THE SOCIALIST REPUBLIC OF VIETNAM
MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM

THE SOCIALIST REPUBLIC OF VIETNAM
PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE

FINAL REPORT
MANUALS AND GUIDELINES

April 2014

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

KATAHIRA & ENGINEERS INTERNATIONAL
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VOLUMES

VOL. I	**ROAD DATABASE USER'S MANUAL**
VOL. II	**DATA CONVERSION SOFTWARE USER'S MANUAL**
VOL. III	**PAVEMENT MANAGEMENT SYSTEM USER'S MANUAL**
VOL. IV	**PAVEMENT MONITORING SYSTEM USER'S MANUAL**
VOL. V	**ROAD FACILITY INSPECTION GUIDELINE**
VOL. VI	**ROAD ROUTINE MAINTENANCE MANUAL**

VOL. I

ROAD DATABASE
USER'S MANUAL

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 IN THE SOCIALIST REPUBLIC OF VIETNAM

ROAD DATABASE USER'S MANUAL

APRIL 2014

JICA PROJECT TEAM

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

Road database system (hereinafter referred to as "the Road Database") has been developed under Activity-1: Enhancement of Road Information Management of the JICA Project on **Capacity Enhancement in Road Maintenance in Vietnam**. This User Manual has been prepared to provide a reference for the potential users of this database. Therefore, this user manual can be best utilized by database operator (i.e. person who input data), database manager, system developer for updating, modifying or understanding the database system.

The Road Database system under the scope of the JICA Project is focused mainly on data related to road assets, pavement condition, pavement maintenance history and traffic volume of the Vietnamese national roads under jurisdiction of RRMB I which accounts a total of approximately 2,360 km of road. However, it is anticipated that the same database system will be expanded to other remaining RRMBs (i.e. RRMB II, RRMB III, and RRMB IV) as a technology transfer by DRVN's own initiation.

It is anticipated that the Road Database system can provide data for several purposes including Pavement Management System (hereinafter referred to as "PMS"), Pavement Monitoring System (hereinafter referred to as "PMoS"), management of other road facilities, road assets and road & traffic management. The scopes of asset data are asset inventory (location, detailed features of the asset facility), asset value and outline of the latest asset repair. Data to be acquired through routine / periodic / unscheduled inspection work are not included. Pavement (structure), pavement condition and pavement maintenance history data are dealt separately because detailed information is needed under each data category not only for using PMS and PMoS but also for other planning and management purposes of road administrator.

1.2 ORGANIZATION OF ROAD DATABASE USER MANUAL

This road database user manual consists of seven (7) chapters followed by 5 appendices. Details of each chapter and appendix are shown below.

Chapter 1: Introduction of Road Database

Chapter 2: Installation of Software and Environment Setting

Chapter 3: Basic Functions

Chapter 4: Operation of Road Database

Chapter 5: VBMS Interface

Chapter 6: Storing Pavement Condition and Traffic Volume Data in Road Database

Chapter 7: Database System Editing and Updating

Appendix - 1: Data Definition

Appendix - 2: VBMS Data Definition

Appendix - 3: Data Validation Check

Appendix - 4: Flow Charts for Basic Functions

Appendix - 5: Sample Data Input Sheet

1.3 DATABASE STRUCTURE

The database structure is divided into three hierarchies considering the data collection & inputting mechanism and database utilization. Since primary data are stored in RRMS-Bs and data inputting work is also presumably carried-out by RRMS-Bs, data are collected from each RRMS-B and forwarded to respective RRMB and eventually to DRVN to store data into the central database. Each RRMB administers national roads under their own jurisdiction only and thus database in RRMB level stores data of their own region only. At DRVN level, data from all RRMBs are collected into the central database. Database hierarchy is shown in **Figure 1.3.1**.

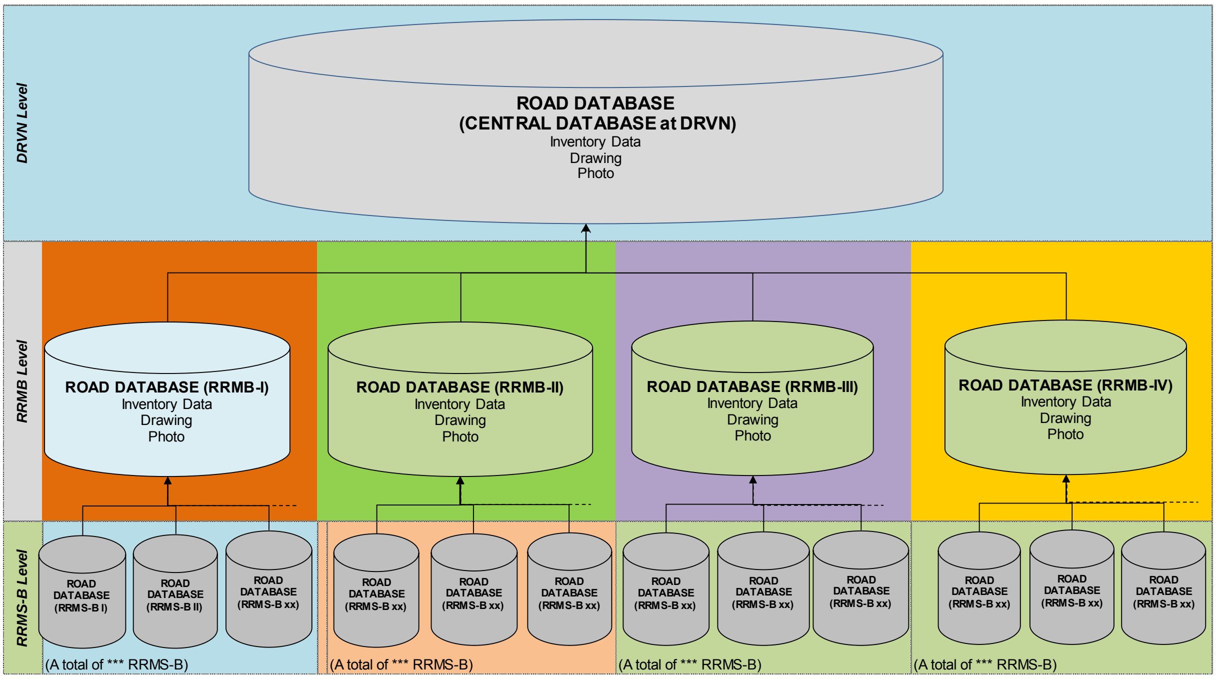


Figure 1.3.1 Database Hierarchy

The Road Database structure comprises five (5) types of data; general road management, road asset (road inventory), pavement condition, maintenance history and traffic volume data. However, general road management data are different from road asset data and solely use by road administrators for their internal management purposes. Thus, general road management data have been dealt separately from the data related to road asset. Database structure is shown in **Figure 1.3.2**.

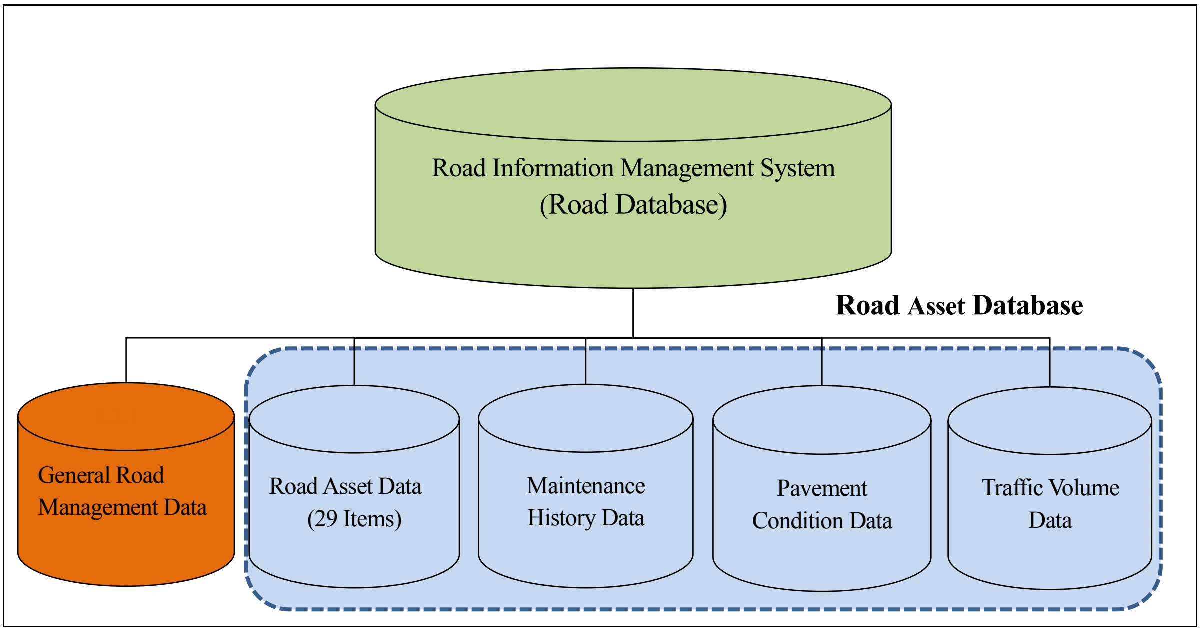


Figure 1.3.2 Road Database Structure

As shown in **Figure 1.3.3**, three (3) types of data formats, namely inventory data, drawing data and photo (including videos) data are stored in corresponding folders for each asset type under the province folder.

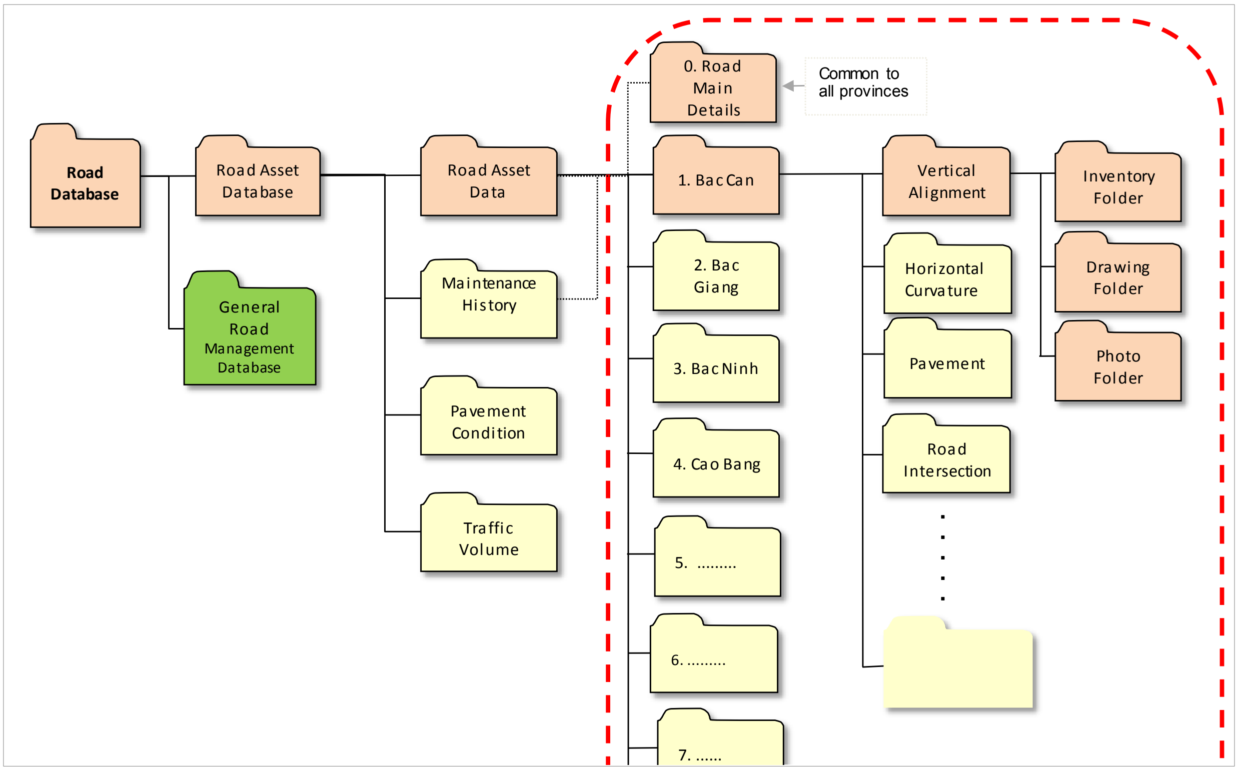


Figure 1.3.3 Database Folder Structure (for RRMB-I Jurisdiction)

It is prerequisite to save all folders and interface file (Program system file) in a common folder. If related folders and interface file are saved in different folders, the system interface prompts error message indicating "C**annot find Pivot Table file**" as shown below. This error occurs because a particular path has been specified in VBA code.

It is strictly prohibited to change any folder names to avoid losing / mismatching any paths or links inserted between interface file and database folders.

1.4 SYSTEM INTERFACE AND DATA STORAGE

In database system, system interface file (program system file) and data storage system (pivot table, photo folder and drawing folder) are kept separately though both tasks are done in MS-Excel platform. Data storage component consists of large number of files including photos and drawings and thus requires a large space. Also, if a single file contains a large volume of data, it is not convenient to work because it needs large memory and takes a long time to work in processing. It is not necessary to revise the structure of data storage system so often. In contrast, system interface file may need revision time to time to fix the problem which generally occurs in the system interface file. Therefore, system interface file and data storage system have been designed separately. However, both systems are linked by Excel VBA. If there are any changes in system interface file, only system interface file can be provided to all users and users can just replace the old system file by the new one. The new system interface file will support all data storage system without any technical problem.

Figure 1.4.1 shows the inter-relationship between system interface file and data storage system. As illustrated in the figure, the system interface saves all data in data storage system and whenever necessary data or information will be extracted to system interface file especially for checking data validation, data displaying, data printing and data editing / updating.

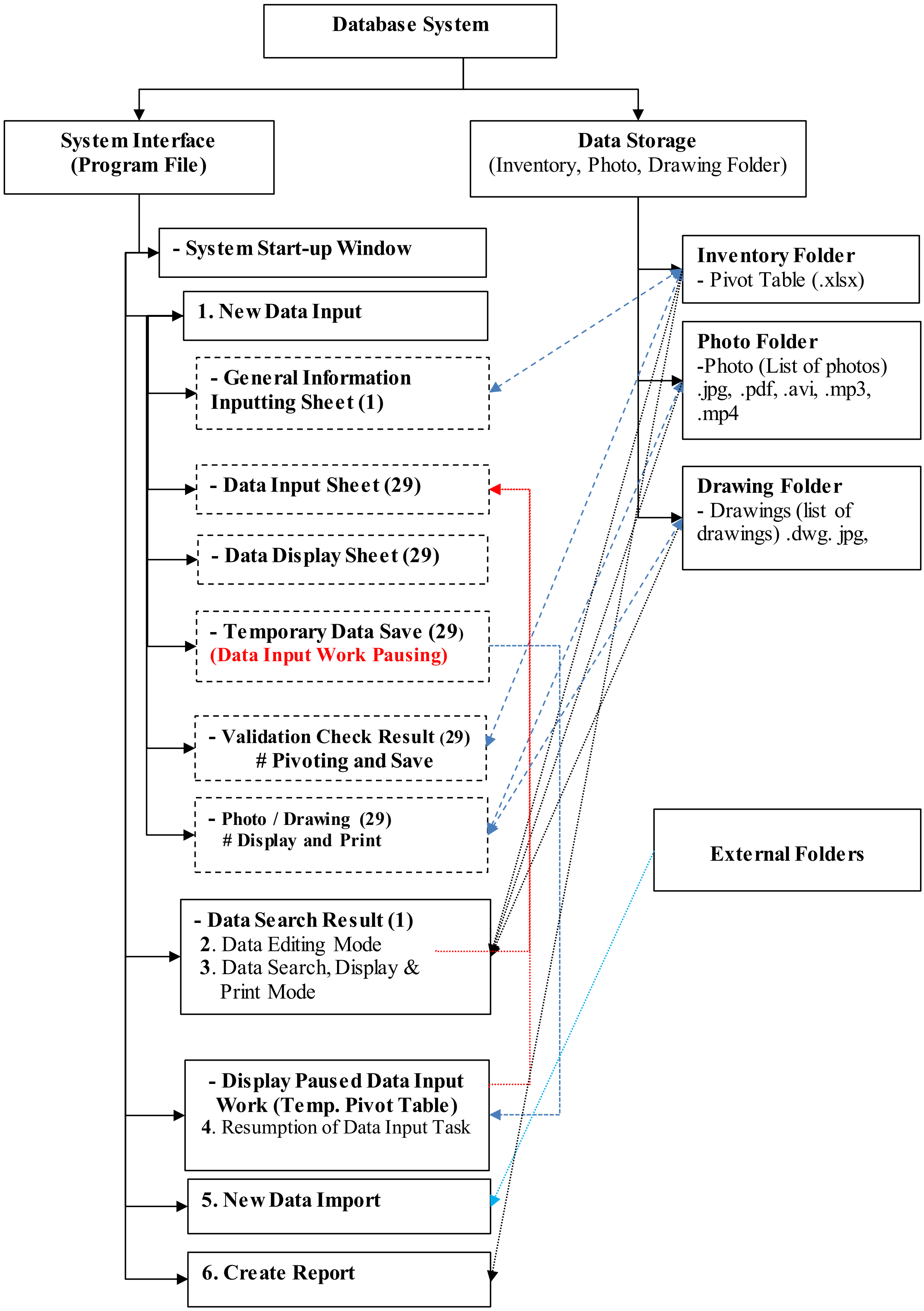


Figure 1.4.1 System Interface and Data Storage Relationship

1.5 DATA TYPE, FILE NAMES AND CODING

1.5.1 Data Type

As shown in **Figure 1.3.2** and **Figure 1.3.3**, the Road Database consists of four (4) types of data under road asset database folder as listed below;

- ✓ Road Asset Data
- ✓ Maintenance History
- ✓ Pavement Condition
- ✓ Traffic Volume Data

A total of twenty nine (29) data items are included in road asset data. The details of road asset data and expected utilization are indicated in **Table 1.5.1**.

Table 1.5.1 Road Asset Data Items and Expected Utilization

SN	Data Items	Expected Utilizations						
		PMS	PMoS	AI	AM	RTOM	SD	Other
1	Road Main Details	√	√	√	√	√		
2	Pavement	√	√	√	√			
3	Overlap Section				√	√		
4	Bridge (VBMS Inventory Module)			√	√	√		
5	Road Intersection			√	√	√		
6	Railway Crossing			√	√	√		
7	Submersible Drainage Facility			√	√	√		
8	River Crossing (Ferry, etc.)			√	√	√		
9	Pontoon Bridge			√	√	√		
10	Tunnel			√	√	√		
11	Slab and Box Culvert			√	√			
12	Pipe Culvert			√	√			
13	Vehicle Weighing / Measuring Facility			√	√	√		
14	Road Damage Inventory (by Disaster)					√	√	
15	Pavement Marking			√	√	√		
16	Road Gradient					√		√
17	Horizontal Curvature					√		√
18	Slope			√	√			
19	Pedestrian Crossing Bridge			√	√	√		
20	Retaining Wall			√	√			
21	Road Lighting			√	√	√		
22	Roadside Plantation			√	√			√
23	Guard Fence			√	√	√		
24	Disaster Response Storage Warehouse			√	√	√		
25	Median Strip			√	√	√		
26	Road Sign			√	√	√		
27	Kilo Post			√	√	√		
28	Noise Barrier			√	√	√		
29	Shade Fence			√	√	√		

1.5.2 File Naming

1) Inventory Data

Database		Data Type		Data Source		Stage of Data		Asset Name		RRMB Number		Province Name		Data Version	.xlsx
DB	_	RA	_	DRVN	_	OR	_	AssetName	_	RRMB-X	_	Province Name	_	Year	.xlsx
Example (Asset Data): DB_RA_DRVN_OR_Pavement_RRMB-I_Hanoi_2013.xlsx															
DB	_	MH	_	DRVN	_	OR	_			RRMBX	_	Province Name	_	Year	.xlsx
Example (Maintenance History) : DB_MH_DRVN_OR_RRMB-I_Hanoi_2013.xlsx															

2) Photos and Videos

RRMB Code		Road Name		Province Code		Asset Name		Section Chainage[1]	Lane Type		Data Version		Multiple Photo/ Video	File Extension
RRMB-I	_	QL.1A	_	Hanoi	_	RoadMain Details	_	35+000	Up	_	2013	_	(1)	.jpg .pdf .avi .mp4 .3gp .mkv .flv .mpg
Example: RRMB-I_QL.1A_Hanoi_RoadMainDetails_35+000_Up_2013(1).jpg Example: RRMB-I_QL.1A_Hanoi_RoadMainDetails_35+000_Up_2013(2).jpg														

3) Drawings

RRMB Code		Road Name		Province Code		Asset Name		Section Chainage[2]	Lane Type		Year		Multiple Drawings	File Extension
RRMB-I	_	QL.1A	_	Hanoi	_	RoadMain Details	_	35+000	Up	_	2013	_	(1)	.dwg .pdf .jpg
Example: RRMB-I_QL.1A_Hanoi_RoadMainDetails_35+000_Up_2013(1).dwg Example: RRMB-I_QL.1A_Hanoi_RoadMainDetails_35+000_Up_2013(2).dwg														

[1] Starting chainage in case of sectional (interval) data

[2] Starting chainage in case of sectional (interval) data

CHAPTER 2 INSTALLATION OF SOFTWARE AND ENVIRONMENT SETTING

2.1 SYSTEM REQUIREMENT

If Microsoft Office 2007 or later version of MS-Office is installed in the computer, there is no other specific requirement to install the Road Database system provided that sufficient free space is available in the computer to store the data. The volume of data in RRMB and RRMB level is relatively small in comparison with DRVN level (central database). Since DRVN receives data from all RRMBs, relatively a large free space is needed to store the data at central database system. The complete installation package is approximately 100MB. However, actual free space required for data inputting and storing depends on volume of data (i.e. inventory, drawings and photo & video) to be inputted. **It is recommended to allocate at least 1GB free space for the Road Database at the time of the Road Database system installation.**

If it is preferable to save database in portable / external hard disk or flash memory, it is also possible. Since photos and drawings can also be saved in PDF format, it is necessary to install at least Acrobat Reader to open PDF files.

