 10236        10011  -1  -1     0      10   10 -1   -10000000  -1  -1  -1  -1 -1 -1 -1   -1 -1 -1 -1 -1 -100  -1  -1  -1  -1 -1 -1
1 10236        10021  -1  -1     0      10   10 -1   -10000000  -1  -1  -1  -1 -1 -1 -1   -1 -1 -1 -1 -1 -100  -1  -1  -1  -1 -1 -1
```

(10) The romen File Integration

The romen files have been prepared by scene. The process integrates all the romen files created by scene. To integrate the files, press “8. Converting combine data.”

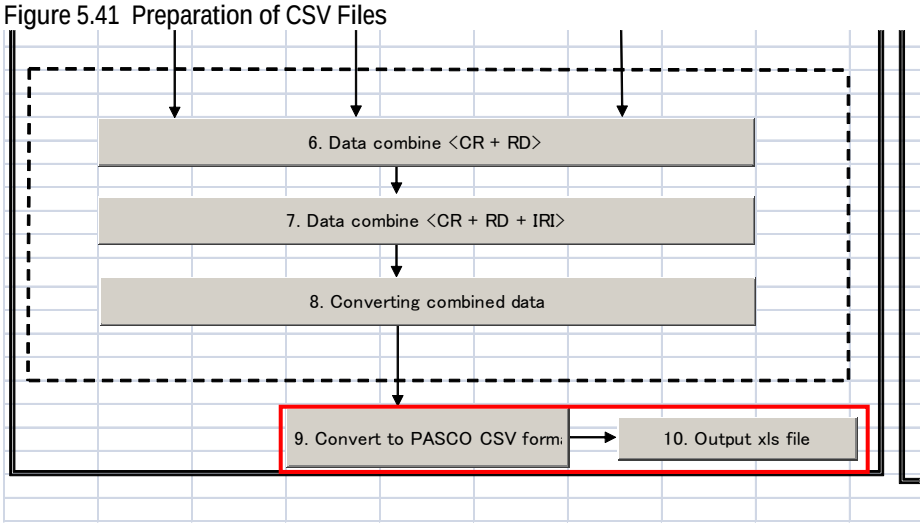
Figure 5.40 The romen File Integration



(11) Road Surface Condition Data File (CSV files) Preparation

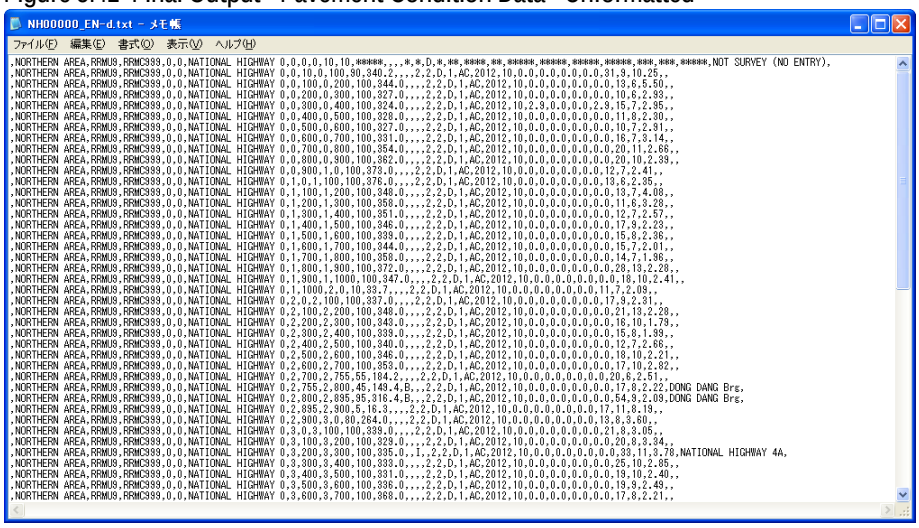
Now the all the romen files by scene were integrated. The integrated file is ready to be converted to output in the csv file format.

Figure 5.41 Preparation of CSV Files



Press “9.Convert to PASCO CSV format” to create the following files.

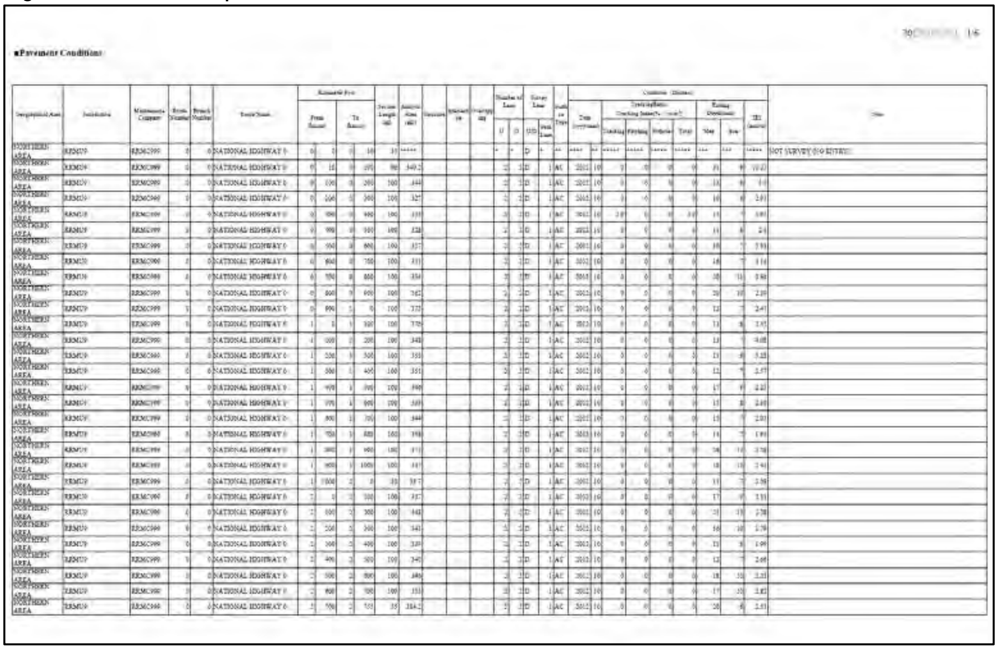
Figure 5.42 Final Output - Pavement Condition Data - Unformatted



(12) Pavement Road Surface Condition Data File (Excel file) Preparation

Press the “10.Output.xls file” button and run the macro program. An Excel file is produced. Name the file according to the file name standards.

Figure 5.43 Final Output - Road Surface Condition Data - Formatted



Forms

Form_FR01_Equipment Check List

Equipment Check List

Field Reconnaissance

№	Check item	Check	Remarks
1	Whiteboard		
2	Hard hat		
3	Safty vest		
4	Paintbrush		
5	Paint		
6	Bucket		
7	Retractable tape measure		
8	Walking measure		
9	Traffic guide device		Stick, flag or equivalent
10	Safty cone		
11	Field note		
12	Daily activity report		
13	Vehicle inspection sheet		
14	Laptop computer		
15	Route map		
16	Pen(s)		
17	Work gloves		
18	Digital camera		
19	Cellphone		
20	Trip Meter		

Inspection date : / / Inspection name :

Survey Route : Remarks :

Form_FR02_Vehicle Inspection

Road Condition Survey Vehicle

inspection date	/ /