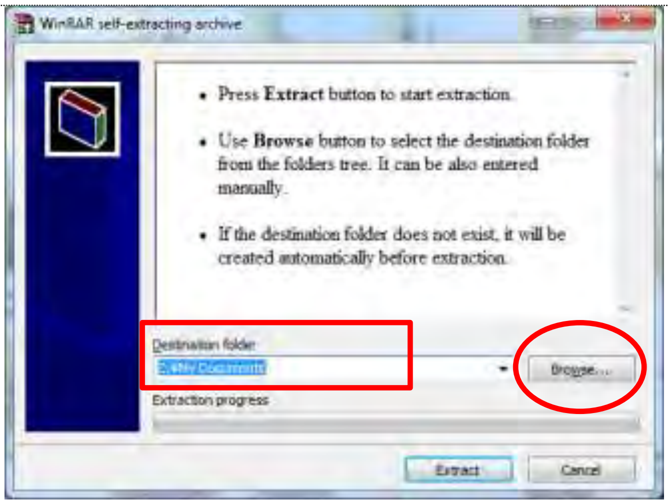
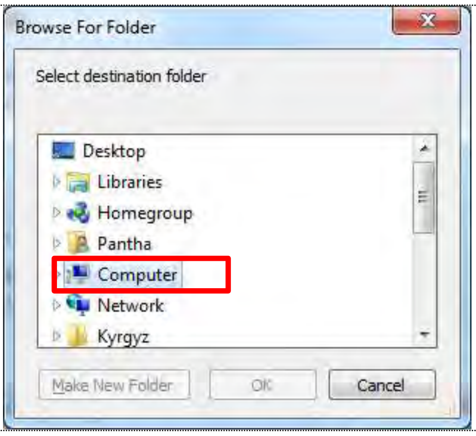
Table 2.1.1 Road Database System Requirements

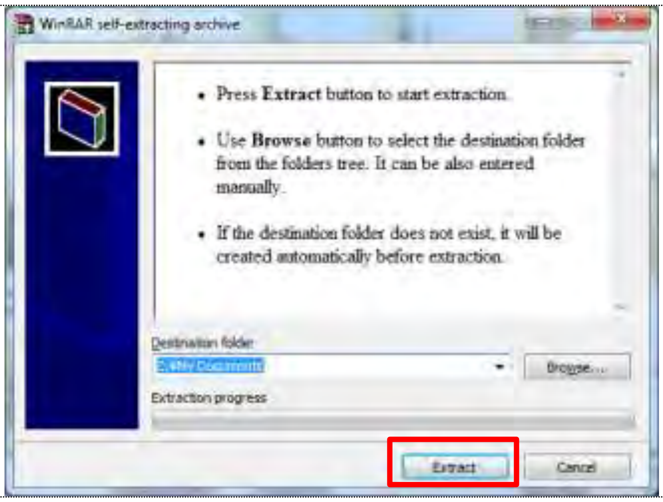
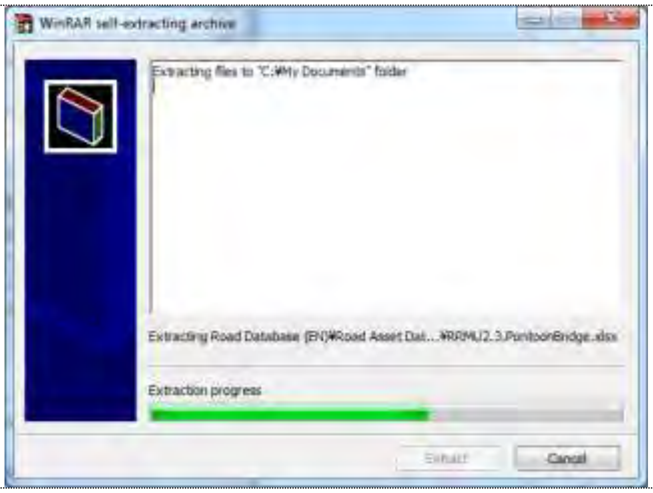
System Requirements	Description
Operation System	Windows XP or later version of Windows (32 bit and 64 bit).
Microsoft Office	The system shall run in MS-Excel installed computer. Considering the data volume, future expansion of database and maximum utilization of MS-Excel functions including VBA-Excel, MS-Excel 2007 or later version of MS-Excel shall be installed in the computers. Excel Macro shall be enabled while working on the database system.
Anti-virus software	It is recommended to install anti-virus software in the computers where this database system is installed to protect from harmful computer viruses. Any functions of the database system shall not be disabled /interrupted by anti-virus software or firewall securities either fully or partially.
System Operation	The system shall be operable by officers of DRVN, RRMU and RRMC administration and engineering staff. The system shall be simple and necessary manuals shall be provided with sufficient explanation.
System Flexibility	The system shall be a flexible which supports future system upgrade and system expansion. The system upgrade and expansion need to be manageable by DRVN. Only for critical technical problems, technical supports from IT specialized agencies such as UTC, RTCs, and private IT companies shall be taken.
Collaboration with DRVN during System Development	The system development is carried out in close collaboration with DRVN and JICA Project Team by taking account of effective technology transfer (capacity enhancement in database development and management), system sustainability, etc.

2.2 INSTALLATION OF ROAD DATABASE

The main folder "Road Database" shall be installed / copied either in C: / drive or My Documents or any places including USB flash memory and external hard disk. In principle, there is no problem in installing / copying in any locations including portable devices such as portable external hard disk and USB flash memory however **it is strongly recommended to install / copy the Road Database system in internal hard disk.** A complete package of the Road Database installation file is provided in .exe file format. The Road Database folder may also be copied directly (i.e. without .zip or .exe file) but it is highly recommended to use .exe file while installing / copying the Road Database because it includes complete set of files and folders in proper order.

Table 2.2.1 Road Database System Installation Steps

<table>
<tr><td>
</td><td>1) Double click “Road Database.exe” file icon to start installation.</td></tr>
<tr><td>
</td><td>2) Click “Run” button to continue installation.</td></tr>
<tr><td>
</td><td>3) Click “Browse” button to select destination folder / location from the floders tree for the installation of the Road Database system.</td></tr>
<tr><td>
</td><td>4) Select the destination folder / location for the installation of the Road Database system.</td></tr>
</table>

<table>
<tr><td>
</td><td>5) After defining destination folder/location, Click “Extract” button to start extraction / installation.</td></tr>
<tr><td>
</td><td>6) Wait until extraction / installation complete.</td></tr>
<tr><td></td><td>7) After extraction / installation work complete, “Road Database” folder appears in destination folder / location.</td></tr>
</table>

The Road Database system consists of several folders and sub-folders as shown in **Figure 2.2.1**. In the main Road Database Folder, there are two (2) broad folders and Road Database System file (system interface file). Under “Road Asset Database”, there are twenty five (25) folders; (0) Road Main Details and from (1) to (24) are by province name and under each province there are four (4) sub-folders, namely “xx.1 Road Asset Data”, “xx.2 Pavement Condition Data”, “xx.3 Repair History Data” and “xx.4 Traffic Volume Data”. Similarly, under “xx.1 Road Asset Data”, there are 28 sub-folders by name of data type. Under each data type, there are three (3) sub-folders, namely “Inventory Data”, “Drawings” and “Photos”. The details of folders and sub-folders are shown in **Figure 2.2.1**.

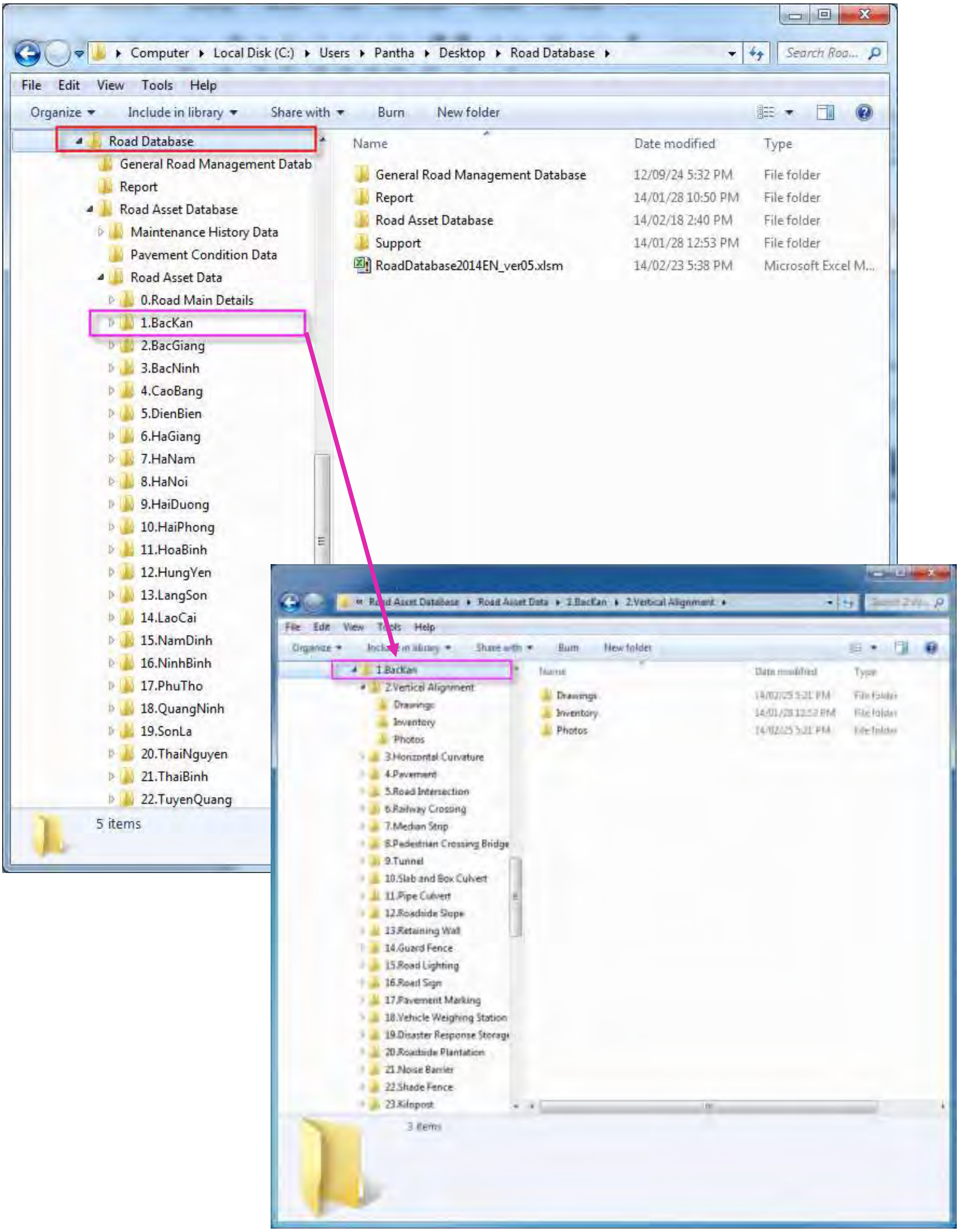


Figure 2.2.1 Folder Tree in Road Database Folder

2.3 PROGRAMMING LANGUAGE / VERSION OF MS-EXCEL

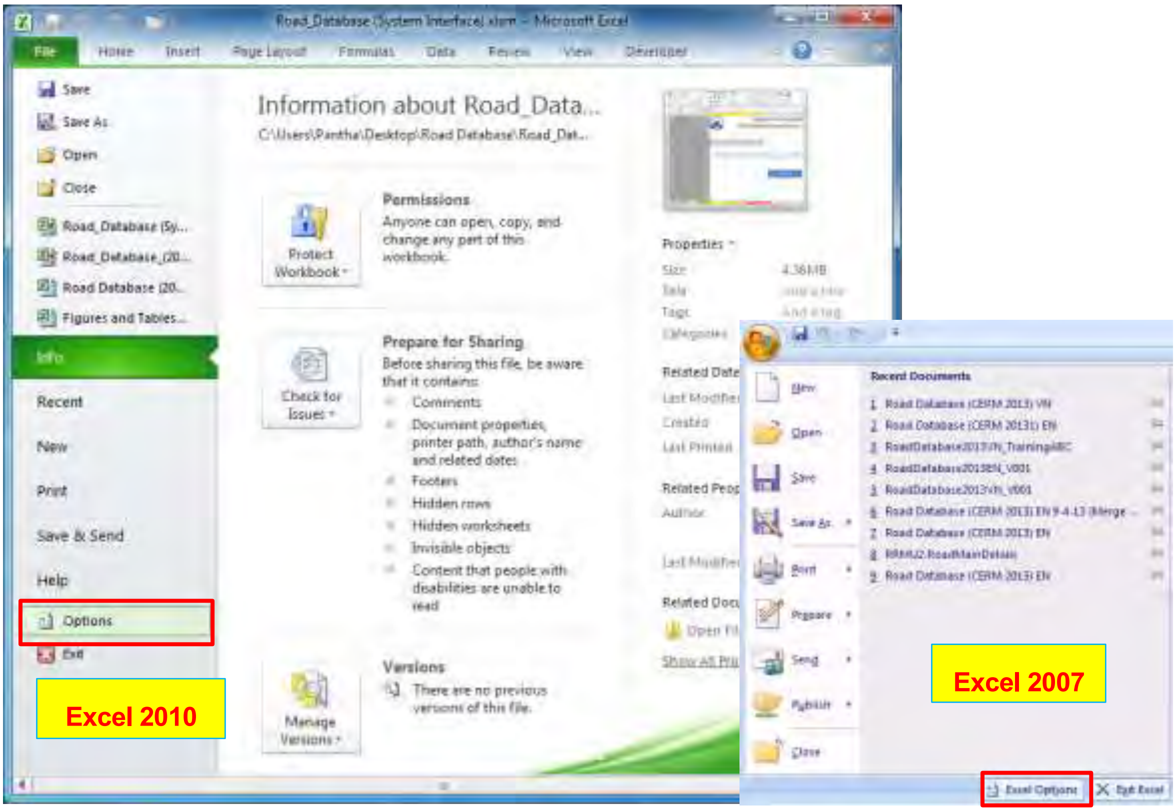
Database system has been developed in MS-Excel platform using Excel Visual Basic Application (hereinafter referred to as "Excel VBA"). Only Excel VBA programming language has been used while inserting various functions. Also, some built-in tools / functions of MS-Excel are used. Therefore, i**t is necessary to enable macro in the Road Database system file (interface file) for data inputting, displaying, editing and updating of the database to ensure that all functions are working properly.** Enabling macro in MS-Excel 2010 and MS-Excel 2007 is slightly different. Procedure of enabling macro in different version of MS-Excel is explained in **section 2.3.1** and **2.3.2**.

2.3.1 Enabling Macro in Microsoft Excel 2007 and 2010

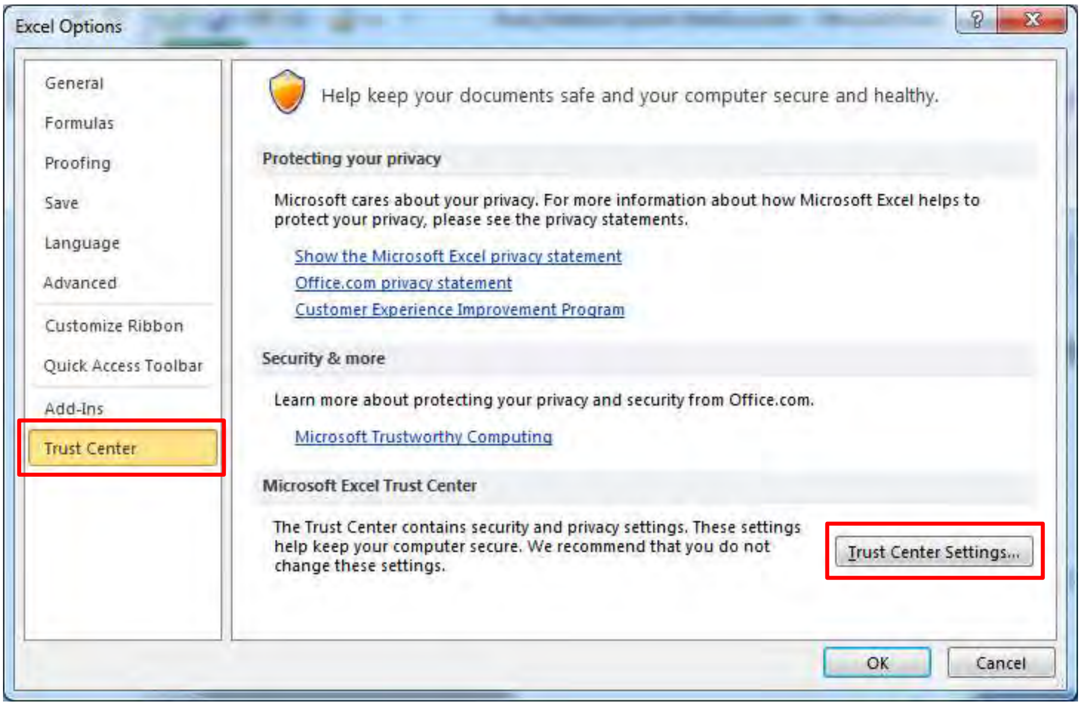
In Microsoft Excel 2007 and 2010, macro can be enabled by two ways;

(1) Using Microsoft Excel's "Options" Setting Option

(1) Click the Microsoft Office Button, and then click **Options**.

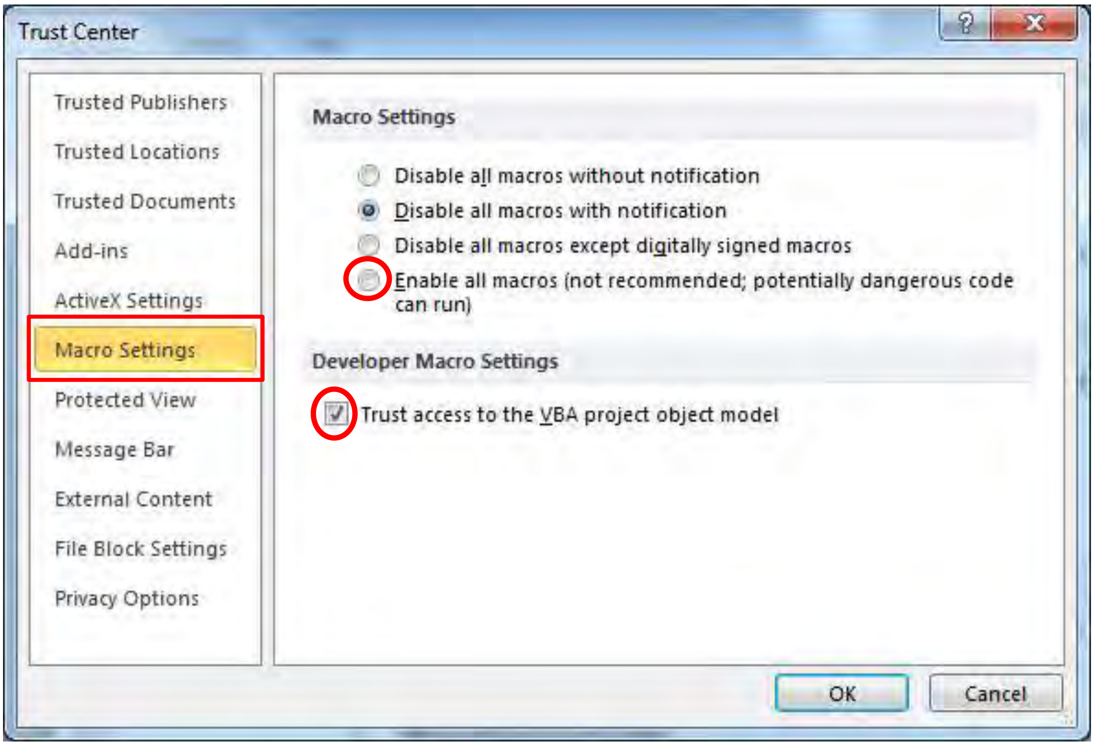


(2) Click **Trust Center** and Click **Trust Center Settings**.