Groupe No	
survey period	/ ~ /
plate number	30T - 5327
inspection name	
operate name	

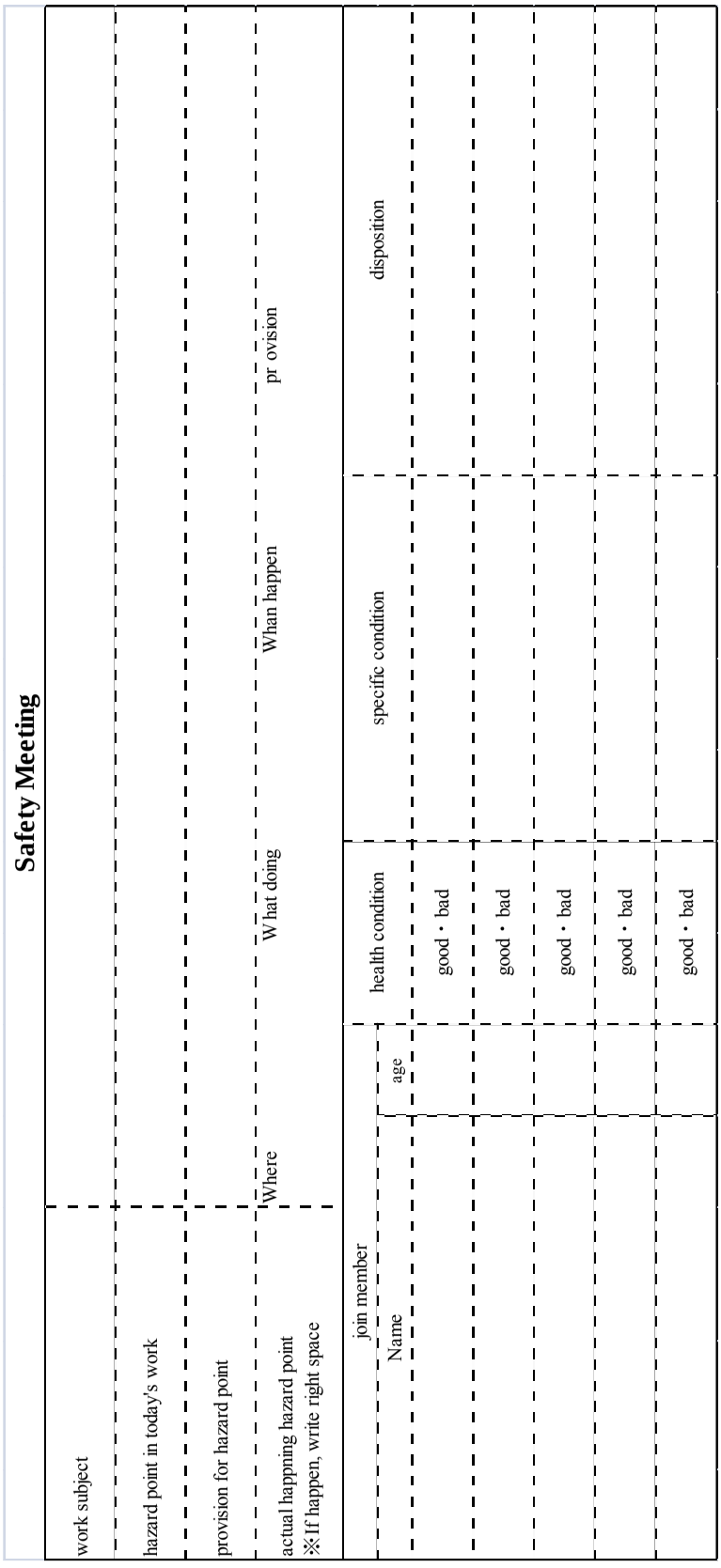
inspection point		inspection content	check
Drive sheet	Brake	treat on degree	
	Parking brake	pull degree	
	Fuel equipment	remaining amount of fuel	
Engine room	Lubrication equipment	engine oil volume	
	Radiator	fluid volume	
		fluid leak	
	Fan belt	Tension degree	
		Damage	
	Window wash	fluid volume	
	Battery	fluid volume	
		Specific gravity	
	transemission	fluid volume	
around vehicle	lamp	Brake lamp	
		Blinker lamp	
		Damage	
	Wheel	air pressure	
		Crack / Damage	
		Wear	
another equipment	MOT test sheet		
	spare wheel, jack, tool		
other			

check vehicle exterior

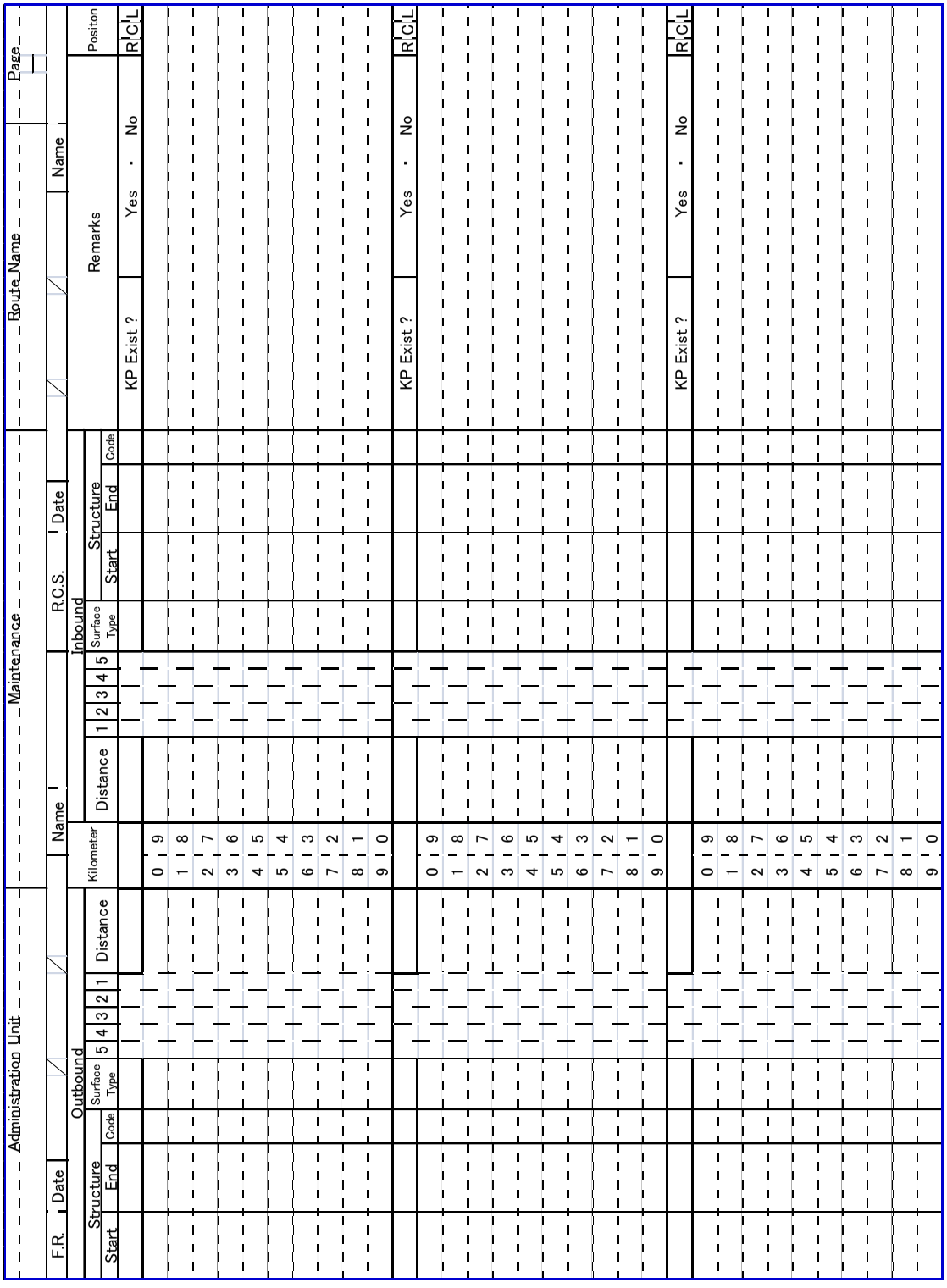
kindication symbol dent scratch

(fill in red pen)

Form_FR03_Safety Meeting Record



Form_FR04_Field Note



Daily Activity Report

measurement item : Craking・Rutting depth・IRI・Forward view

Name : ① ② ③ ④ ⑤ ⑥ ⑦

date	survey	Route	wether	road	survey section			survey period				mileage			driver's
	detail	number		surface	start	end	difference	start	end	work hour	rest hour	start	end	difference	name
／															
	total														

Appendices

App.1 Jurisdiction and Management Company (English, Vietnamese)

Geographic Area Code	Jurisdiction Code	Management Company Code	English	Vietnamese
1	0	0	Northern Area	Miền Bắc
1	10	0	RRMU2	Khu Quản Lý Đường Bộ 2
1	10	222	RRMC222	Công Ty 222
1	10	224	RRMC224	Công Ty 224
1	10	226	RRMC226	Công Ty 226
1	10	232	RRMC232	Công Ty 232
1	10	234	RRMC234	Công Ty 234
1	10	236	RRMC236	Công Ty 236
1	10	238	RRMC238	Công Ty 238
1	10	240	RRMC240	Công Ty 240
1	10	242	RRMC242	Công Ty 242
1	10	244	RRMC244	Công Ty 244
1	10	248	RRMC248	Công Ty 248
1	10	999	Other	Khác
1	50	0	Province	Tỉnh
1	50	999	Other	Khác
1	60	0	Company	Công ty
1	60	999	Other	Khác
1	70	0	Under Construction	Đang xây dựng
1	70	999	Other	Khác
2	0	0	Northern Middle Area	Bắc Trung Bộ
3	0	0	Southern Middle Area	Nam Trung Bộ
4	0	0	Southern Area	Miền Nam

App. 2 Route Names

Route Number	Branch	English	Vietnamese
1	0	National Highway 1	Quốc Lộ 1
1	1	Southern Ring Road 3 to Cau Dau	Đường Vành Đai 3 Phía Nam tới Cầu Dậu
2	0	National Highway 2	Quốc Lộ 2
3	0	National Highway 3	Quốc Lộ 3
3	1	National Highway 3B	Quốc Lộ 3B