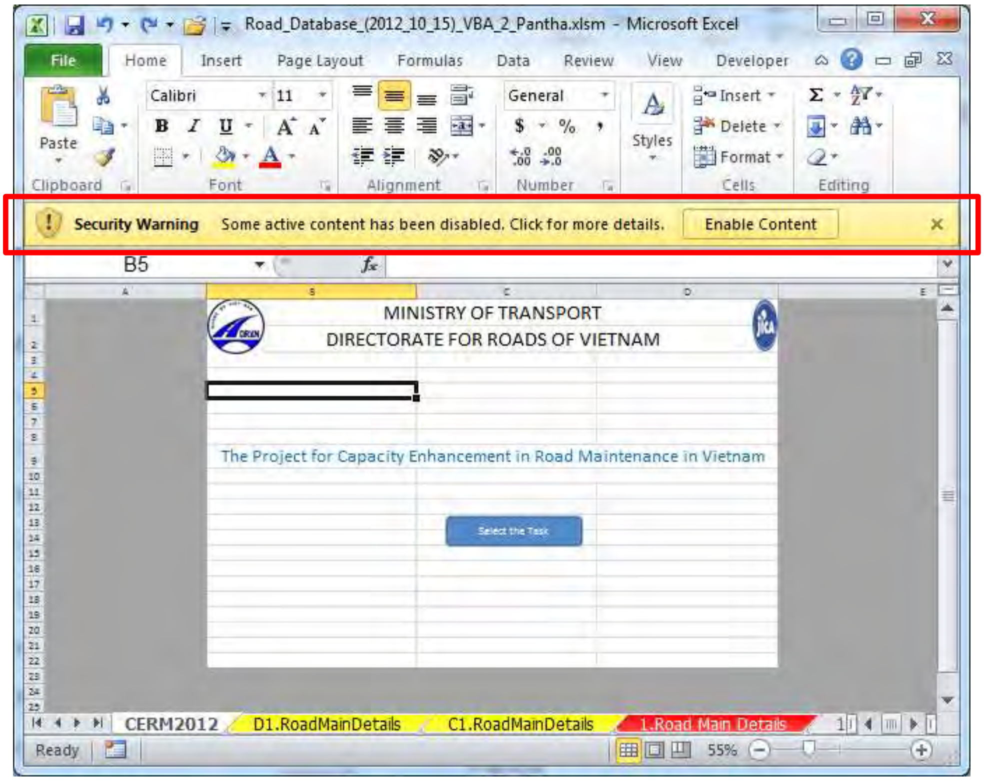
(3) Click **Macro Settings**. Click the options that you want:

- Disable all macros without notification.
- Disable all macros with notification (**Recommended**).
- Disable all macros except digitally signed macros.
- Enable all macros (not recommended, potentially dangerous code can run).
- Click **Trust access to the VBA project object model**.



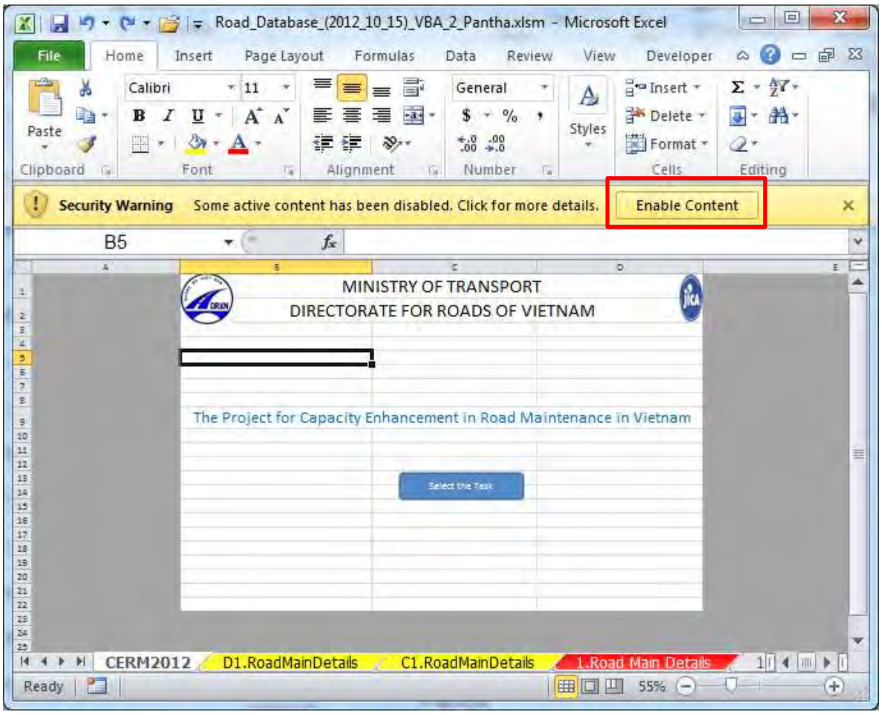
(2) Following "Security Warning" Alerts

If system interface file is opened without enabling macro, "**Security Warning**" will appear with the following message.

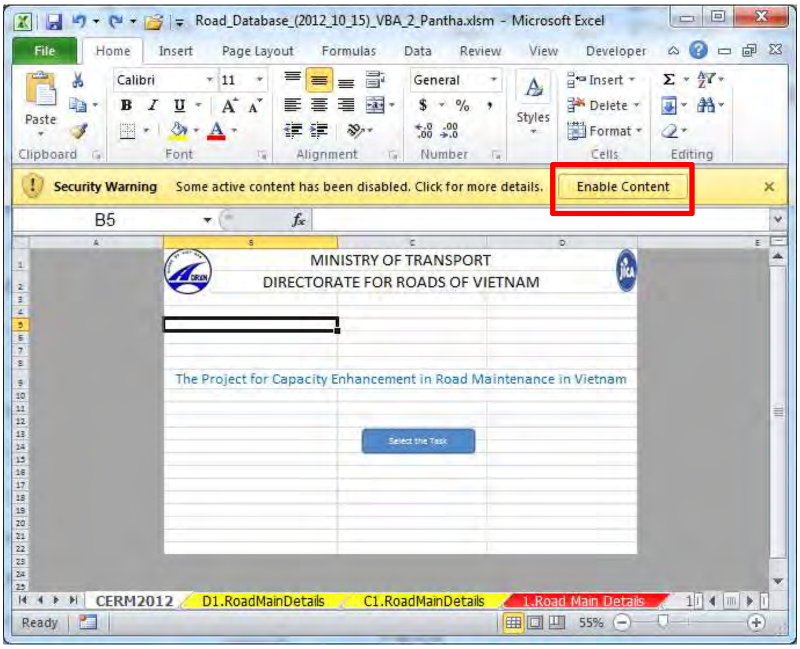


In this case, macro can be enabled by two ways;

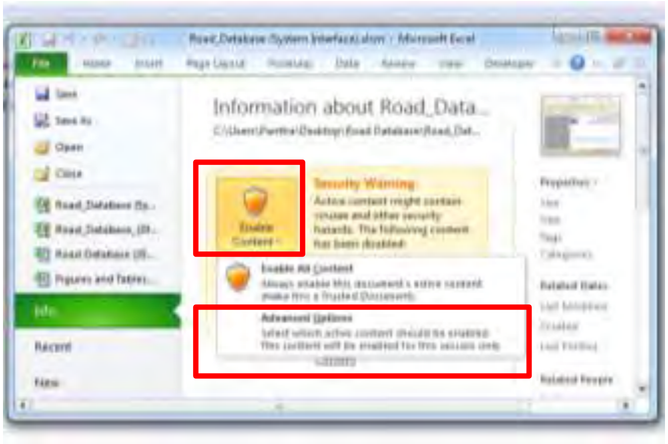
(1) Click **Enable Content** appeared at the warning message bar.



(2) Click **Click for more details** in the error message bar.



(3) Click **Enable Content** and then click **Advanced Options.**



(4) Click option **Enable content for this session**.

2.3.2 Bypassing Scanning of Encrypted Macro Content (Applicable for only MS-Office 2007, SP1)

If MS-Excel sheet / workbook is protected by password, macro may not run as expected in MS-Office 2007 with Service Pack 1 (SP1). To run the system without any unexpected trouble, it is recommended to install MS-Office 2007 Service Pack 2 (SP2) or later version or change the registry setting of MS-Excel to ignore scanning of password protected macro program.

To resolve this problem, following two methods can be applied as described below.

i) Installation of The 2007 Microsoft Office Suite Service Pack 2 (SP2) or later version

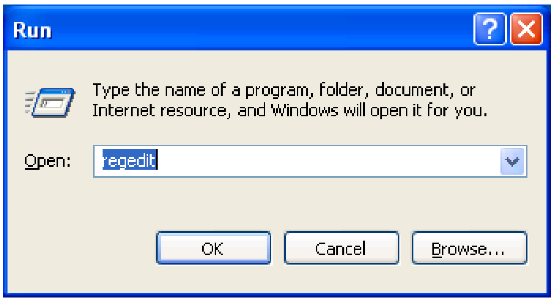
- ✓ Download The 2007 Microsoft Office Suite Service Pack 2 (SP2) or later version from the Microsoft download center at http://www.microsoft.com/en-us/download/details.aspx?id=5

- ✓ Install MS-Office Service Pack 2 (SP2) in the computer by double clicking installation file 

and follow the steps as directed by the installation process.

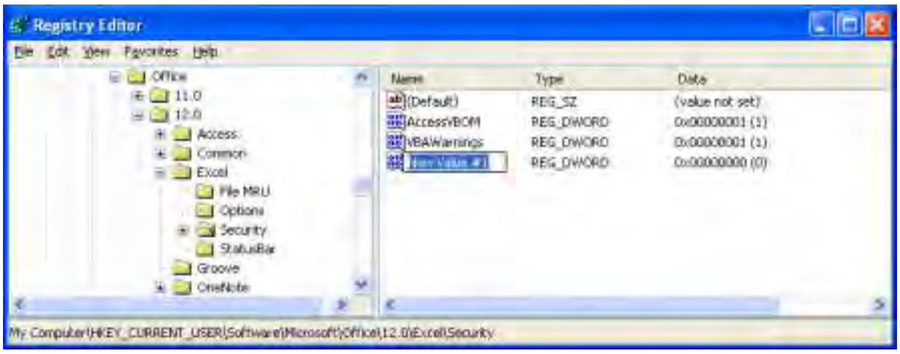
ii) Security Setting of MS-Excel 2007

- ✓ Click **Start**, click **Run**, Type **regedit**, and the click **OK**

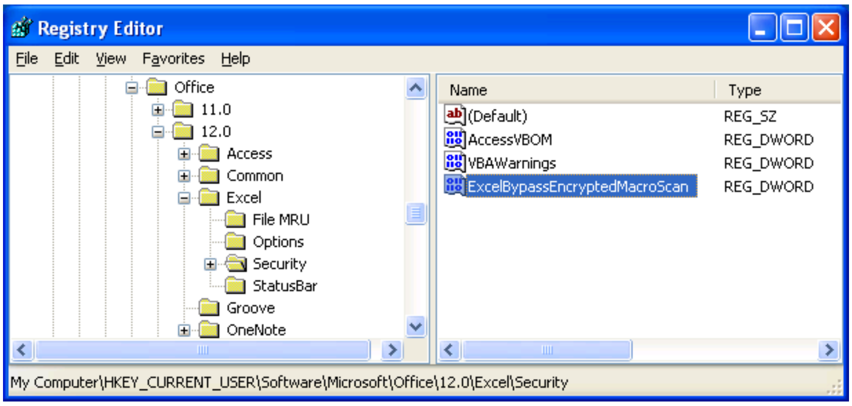


- ✓ Locate and then click registry subkey as HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Excel\Security
- ✓ Right click to **Security**, then click **New** and then click **DWORD Value**

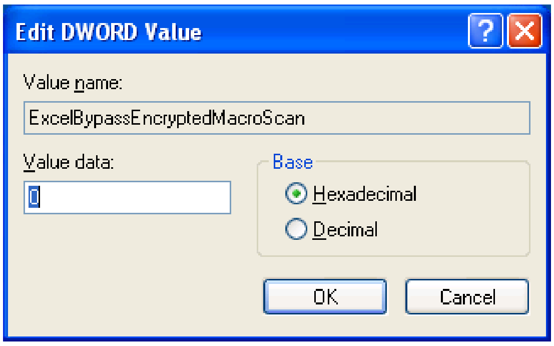
✓ New file will create with file name New Value #1 as shown below



✓ Replace New Value #1 by **ExcelBypassEncryptedMacroScan** in file name



✓ Double click **ExcelBypassEncryptedMacroScan** and type 1 in value data and click **OK**

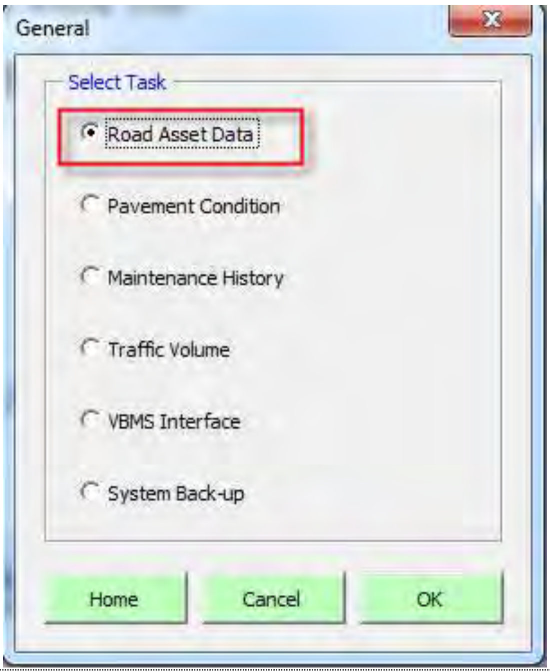


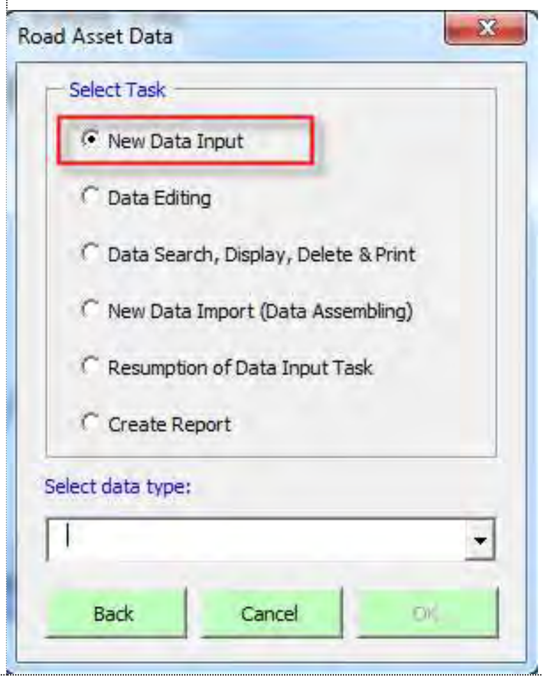
CHAPTER 3 BASIC FUNCTIONS

3.1 MAIN FUNCTIONS

3.1.1 New Data Input

New data input function is provided in Data Input Sheet in MS-Excel platform with embedded Excel VBA. Road asset and maintenance history data to be stored in the Road Database system shall be inputted in data input sheet. Without inputting inventory data (of road asset and maintenance history), photos and drawings cannot be inputted in the Road Database system. However, photos and drawings are not mandatory always like inventory / asset data (i.e. only available photos and drawings can be inputted). Data storing / saving function for inventory / asset data, drawing and photo is provided to save data in inventory folder (as pivot table), drawing folder and photo folder respectively.



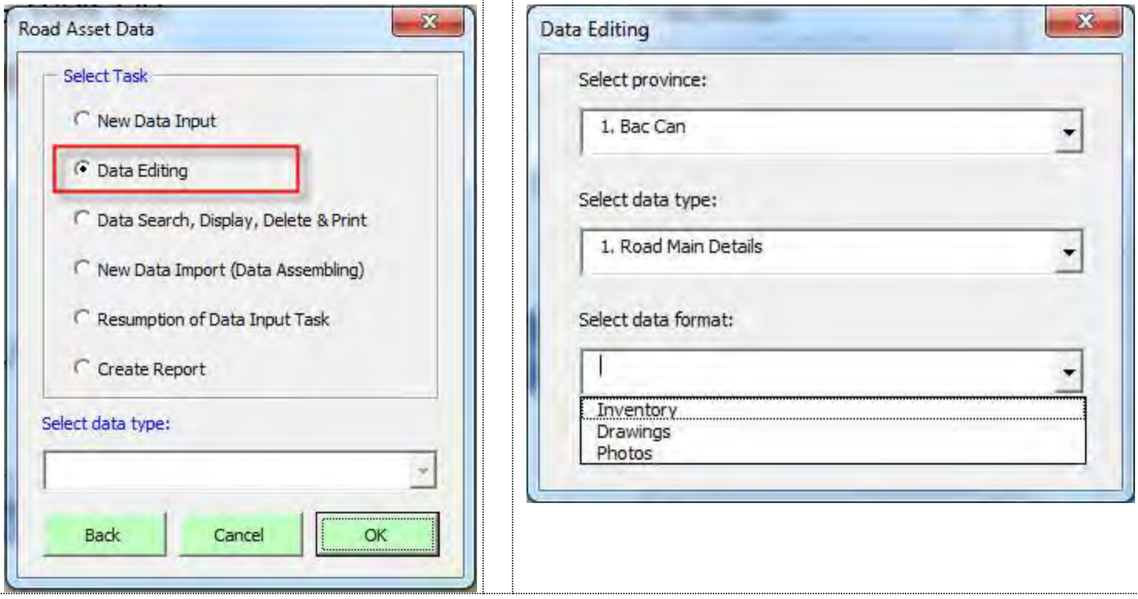


Note: *For inputting maintenance history data, user shall enter through maintenace history from the general window.*

Figure 3.1.1 New Data Input

3.1.2 Data Editing and Updating

Data editing and updating function is provided to amend the stored data whenever necessary. During data editing and updating, data editing and updating work shall pass through data validation check also. If necessary, adjustments in adjacent sections should also carry out whenever the data editing and updating work is performed.



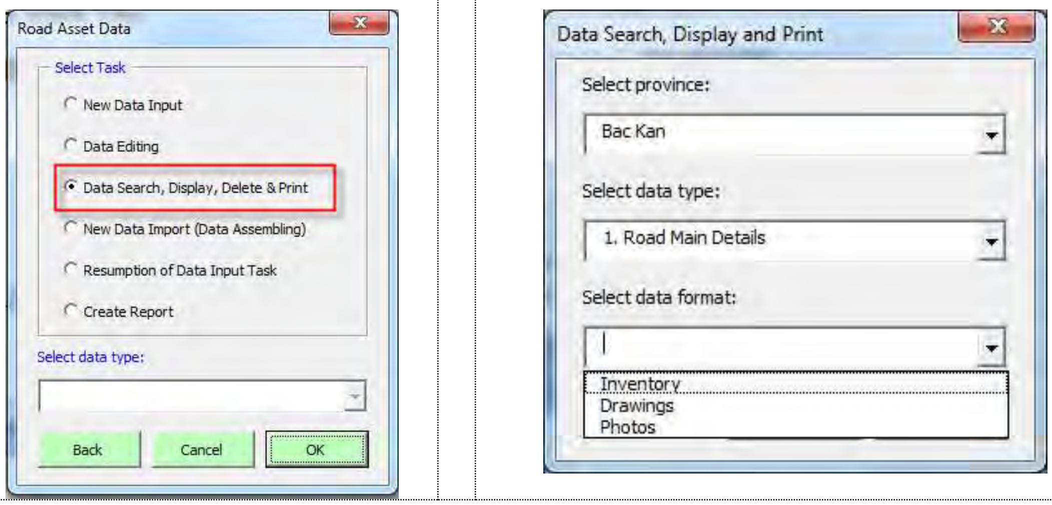
***Note**: For editing maintenance history data, user shall enter through maintenace history from the general window.*

Figure 3.1.2 Data Editing and Updating

3.1.3 Data Search, Display, Delete and Print

Data search and display function is provided in the Road Database system. Firstly, data is searched and listed up. Upon displaying the results of search operation, stored data can be displayed in details. Also, data will be displayed before converting data from input sheet into pivot table to reconfirm the entered data.

If some of the data need to be deleted from the database system, this function can also be used. The intended data can be printed out from display mode as necessary by setting page setup and printer. As a default setting, a default printer is activated and page set up is automatically selected either A4 or A3.

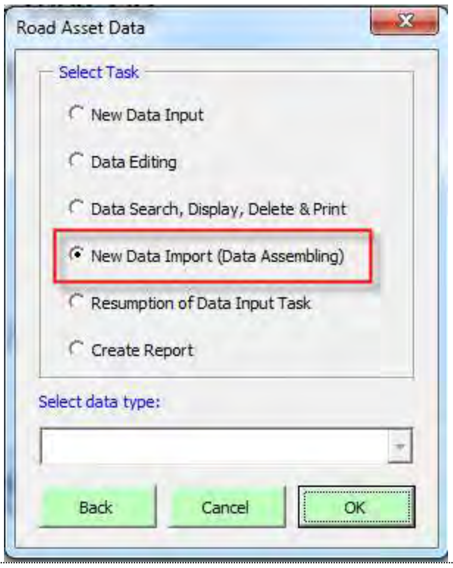


***Note**: For data search, display, delete and printing maintenance history data, user shall enter through maintenace history from the general window.*

Figure 3.1.3 Data Search, Display and Print

3.1.4 New Data Import (Data Assembling)

New data import function is provided specially for RRMB and DRVN to assemble data in a single database system. It is necessary for regional (i.e. at RRMB) and central (i.e. at DRVN) data collection. RRMBB collects data from various RRMS-Bs and DRVN collects data from all RRMBs.

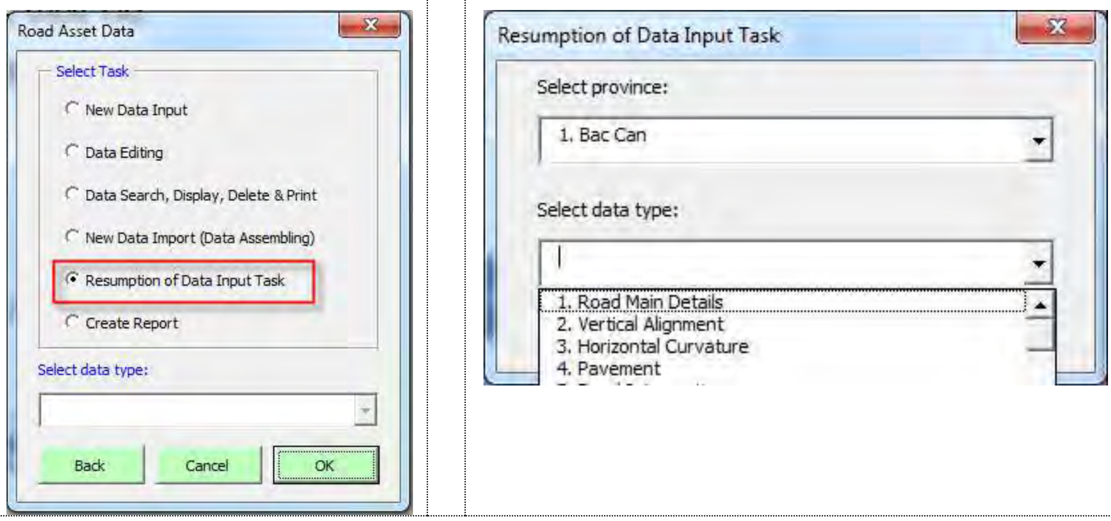


Note*: For data assembling of maintenance history data, user shall enter through maintenace history from the general window.*

Figure 3.1.4 New Data Import

3.1.5 Resumption of Data Input Work

This function is provided for resuming the data input work if any of the data inputting work is temporarily saved without performing data validation check. This function is specially provided by taking into consideration of possibility of not completing the data inputting work from start to the end, particularly when data inputting work is paused / halted before performing data validation check. This function extracts temporarily saved data into input sheet and follows same procedure as in ordinary case of new data input work.

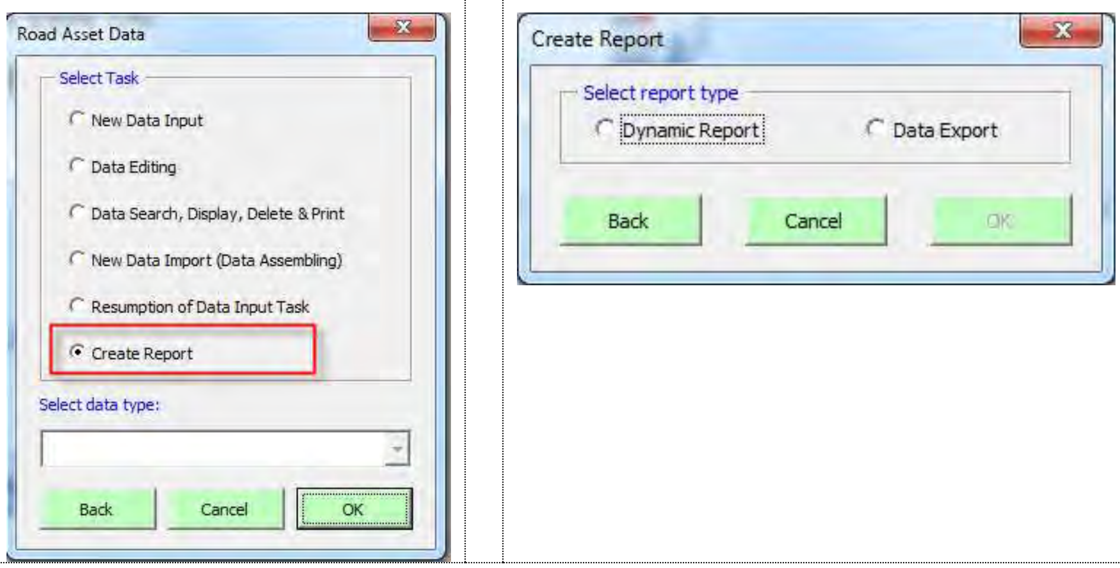


Note: *For resumption of data input task of maintenance history data, user shall enter through maintenace history from the general window.*

Figure 3.1.5 Resumption of Data Input Work

3.1.6 Create Report

This function is provided to create a report required for DRVN for their reporting and management purpose. This function generates the dynamic report in the users' desired format. The system searches the related data from the database and creates the dynamic report. User can customize or design the final desired format using functions of MS-Excel. In addition to the dynamic report, this function can also export the selected data stored in the database.



Note: *For createing report of maintenance history data, user shall enter through maintenace history from the general window.*

Figure 3.1.6 Create Report

3.2 FUNCTIONS IN DATA INPUT SHEET

3.2.1 Data Input Control

To avoid data input error, data input control functions are inserted using MS-Excel's available tools and Excel VBA. As shown in **Figure 3.2.1**, only yellow color cells are allocated for data input. Except yellow color cells, all cells are locked with password. Therefore, data can be inputted only in yellow color cells. Also, wherever possible, data are coded and selection option is provided with drop down list / combo-box. A provision of displaying error / caution message is provided if attempt is made to input data wrongly or in different format. In those cells where dropdown list are inserted, information shall be selected from within the list. Any attempts to inputting new information except listed-up in dropdown list, cause error message. Data items which can be computed internally based on inputted data, formulas have been inserted in those cells. Also, prevailing Vietnamese standards and regulation such as geometric design guide, pavement design and other standards for road facilities have been incorporated as much as possible.

Moreover, general information data are inputted from the common platform because some of the information are fixed and shall be common to all types of data. Management agencies, road names, province etc. are common to all types of data and thus such information are inputted from general information inputting sheet.

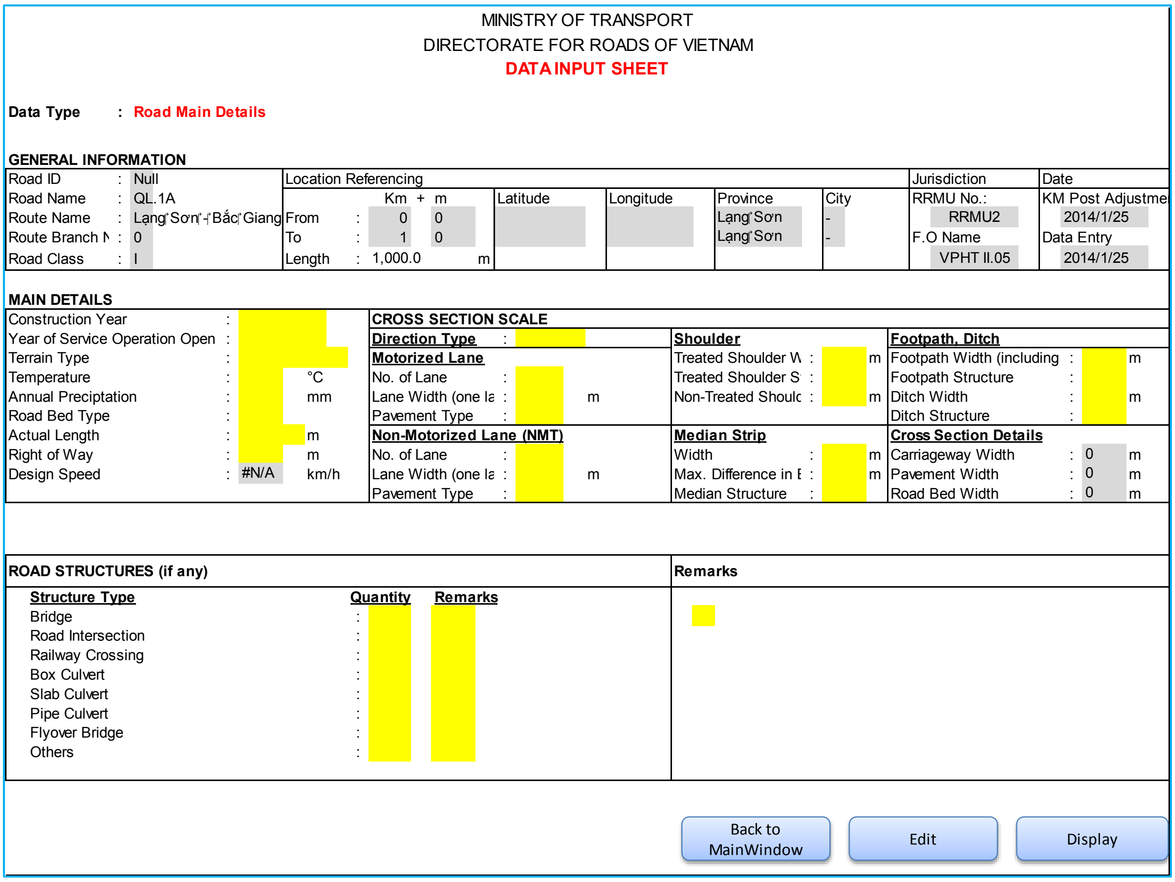


Figure 3.2.1 Data Input Sheet

3.2.2 Data Displaying Before Pivoting

Before proceeding to validation check, entered data are displayed as shown in **Figure 3.2.2** for reconfirmation of inputted data. In a quick review, if any of the inputted data are found wrong or missing, data inputting work can be returned back to main data input sheet and necessary modification can be made. Modification on display mode is not allowed.

MINISTRY OF TRANSPORT

DIRECTORATE FOR ROADS OF VIETNAM

DATA CONFIRMATION

Data Type : **Road Main Details**

SN	Item		Sub-Item	Unit	Value	Remarks
1.1	**General Information**		Road ID			
			Road Name		QL.1A	
			Route Name		Hà Nội - Hà Nam	
			Route Branch No.		0	
			Road Class		III	
		Jurisdisction	RRMU No.		RRMU-2	
			RRMC No.		RRMC234	
		KM Post	From	km	3	
				m	100	
			To	km	4	
				m	100	
		From	Latitude		200000	
			Longitude		1000000	
		To	Latitude		200000	
			Longitude		1000000	
		From	Province		Bac Can	
			City		x	
		To	Province		Bac Giang	
			City		x	
		Date	Kilopost Update	YY	4/2/2013	
			Data Entry	YY	4/2/2013	
		Length		m	1000	
		Actual Length		km	1000	
1.2	**Main Details**		Construction Completion Year	YY	11/11/1990	
			Year of Service Operation Open	YY	12/12/1990	
			Terrain Type		1	
			Temperature	°C	25	
			Annual Preciptation	mm	80	
			Road Bed Type		1	
			Design Speed	km/h	60	
		Roadway Lane Details	Lane Type		Down	
			Right of Way	m	15	
			Carriageway Width	m	7	
			Pavement Width	m	9	
		Motorized Lane	No. of Lane		2	
			Width of Lane	m	3	
			Pavement Type		3	
		Non-Motorized Lane	No. of Lane		1	
			Width of Lane	m	2	
			Pavement Type		1	
	Shoulder	Left Side	Width	m	1	
			Type (Pavement)		6	
		Right Side	Width	m	1	
			Type (Pavement)		5	
	Footpath	Left-side	Width	m	1	
			Type (Pavement)		5	
		Right Side	Width	m	1	
			Type (Pavement)		4	
	Road Structures	Structures (I)	Structure Type		1	
			Start Point	km	50000	
				m		
			End Point	km		
				m	50200	
			Center Point	km		
				m	50100	
			Location Name		HN	
1.3	**Remarks**					

Back to Select Data | Print | Edit | Check Validity

Figure 3.2.2 Data Display

3.2.3 Temporary Saving of Inputted Data

Temporary saving function is provided to save inputted data temporarily before performing data validation check. Therefore, a window before entering into validation check as shown below is appeared to confirm whether to perform validation check now. If "No" button is pressed, the system prompts the message "Do you want to save inputted data temporally" to let user to decide whether inputted data needs to be saved. If "Yes" button is clicked, the system will save the inputted data temporarily within the interface system file automatically in the pivot table format.

Figure 3.2.3 Temporary Saving of Inputted Data

3.2.4 Data Validation Check

Data validation check function is provided to check inputted data thoroughly with the set criteria. Validation check function for checking items such as section overlap, data range, blank data and data format type (number & text) are provided. Validation check starts from checking section overlap. If validation check identifies the section overlap, checking of other check items are stopped and the process is backed to data input sheet automatically for necessary alteration in designated section. Section overlap is not allowed in any case. The result of validation check will be displayed and check-boxes for declaration of validity results (except for section overlap) whether to stop data pivoting based on validation result of a particular validation check item or converting data to pivot table by ignoring that particular validation check result. This declaration option is necessary to allow database operator for saving data even if all validation criteria do not meet. **However, it is highly recommended to input data and pass all validation check items successfully**. This option is included by considering the possibility of occurrence of blank data for some data items because some information / documents might have already lost.

3.3 ADDITIONAL FUNCTIONS

3.3.1 Interface for VBMS

Interface for VBMS is provided to link the Road Database system and VBMS system. The current VBMS interface needs to login manually by inputting VBMS user ID and Password issued by VBMS team because automatic login is not allowed because of internet security system of VBMS. VBMS system stores bridge data in four modules and this interface is designed to import bridge inventory data only from the inventory module of VBMS system into the Road Database system.

Since VBMS has developed a more comprehensive bridge database system, the interface will directly access to VBMS website and follow the general procedure of data searching and exporting data in VBMS database. A specific port (access point) is designed in VBMS system so that data stored in inventory module can be downloaded at one-click.

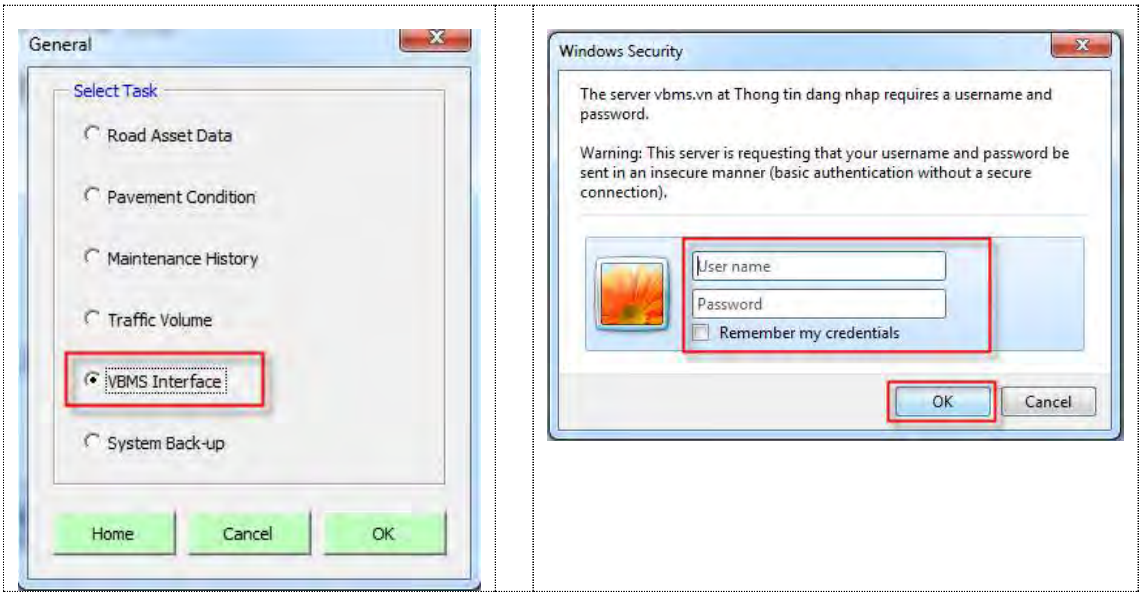


Figure 3.3.1 VBMS Interface

3.3.2 Data Back-up System

Data back-up function is provided to preserve the data and system interface from any accidental data losses or system troubles. Data back-up system stores the data in the folder defined by the user. The system will create name of system back-up folder and date automatically.

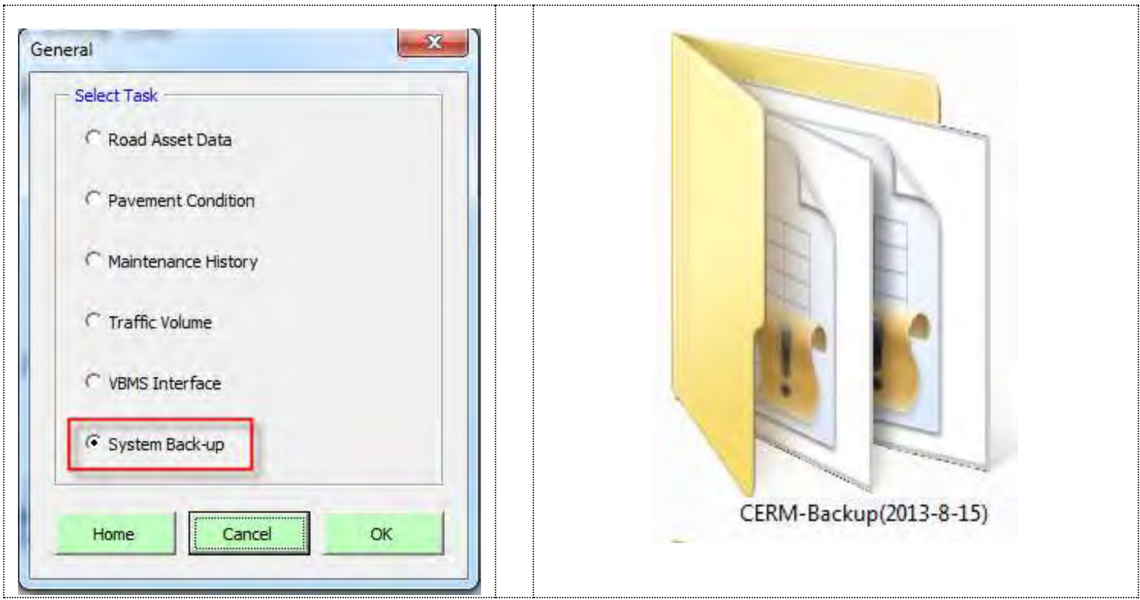
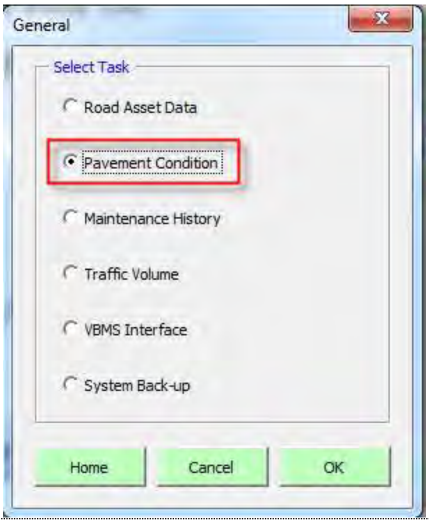


Figure 3.3.2 Data Back-up System

3.3.3 Access to Pavement Condition Data

This function is provided to access the pavement condition data stored in the road database. Since pavement condition data are (to be) collected by special survey team using vehicle and analysis software, it is not necessary to input data using data input sheet. Therefore, the final product (i.e. data) of the survey team can be saved directly in the pavement condition folder provided in the road database structure. Therefore, pavement condition data can be accessed by clicking the "Pavement Condition" button. Also, main details of pavement condition data which is necessary for creating PMS and PMoS dataset are prepared using this function.