3	2	National Highway 3 (The old road branch)	Quốc Lộ 3 (Đường nhánh cũ)
4	0	National Highway 4E	Quốc Lộ 4E
5	0	National Highway 5	Quốc Lộ 5
6	0	National Highway 6	Quốc Lộ 6
6	1	National Highway 6-1 (The old bypass road)	Đường Vòng Tránh 6-1
6	2	National Highway 6-2 (The old bypass road)	Đường Vòng Tránh 6-2
6	3	National Highway 6-3 (The old bypass road)	Đường Vòng Tránh 6-3
10	0	National Highway 10	Quốc Lộ 10
10	1	Connecting National Highway 1 with Ninh Phuc Port	Đoạn nối QL1 với Cảng Ninh Phúc
15	0	National Highway 15	Quốc Lộ 15
18	0	National Highway 18	Quốc Lộ 18
18	1	Route Noi Bai - Bac Ninh	Tuyến Nội Bài - Bắc Ninh
21	0	Ho Chi Minh Route	Đường HCM
37	0	National Highway 37	Quốc Lộ 37
38	0	National Highway 38	Quốc Lộ 38
38	1	National Highway 38B	Quốc Lộ 38B
43	0	National Highway 43	Quốc Lộ 43
70	0	National Highway 70	Quốc Lộ 70
279	0	National Highway 279	Quốc Lộ 279

App. 3 Input Data

Data Code	Code	English	Vietnamese
0104	B	Bridge	Cầu
0104	T	Tunnel	Hầm
0104	R	Rock Shed	" Hầm " phòng đá lăn
0104	O	Other	Khác
0105		U/N (UnKnown)	Chưa xác định
0201	1	Not Survey (No Entry)	Không khảo sát (không vào được)
0201	2	Not Survey (Other)	Không Khảo sát (các lý do khác)