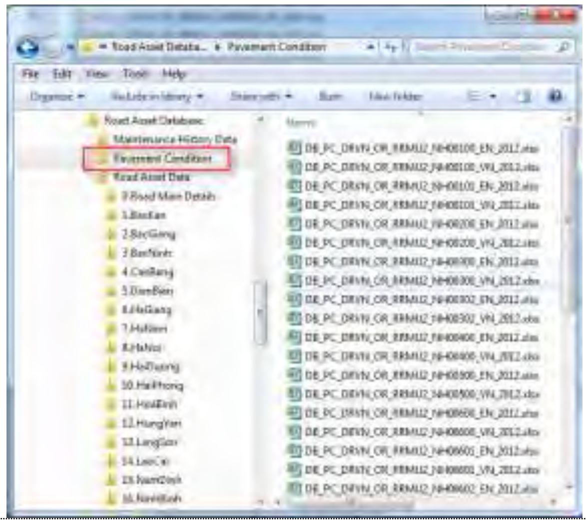
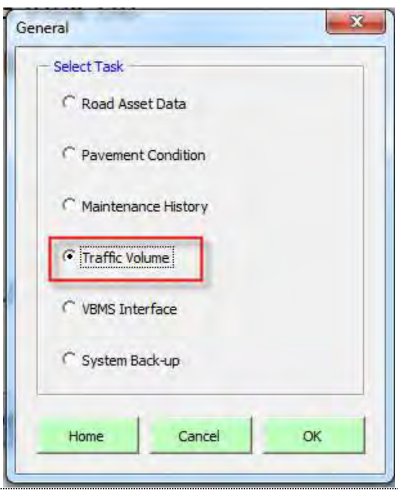


Figure 3.3.3 Pavement Condition Data

3.3.4 Access to Traffic Volume Data

This function is provided to access traffic volume data stored in the road database. Since DRVN is collecting traffic volume data regularly and processed in the specified format, it is not necessary to input data using data input sheet separately by using road database system (i.e. current DRVN practice and method will be continued). Traffic volume data can be saved directly in the traffic volume folder provided in the road database structure. Traffic volume data can be accessed by clicking the "Traffic Volume" button. Also, main details of traffic volume data which is necessary for creating PMS and PMoS dataset are prepared using this function.



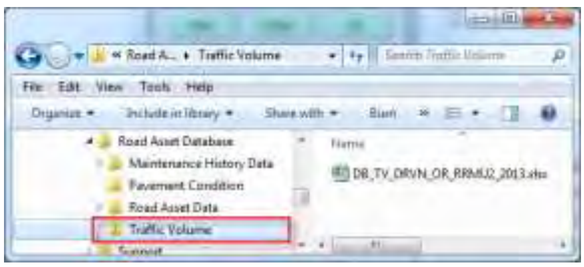


Figure 3.3.4 Traffic Volume Data

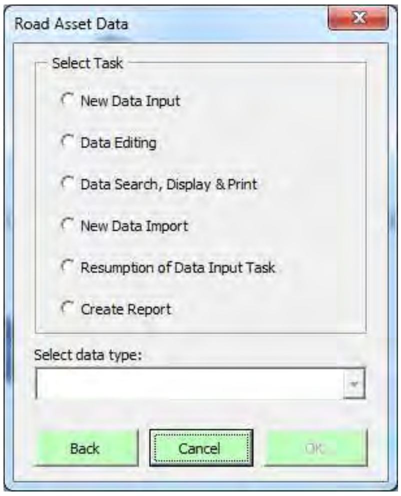
CHAPTER 4 OPERATION OF ROAD DATABASE

4.1 NEW DATA INPUT

4.1.1 Data Input

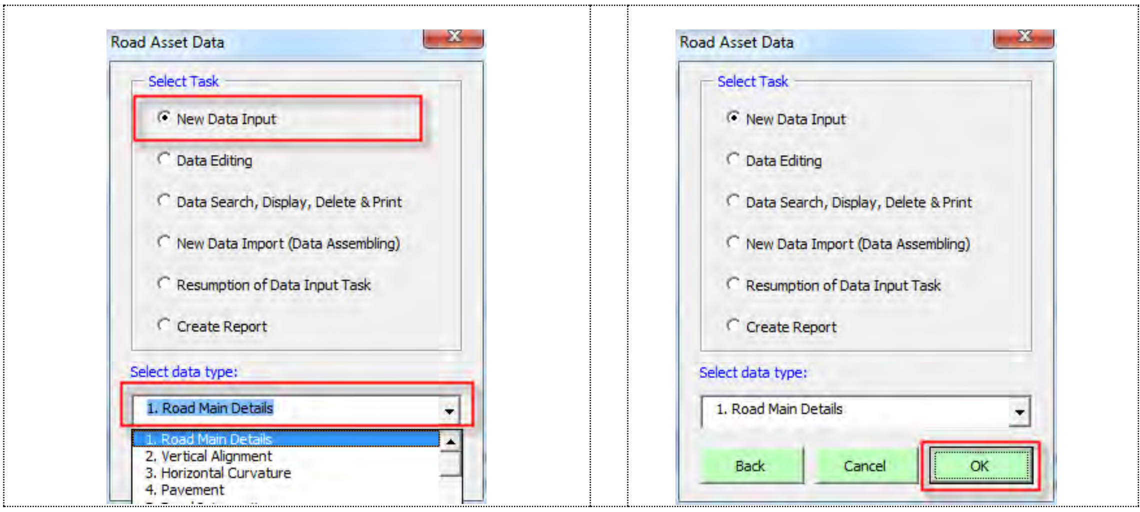
(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shwon.

(2) Click "**Select the Task**". General window is appeared. Required task can be selected from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to the respective data type as shwon below.

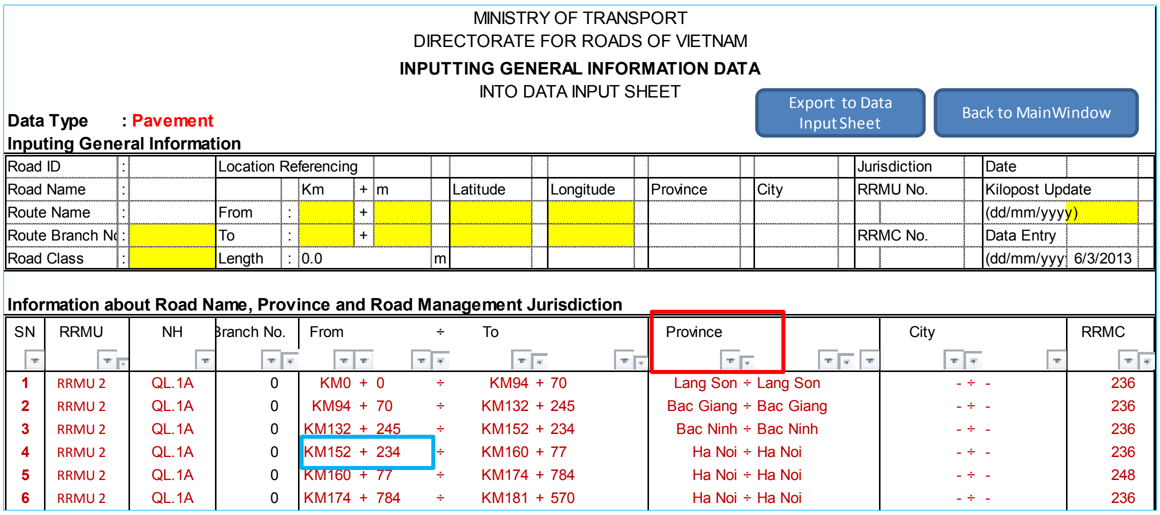


***Note**: For inputting maintenance history data, user shall enter through maintenace history from the general window.*

(3) Select "**New Data Input**" and Click "**OK**". To terminate / exit from the data inputting work, click "**Cancel**".



(4) After selecting data type from select data type combo-box and clicking "OK", General Information Inputting Sheet will appear as shown below


MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
INPUTTING GENERAL INFORMATION DATA
INTO DATA INPUT SHEET

Export to Data Input Sheet | Back to MainWindow

Data Type : Pavement

Inputing General Information

Road ID	:	Location Referencing								Jurisdiction	Date
Road Name	:		Km	+	m	Latitude	Longitude	Province	City	RRMU No.	Kilopost Update
Route Name	:	From	:	+							(dd/mm/yyyy)
Route Branch No	:	To	:	+						RRMC No.	Data Entry
Road Class	:	Length	: 0.0		m						(dd/mm/yyyy) 6/3/2013

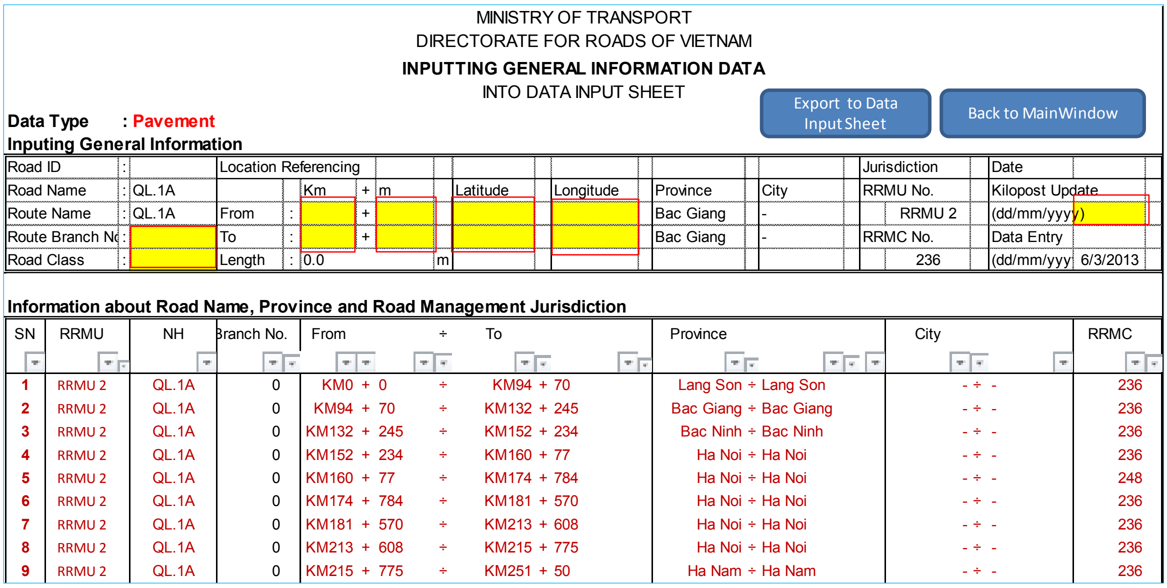
Information about Road Name, Province and Road Management Jurisdiction

SN	RRMU	NH	Branch No.	From	÷	To	Province	City	RRMC
1	RRMU 2	QL.1A	0	KM0 + 0	÷	KM94 + 70	Lang Son ÷ Lang Son	- ÷ -	236
2	RRMU 2	QL.1A	0	KM94 + 70	÷	KM132 + 245	Bac Giang ÷ Bac Giang	- ÷ -	236
3	RRMU 2	QL.1A	0	KM132 + 245	÷	KM152 + 234	Bac Ninh ÷ Bac Ninh	- ÷ -	236
4	RRMU 2	QL.1A	0	KM152 + 234	÷	KM160 + 77	Ha Noi ÷ Ha Noi	- ÷ -	236
5	RRMU 2	QL.1A	0	KM160 + 77	÷	KM174 + 784	Ha Noi ÷ Ha Noi	- ÷ -	248
6	RRMU 2	QL.1A	0	KM174 + 784	÷	KM181 + 570	Ha Noi ÷ Ha Noi	- ÷ -	236

(5) Customize the general information list by using filter inserted in each column (i.e. Road Name, RRMB, RRMS-B, etc.). The best preferable selection might be RRMS-B which customize the information and display only the road sections which belongs to that particular RRMS-B.

(6) Select the proper section of which section you want to input the data. Selection can be done either by selecting whole row or any one cell of the particular row. This selection extracts / exports some of the general information such as Road Name, Route Name, Province, RRMB and RRMS-B into the "Inputting General Information" table as shown below. **In this stage, the system generates the name of province based on the province name at From Station / Chainage and all necessary interactions (such as validation check and saving data) hereinafter until finishing the data input work of this particular section are done with that province only except for road main details data because road main details data are saved in a single file of all provinces regardless of province name.**

(7) Fill up other remaining data in the yellow-colored cell.



MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
INPUTTING GENERAL INFORMATION DATA
INTO DATA INPUT SHEET

Export to Data Input Sheet | Back to MainWindow

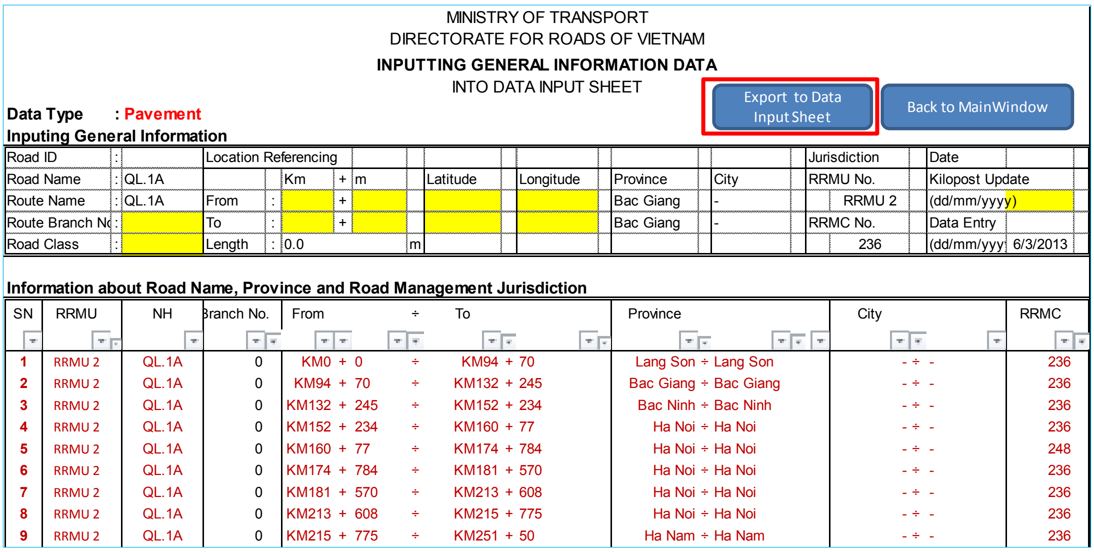
Data Type : Pavement
Inputing General Information

Road ID	:	Location Referencing							Jurisdiction	Date
Road Name	: QL.1A		Km	+ m	Latitude	Longitude	Province	City	RRMU No.	Kilopost Update
Route Name	: QL.1A	From	:	+			Bac Giang	-	RRMU 2	(dd/mm/yyyy)
Route Branch No	:	To	:	+			Bac Giang	-	RRMC No.	Data Entry
Road Class	:	Length	: 0.0	m					236	(dd/mm/yyyy 6/3/2013

Information about Road Name, Province and Road Management Jurisdiction

SN	RRMU	NH	Branch No.	From	÷	To	Province	City	RRMC
1	RRMU 2	QL.1A	0	KM0 + 0	÷	KM94 + 70	Lang Son ÷ Lang Son	- ÷ -	236
2	RRMU 2	QL.1A	0	KM94 + 70	÷	KM132 + 245	Bac Giang ÷ Bac Giang	- ÷ -	236
3	RRMU 2	QL.1A	0	KM132 + 245	÷	KM152 + 234	Bac Ninh ÷ Bac Ninh	- ÷ -	236
4	RRMU 2	QL.1A	0	KM152 + 234	÷	KM160 + 77	Ha Noi ÷ Ha Noi	- ÷ -	236
5	RRMU 2	QL.1A	0	KM160 + 77	÷	KM174 + 784	Ha Noi ÷ Ha Noi	- ÷ -	248
6	RRMU 2	QL.1A	0	KM174 + 784	÷	KM181 + 570	Ha Noi ÷ Ha Noi	- ÷ -	236
7	RRMU 2	QL.1A	0	KM181 + 570	÷	KM213 + 608	Ha Noi ÷ Ha Noi	- ÷ -	236
8	RRMU 2	QL.1A	0	KM213 + 608	÷	KM215 + 775	Ha Noi ÷ Ha Noi	- ÷ -	236
9	RRMU 2	QL.1A	0	KM215 + 775	÷	KM251 + 50	Ha Nam ÷ Ha Nam	- ÷ -	236

(8) Upon completion of filling up yellow-colored cells, click  button to import general information into Data Input Sheet. All general information data will be exported to Data Input Sheet and Data Input Sheet will appear as shown in step 9.



MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
INPUTTING GENERAL INFORMATION DATA
INTO DATA INPUT SHEET

Export to Data Input Sheet | Back to MainWindow

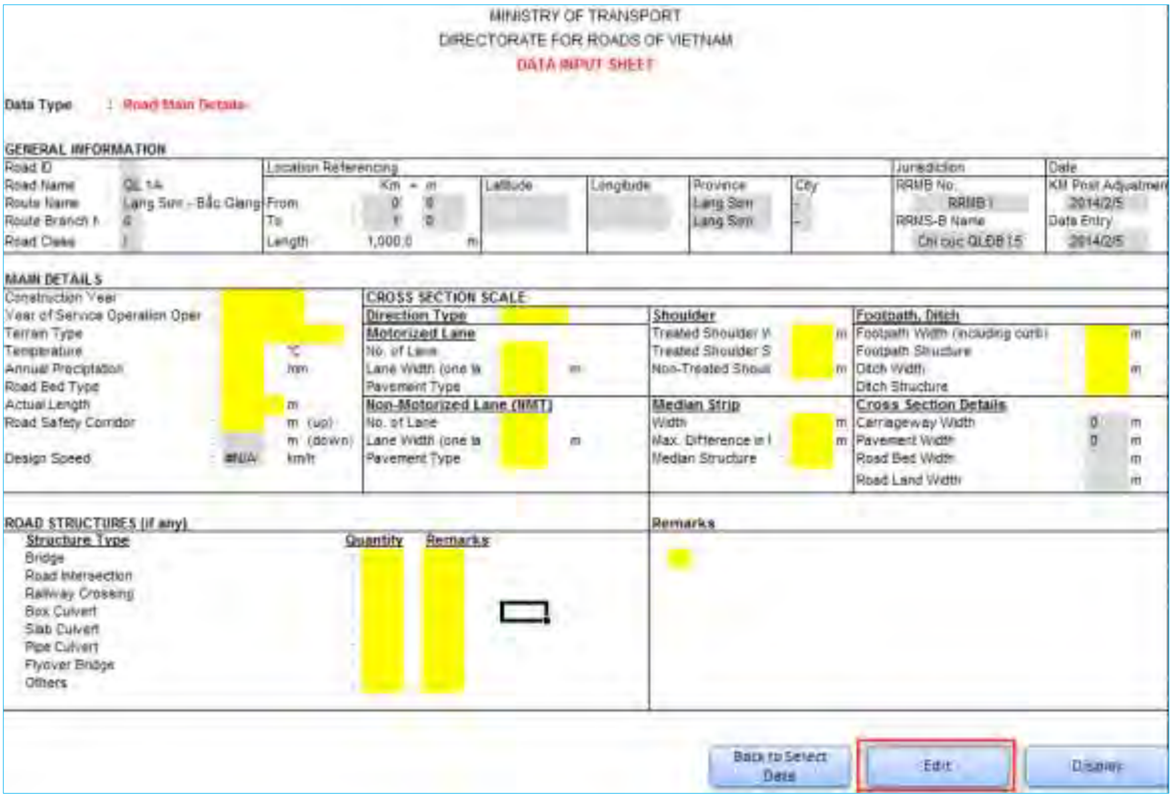
Data Type : Pavement
Inputing General Information

Road ID	:	Location Referencing							Jurisdiction	Date
Road Name	: QL.1A		Km	+ m	Latitude	Longitude	Province	City	RRMU No.	Kilopost Update
Route Name	: QL.1A	From	:	+			Bac Giang	-	RRMU 2	(dd/mm/yyyy)
Route Branch No	:	To	:	+			Bac Giang	-	RRMC No.	Data Entry
Road Class	:	Length	: 0.0	m					236	(dd/mm/yyyy 6/3/2013

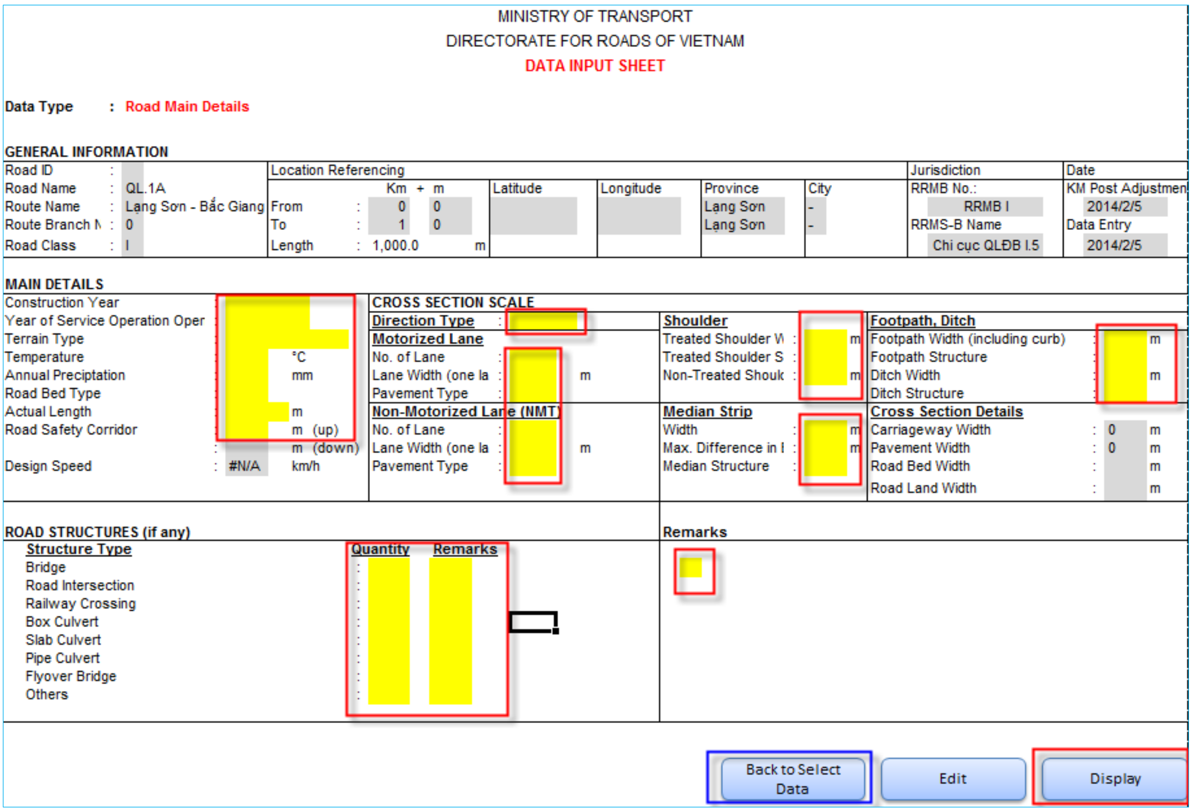
Information about Road Name, Province and Road Management Jurisdiction

SN	RRMU	NH	Branch No.	From	÷	To	Province	City	RRMC
1	RRMU 2	QL.1A	0	KM0 + 0	÷	KM94 + 70	Lang Son ÷ Lang Son	- ÷ -	236
2	RRMU 2	QL.1A	0	KM94 + 70	÷	KM132 + 245	Bac Giang ÷ Bac Giang	- ÷ -	236
3	RRMU 2	QL.1A	0	KM132 + 245	÷	KM152 + 234	Bac Ninh ÷ Bac Ninh	- ÷ -	236
4	RRMU 2	QL.1A	0	KM152 + 234	÷	KM160 + 77	Ha Noi ÷ Ha Noi	- ÷ -	236
5	RRMU 2	QL.1A	0	KM160 + 77	÷	KM174 + 784	Ha Noi ÷ Ha Noi	- ÷ -	248
6	RRMU 2	QL.1A	0	KM174 + 784	÷	KM181 + 570	Ha Noi ÷ Ha Noi	- ÷ -	236
7	RRMU 2	QL.1A	0	KM181 + 570	÷	KM213 + 608	Ha Noi ÷ Ha Noi	- ÷ -	236
8	RRMU 2	QL.1A	0	KM213 + 608	÷	KM215 + 775	Ha Noi ÷ Ha Noi	- ÷ -	236
9	RRMU 2	QL.1A	0	KM215 + 775	÷	KM251 + 50	Ha Nam ÷ Ha Nam	- ÷ -	236

(9) Upon clicking  button, all general information data will be exported to Data Input Sheet and Data Input Sheet will appear as shown below. General information data cannot be modified directly from Data Input Sheet. If it is necessary to edit general information data, click "**Edit**" button and follow the same steps as decribed from Step 5 to 8.



(10) Input data in **yellow-colored cell** only. Use **drop-down list / combo-box** to select data wherever applicable. Input control is inserted in Data Input Sheet.



4.1.2 Data Display

(11) Click "**Display**" button to display the inputted data upon completion of data inputting. Data display window is shown below. To return to main window, click "**Back to Main Window**" button.

MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
DATA CONFIRMATION

Data Type : **Road Main Details**

SN	Item		Sub-Item	Unit	Value	Remarks
1.1	**General Information**		Road ID		QLLLLLLLLLL7	
			Road Name		QL-1	
			Route No.		QL-26	
			Route Branch No.		10	
			Road Class		III	
		Jurisdisction	RRMU No.		RRMU-2	
			RRMC No.		RRMC234	
		KM Post	From	km, m	350000	
			To	km,m	450000	
		From	Latitude		200000	
			Longitude		1000000	
		To	Latitude		200000	
			Longitude		1000000	
		From	Province		Bac Can	
			City		x	
		To	Province		Bac Giang	
			City		x	
		Date	Kilopost Update	YY	12/5/2012	
			Data Entry	YY	12/21/2012	
		Length		m	100000	
		Actual Length		km	1000	
1.2	**Main Details**		Construction Completion Year	YY	11/11/1990	
			Year of Service Operation Open	YY	12/12/1990	
			Terrain Type		1	
			Temperature	°C	25	
			Annual Preciptation	mm	80	
			Road Bed Type		1	
			Design Speed	km/h	60	
		Roadway Lane Details	Lane Type		Down	
			Right of Way	m	15	
			Carriageway Width	m	7	
			Pavement Width	m	9	
		Motorized Lane	No. of Lane		2	
			Width of Lane	m	3	
			Pavement Type		3	
		Non-Motorized Lane	No. of Lane		1	
			Width of Lane	m	2	
			Pavement Type		1	
	Shoulder	Left Side	Width	m	1	
			Type (Pavement)		6	
		Right Side	Width	m	1	
			Type (Pavement)		5	
	Footpath	Left-side	Width	m	1	
			Type (Pavement)		5	
		Right Side	Width	m	1	
			Type (Pavement)		4	
	Road Structures	Structures (I)	Structure Type		1	
			Start Point		50000	
			End Point		50200	
			Center Point		50100	
			Location Name		x	
1.3	**Remarks**					

Back to Select Data | Print | Edit | Check Validity

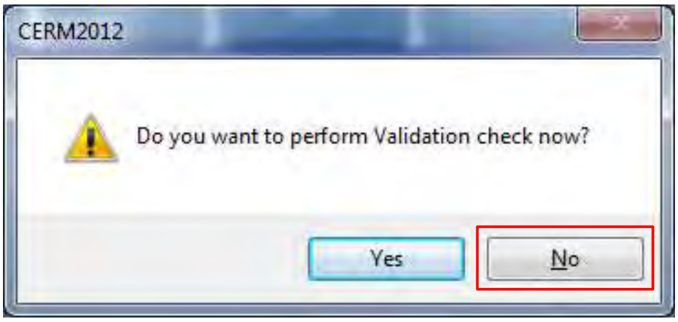
Click this button to return Back to **Main Window.**

Click this button for **Printing** the data.

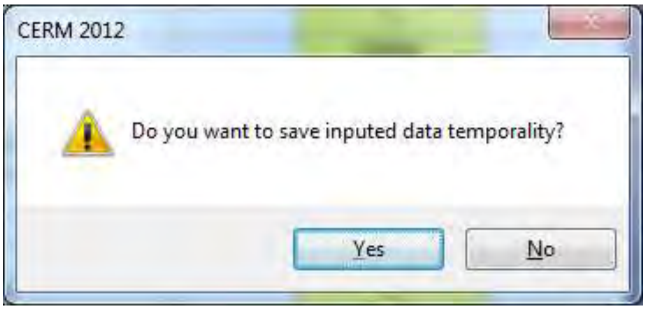
Click this button to return back to **Data Input Sheet.**

Click this button to proceed to **Validation Check**.

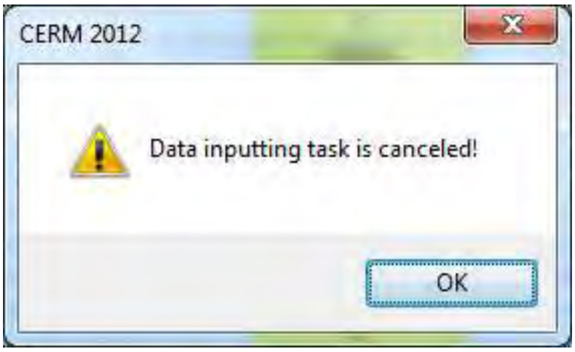
(12) Click "Check Validity" button to proceed to Data Validation Check or save the inputted data temporarily. A window is appeared with message "**Do you want to perform Validation Check now?**"



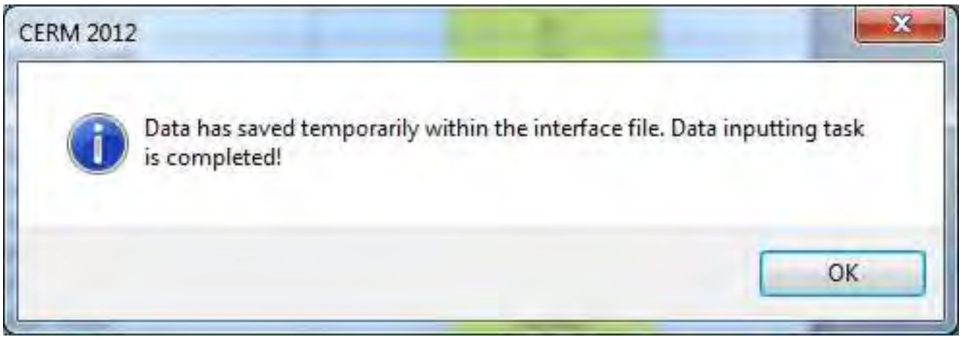
(13) Click "**No**" button to terminate / exit from data inputting work and save inputted data temporarily within the system interface file.

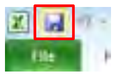


(14) Click "**No**" button to cancel New Data Input task. The following window is appeared when "**No**" button is clicked.



(15) Click "**Yes**" to save data temporarily within the system interface file. Temporarily saved data can be extracted to Data Input Sheet by using function "**Resumption of Data Input Task**".

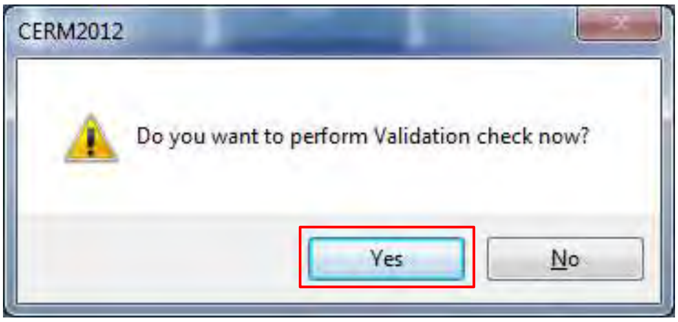


Since inputted data will be saved temporarily within the system interface file, the interface file should be saved WITHOUT changing interface file name. Click save icon  to save interface file.

(16) Inputted data of particular section or location can be saved temporarily only one time. If it is attempted to save multiple times, error message is appeared as below. Click "**OK**" button to return to Data Input Sheet for correction.

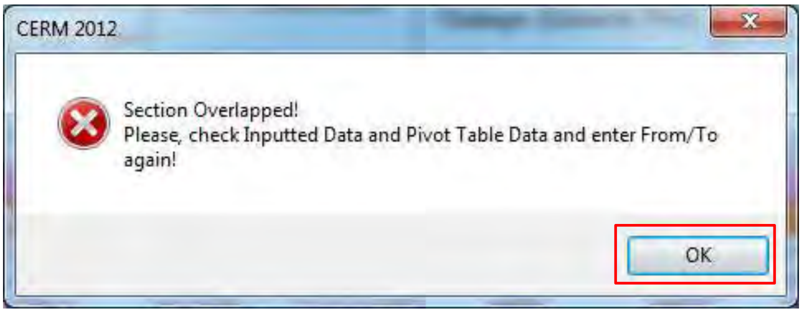
4.1.3 Validation Check

(17) Click "**Yes**" button to proceed to Data Validation Check.

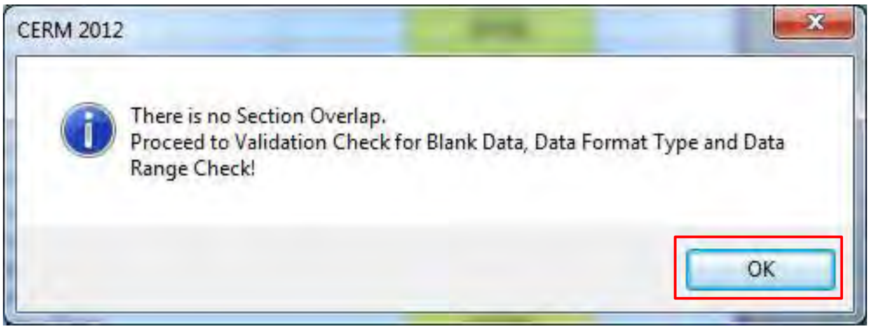


(18) Validation Check process carry-out validation check process starting from Section Overlap Check.

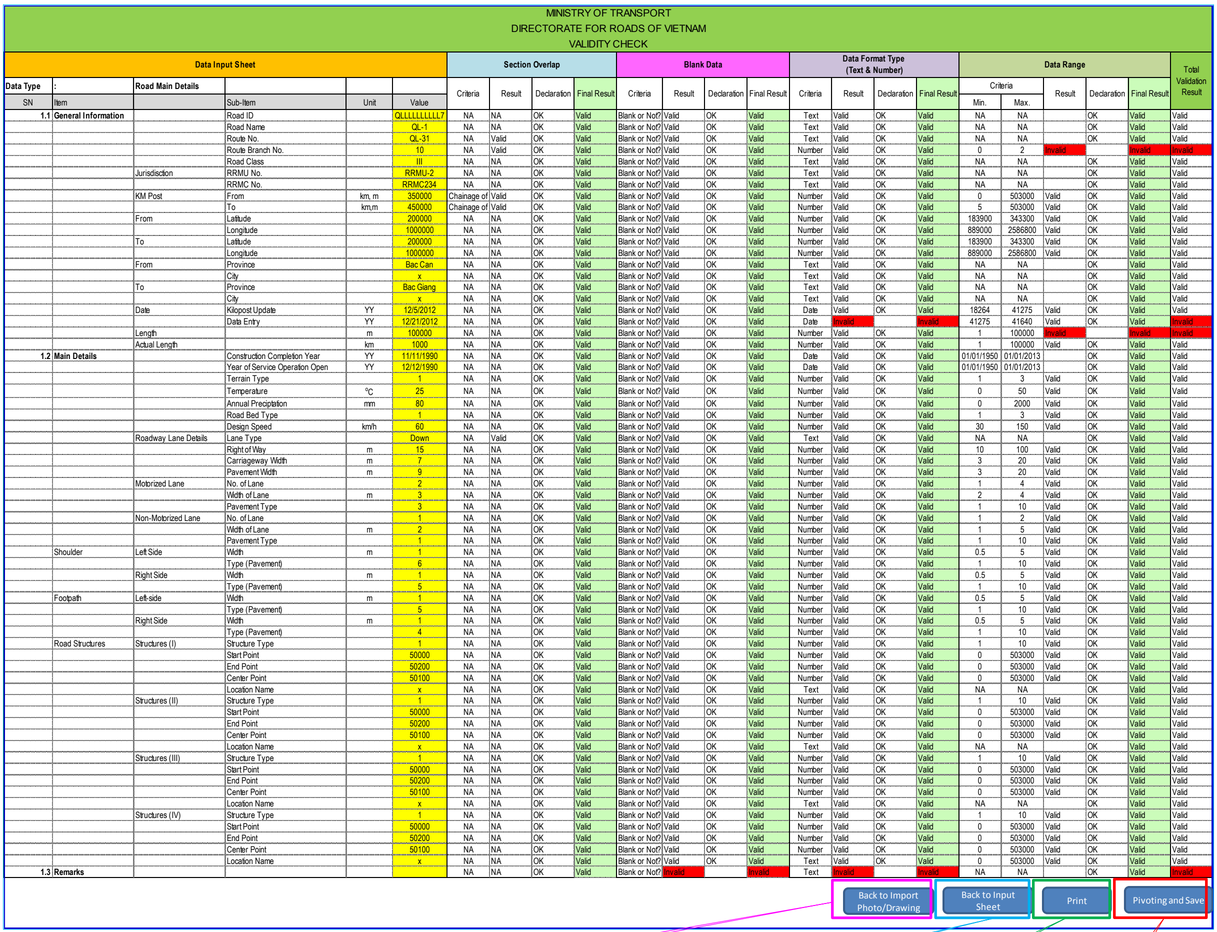
- ✓ If the system identifies Section Overlap, the following window is appeared with the massage indicated in the window. Click "**OK**" button to correct the inputted data. When "**OK**" button is clicked, the system activates Data Input Sheet automatically to make necessary corrections.



✓ Contrary, if the system does not identify Section Overlap, the following window is appeared with the message indicated in the window. Click "**OK**" to proceed validation check for blank data, data format type and data range.



(19) The system performs Validation Check internally and displays the results as shown below. Invalidated items are displayed in red-colored cells with message "**Invalid**".



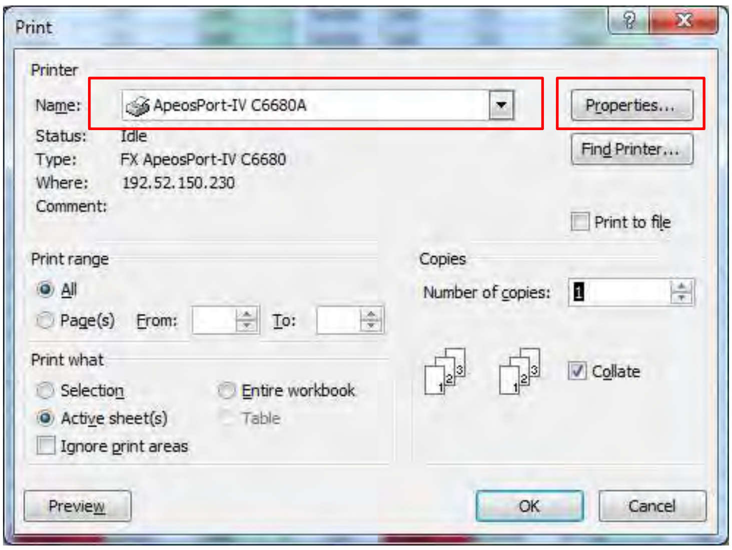
Click this button to return back to **import Photo / Drawing**

Click this button for Returning **Back to Data Input Sheet.**

Click this button to **Print** validation result.

Click this button to **Save data in Pivot Table**

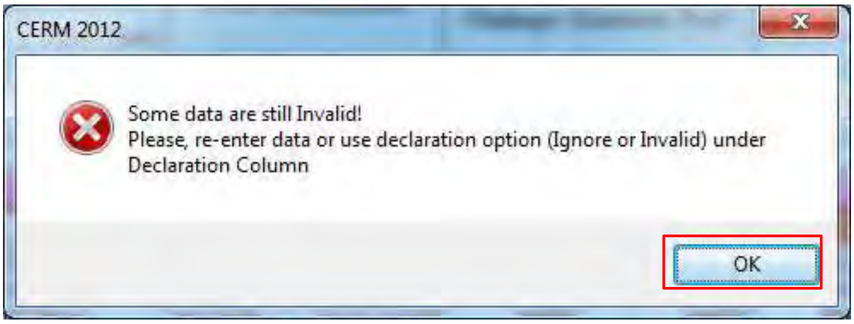
(20) Click "**Print**" button if necessary. A default "**Print**" window is appeared. Select proper printer and settings of printing environment and page set up as desired.



(21) Use declaration option tool to declare whether invalid items are considered as valid or invalid using drop-down menu inserted automatically in the cells where data items are invalid. Select "**Ignore**" to consider invalid data as valid. Similarly, select "**Invalid**" to consider invalid data as invalid. Upon declaration of invalid data, total validation is checked again and corresponding result is displayed. All cells where data items are made valid by using declaration option will be displayed with yellow color to distinguish which items are made valid though they are invalid in reality. Therefore, it is operator's risk and responsibility if invalid data are made valid without trying to make them valid by checking data carefully.

4.1.4 Pivoting and Saving

(22) Click "**Pivoting and Save**" button to save data in pivot table. If "**Pivoting and Save**" button is pressed without declaring the invalid data, error message is appeared as shown below.

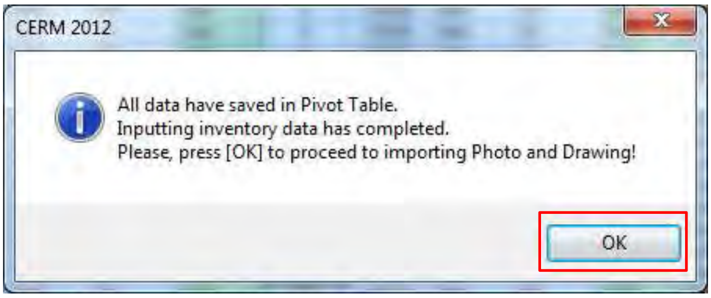


(23) When "**OK**" button is clicked, the window which displays validation check result is appeared again and declaration on invalid items can be made. Unless total validation results are all "**Valid**", Pivoting and Save cannot be successful. If data need to be corrected by inputting new data from Data Input Sheet, click "**Back to Input Sheet**" to correct the data from Data Input Sheet. Upon clicking "**Back to Input Sheet**", Input Sheet is activated.

(24) If "Pivoting and Save" button is clicked after making total validation result "Valid", inputted data are pivoted and saved in pivot table successfully. The following window is

appeared when data are successfully pivoted and saved. **Data inputting task of asset / inventory data is completed at this stage.** From this stage onwards, the data inputting process proceeds to importing photos / videos and drawings of the same location.

(25) Press "**OK**" to proceed to importing photo and drawing of this particular section or location.



4.1.5 Importing Photos and Drawings

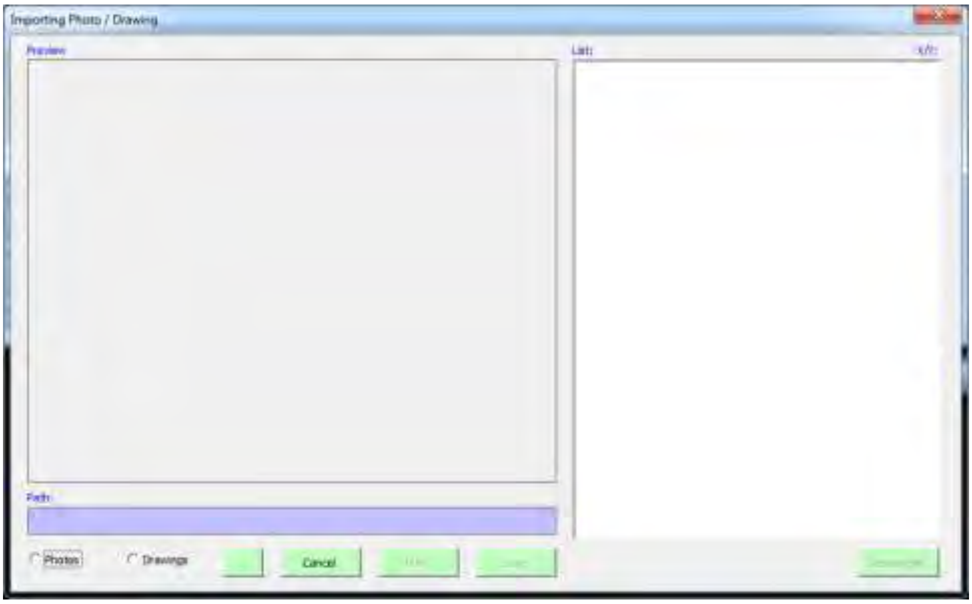
(26) When "**OK**" button is clicked after saving inventory / asset data in pivot table successfully, the following window is appeared by asking whether **Photo of this Road Section / Facility** available.

(27) Click "**NO**" button, if Photo or video of this Road Section / Facility is not available. The process proceeds to **importing drawing** of the same section or location of road.

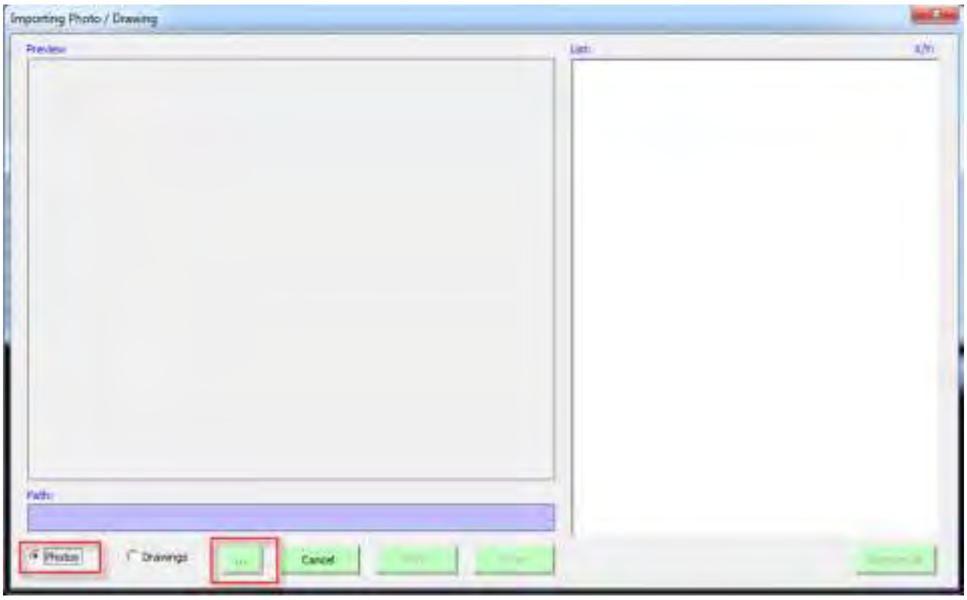
4.1.6 Saving Photos

(28) Click "**Yes**" button, if photo or Video of this Road Section / Facility is available.

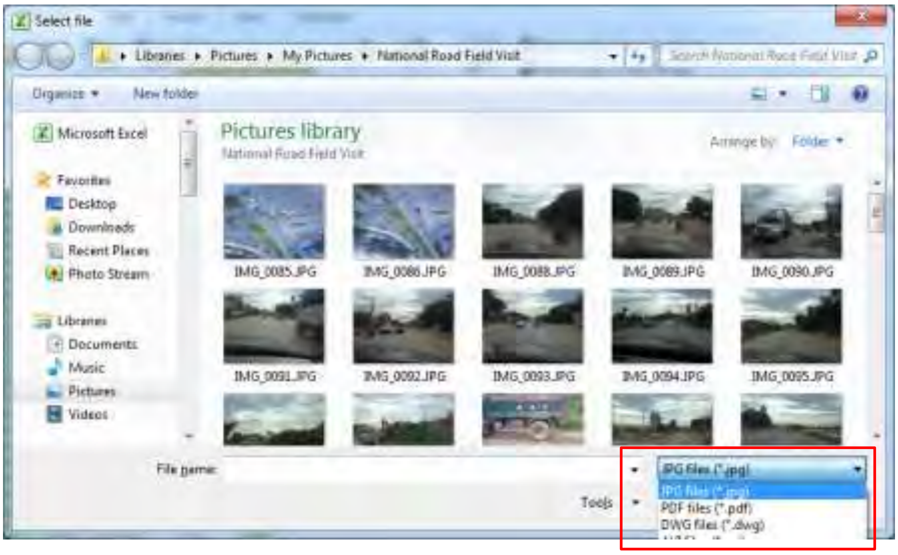
The following window "**Importing Photo / Drawing**" is appeared.



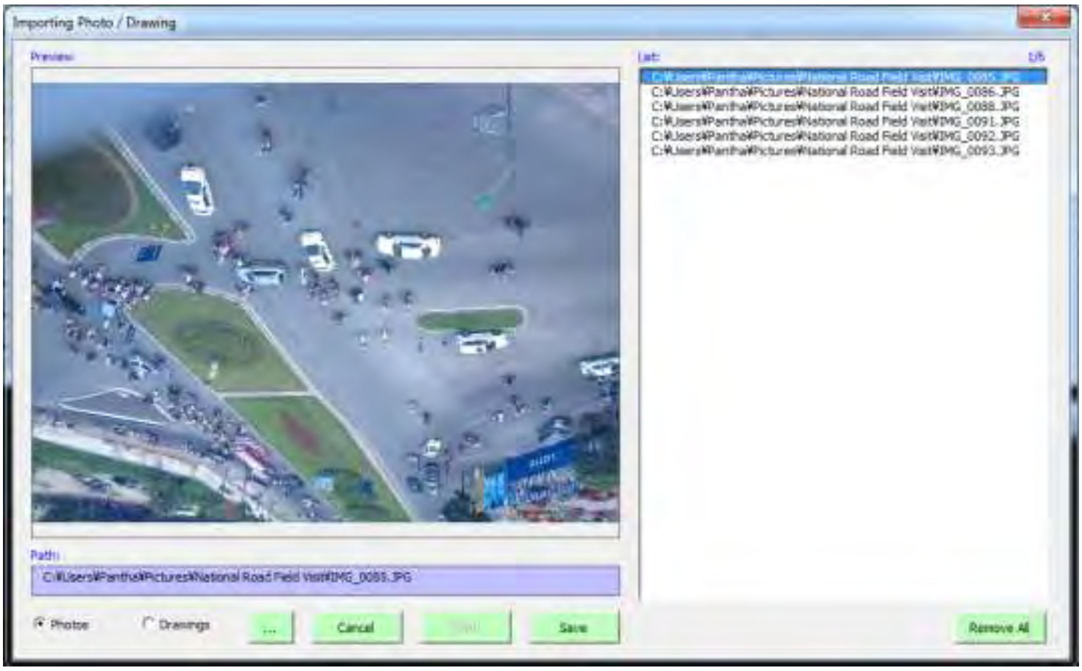
(29) Click "**Photo**" button and Click "**Browse**" button.



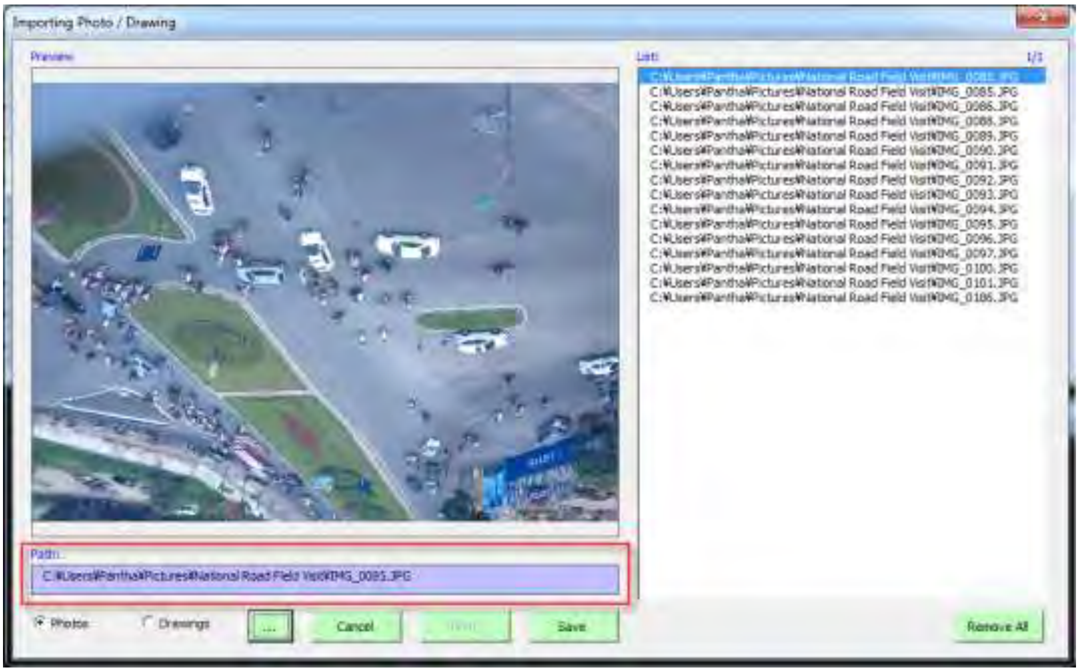
(30) "**Select file**" window is appeared. Browse photo by selecting appropriate photo format (JPG or PDF). Video can also be imported by selecting appropriate video format (i.e.* .AVI, *.MP4, *.3GP, *.MKV, *.FLV, *.MPG).



(31) Single or multiple photos can be selected and uploaded at once. Upon selection of the photo(s), detailed path of selected files is also appeared in right side of the photo importing window. Selected photos can be previewed in the left side of the same window.



(32) If wrong photos are uploaded mistakenly, photos can be removed from the list by clicking "**Remove All**" button. Additional photos can also be uploaded however the maximum size (total size of uploaded photos) should be within 100MB. The file path of previewed photo is also displayed in the path box in the same window.



(33) Click “**Save**” after browsing appropriate file. A confirmation window is appeared as below upon successful saving of photo / video. Click “**OK**” button to complete photo / video importing.

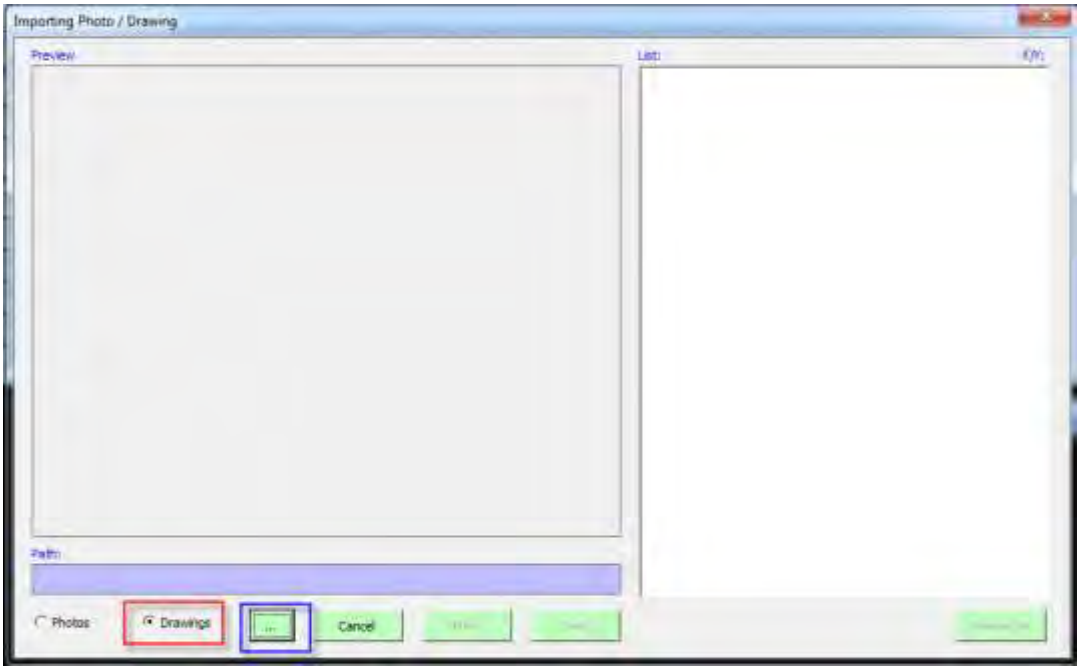
(34) Photo importing window is still active. If additional photos / videos are available of the same location, import desired photo / video. Follow the same process as illustrated from Step 29 to 33.

(35) File name of the photo(s) / video(s) is/are created automatically by the system. If multiple photos are imported, file naming will be continued with suffix number in increasing order.

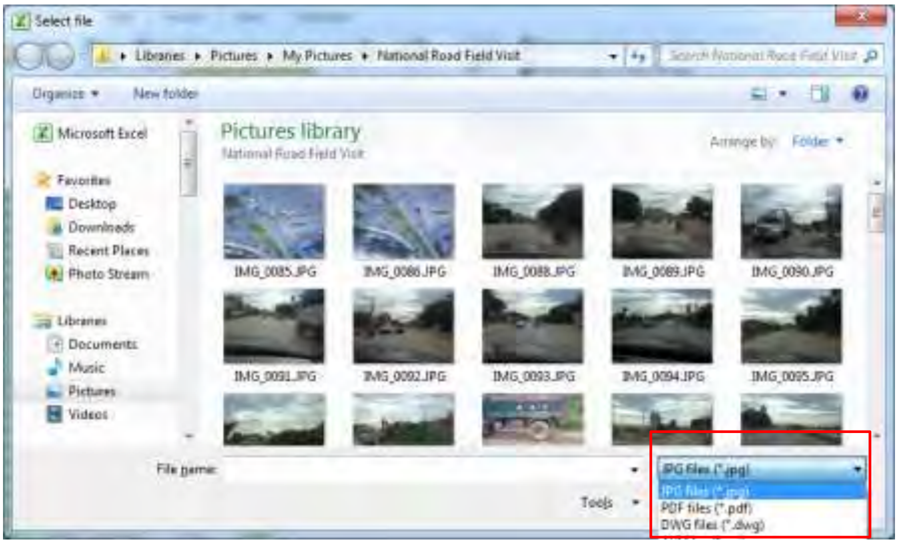
(36) Upon importing all photos and videos, click "**OK**" button to proceed to importing drawings of the same location. Photo and Drawing importing window is still active. Alternatively, Click "**Cancel**" button on active Photo and Drawing Importing Window. Window shown in Step 19 is appeared. Click "**Import Photo / Drawing**" as shown in Step 15.

4.1.7 Importing Drawings

(37) Click "**Drawings**" button and click "**Browse**" button.



(38) Browse drawings by selecting appropriate drawing file format (*.DWG, PDF, JPG) using "**Select file**" window.

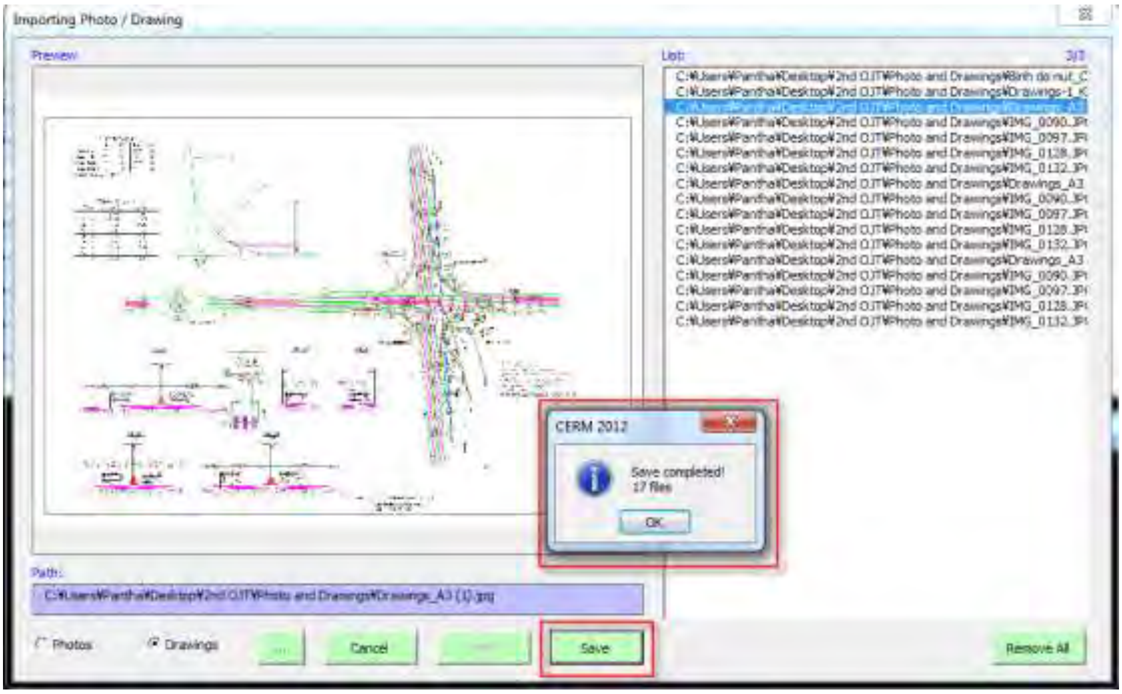


(39) Single or multiple drawings can be selected and uploaded at once. Upon selection of the drawing(s), detailed path of selected files is also appeared in right side of the drawing importing window. Selected drawings can be previewed in the left side of the same window.

(40) If wrong photos are uploaded mistakenly, photos can be removed from the list by clicking "Remove All" button. Additional photos can also be uploaded however the maximum size (total size of uploaded photos) should be within 100MB. The file path of previewed photo is also displayed in the path box in the same window.

4.1.8 Saving Drawings

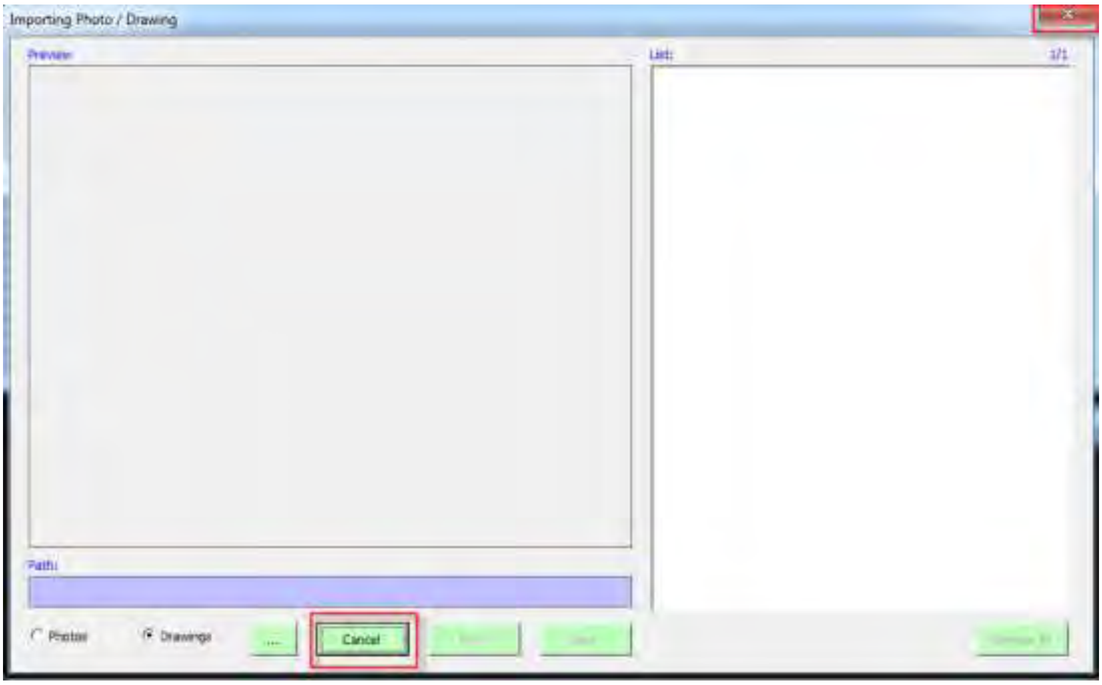
(41) Click "**Save**" after browsing appropriate file. A confirmation window is appeared as below upon successful saving of drawing.



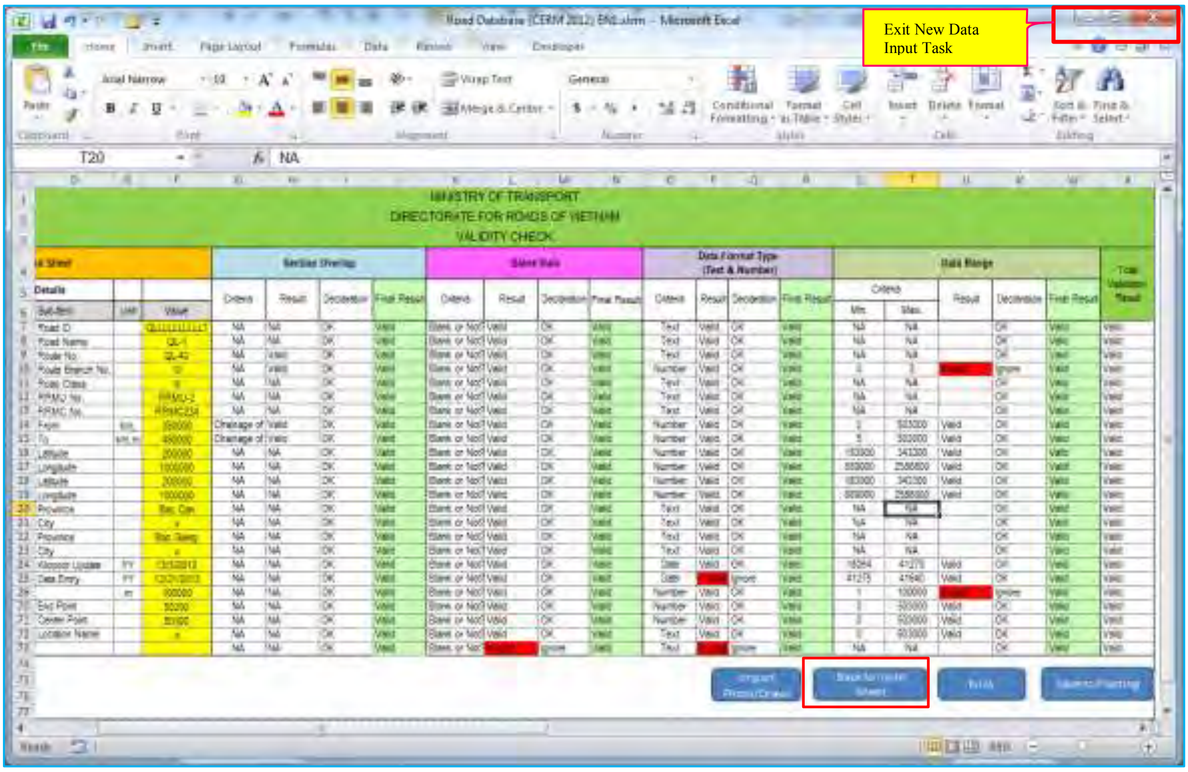
(42) Drawing importing window is still active. If additional drawings are available of the same location, import desired drawing. Follow the same process as illustrated from Step 37 to 41.

(43) File name of the drawing(s) is/are created automatically by the system. If multiple drawings are imported, file naming will be continued with suffix number in increasing order.

(44) "**Importing Photo / Drawing**" window is appeared. Click "**Cancel**" button or "**X**" tab to exit from photo and drawing importing task.



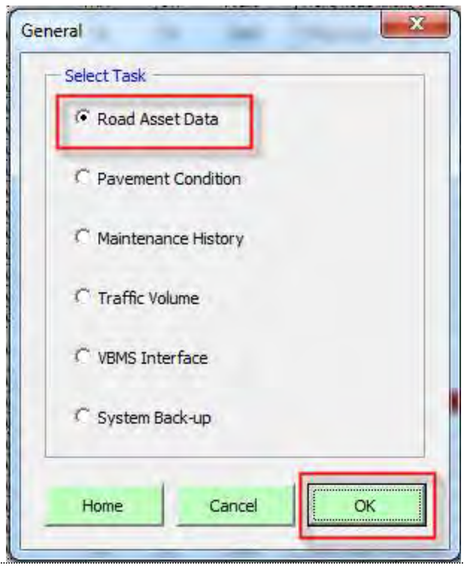
(45) The window which displays result of validation check is appeared or activated. Click "**Back to Input Sheet**" if new data input of next section or location is intended to continue. Click "**Close (X)**" button to exit from new data input task.



4.2 DATA EDITING

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

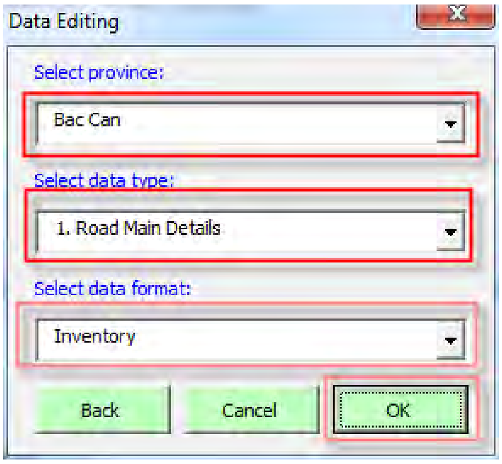
(2) Click "**Select the Task**". General Window is appeared as shown below. Required task can be selected from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to the respective data type as shown below.



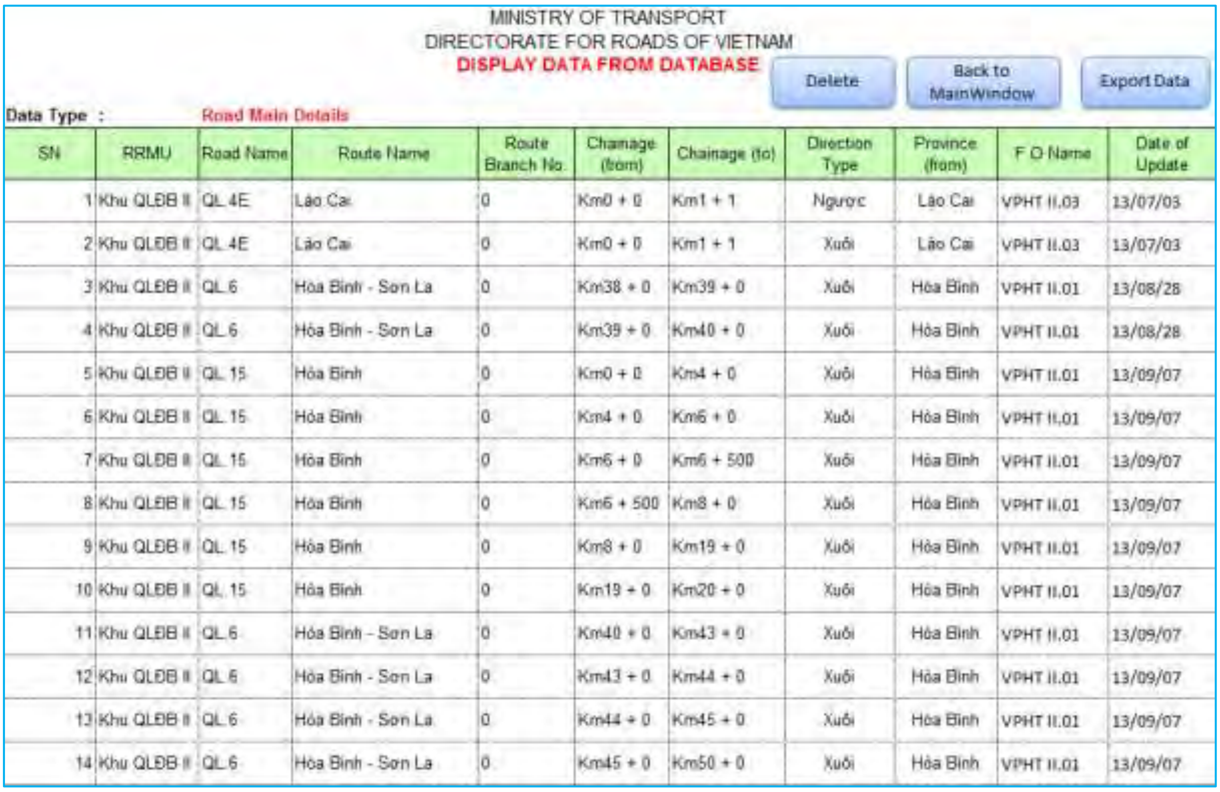
***Note**: For editing maintenance history data, user shall enter through maintenance history from the general window.*

(3) Select "**Data Editing**" and Click "**OK**". To exit from Main Window, click "**Cancel**".

(4) Select "**Province**", "**Data Type**" and "**Data Format**" from Data Editing Window. List of provinces, data types and data format type are listed-up in the combo box. After selecting Province, Data Type and Data Format, Click "**OK**".



(5) List of Road sections / locations are displayed as shown below with the information as indicated in the below window. Only certain data items are displayed to recognize the data which is intended to edit /revise.



SN	RRMU	Road Name	Route Name	Route Branch No.	Chainage (from)	Chainage (to)	Direction Type	Province (from)	F O Name	Date of Update
1	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Ngược	Lào Cai	VPHT II.03	13/07/03
2	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Xuôi	Lào Cai	VPHT II.03	13/07/03
3	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km38 + 0	Km39 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
4	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km39 + 0	Km40 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
5	Khu QLĐB II	QL 15	Hòa Bình	0	Km0 + 0	Km4 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
6	Khu QLĐB II	QL 15	Hòa Bình	0	Km4 + 0	Km6 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
7	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Xuôi	Hòa Bình	VPHT II.01	13/09/07
8	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 500	Km8 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
9	Khu QLĐB II	QL 15	Hòa Bình	0	Km8 + 0	Km19 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLĐB II	QL 15	Hòa Bình	0	Km19 + 0	Km20 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
11	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km40 + 0	Km43 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
12	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km43 + 0	Km44 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
13	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km44 + 0	Km45 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
14	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km45 + 0	Km50 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07

(6) Select the Road Section / Location of which data editing is necessary. Selection can be done **either selecting the whole row or just clicking in one of the cells** of the desired data / row. After selecting proper data, click "**Export Data**" button.

MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
DISPLAY DATA FROM DATABASE

Delete | Back to MainWindow | Export Data

Data Type : Road Main Details

SN	RRMU	Road Name	Route Name	Route Branch No	Chainage (from)	Chainage (to)	Direction Type	Province (from)	F O Name	Date of Update
1	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Ngược	Lào Cai	VPHT II.03	13/07/03
2	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Xuôi	Lào Cai	VPHT II.03	13/07/03
3	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km38 + 0	Km39 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
4	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km39 + 0	Km40 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
5	Khu QLĐB II	QL 15	Hòa Bình	0	Km0 + 0	Km4 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
6	Khu QLĐB II	QL 15	Hòa Bình	0	Km4 + 0	Km6 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
7	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Xuôi	Hòa Bình	VPHT II.01	13/09/07
8	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 500	Km8 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
9	Khu QLĐB II	QL 15	Hòa Bình	0	Km8 + 0	Km19 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLĐB II	QL 15	Hòa Bình	0	Km19 + 0	Km20 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
11	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km40 + 0	Km43 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
12	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km43 + 0	Km44 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
13	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km44 + 0	Km45 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
14	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km45 + 0	Km50 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07

(7) After clicking "**Export Data**" button as shown in the above window, all stored data of that particular road section or location are exported into Data Input Sheet as shown below.

MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
DATA INPUT SHEET

Data Type : Road Main Details

GENERAL INFORMATION

Road ID :
Road Name : QL.6
Route Name : Hòa Bình - Sơn La
Route Branch N : 0
Road Class : Cấp III

Location Referencing

	Km	+ m	Latitude	Longitude	Province	City
From :	39	0			Hòa Bình	-
To :	40	0			Hòa Bình	-
Length :	1,000.0	m				

Jurisdiction
RRMU No.: Khu QLĐB II
F.O Name: VPHT II.01

Date
KM Post Adjustme: 1905/06/29
Data Entry: 13/08/28

MAIN DETAILS

Construction Year : 1905/06/03
Year of Service Operation Open : 1905/06/03
Terrain Type : Đồng bằng
Temperature : °C
Annual Preciptation : mm
Road Bed Type : 2
Actual Length : 1000 m
Right of Way : m
Design Speed : #N/A km/h

CROSS SECTION SCALE

Direction Type : Xuôi

Motorized Lane
No. of Lane : 1
Lane Width (one la : 3.5 m
Pavement Type : AC

Non-Motorized Lane (NMT)
No. of Lane :
Lane Width (one la : m
Pavement Type :

Shoulder
Treated Shoulder W : m
Treated Shoulder S :
Non-Treated Shoulc : 2.5 m

Median Strip
Width : m
Max. Difference in E : m
Median Structure :

Footpath, Ditch
Footpath Width (including : m
Footpath Structure :
Ditch Width : m
Ditch Structure :

Cross Section Details
Carriageway Width : 3.5 m
Pavement Width : 3.5 m
Road Bed Width : 6 m

ROAD STRUCTURES (if any)

Structure Type	Quantity	Remarks
Bridge	1	Cầu Ké L=28,2m
Road Intersection		
Railway Crossing		
Box Culvert		
Slab Culvert		
Pipe Culvert		
Flyover Bridge		
Others		

Remarks

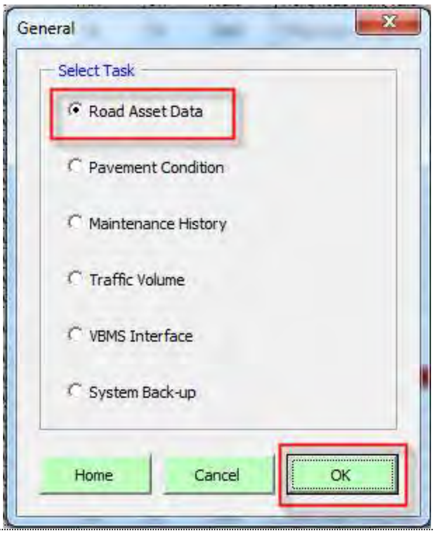
Back to MainWindow | Edit | Display

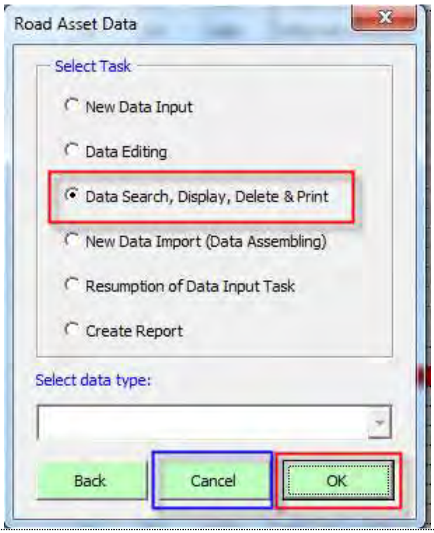
(8) Necessary editing can be carried-out only in the **yellow-colored cells**. The steps from this point shall follow the same steps (except file naming) as for New Data Input as explained in **Sub-chapter 4.1** above. ***The Road Database System will generate a new file name for pivot table, if data are edited in a different year than the current version (i.e. year), automatically by preserving existing pivot table file without any modifications***. ***If data are edited within the same year of the existing file version, data will be overwritten and saved in the same file.***

4.3 DATA SEARCH, DISPLAY, DELETE AND PRINT

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

(2) Click "**Select the Task**". General Window is appeared as shown below. Required task can be selected from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to the respective data type as shown below.

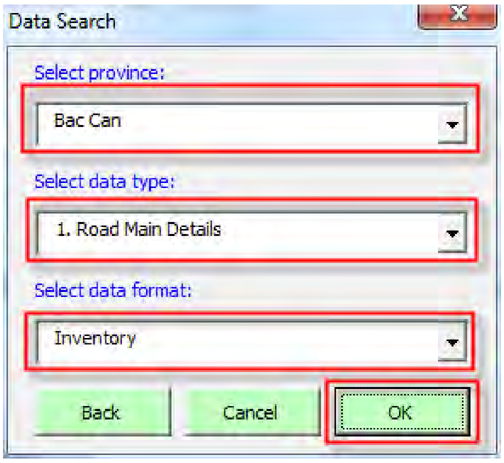




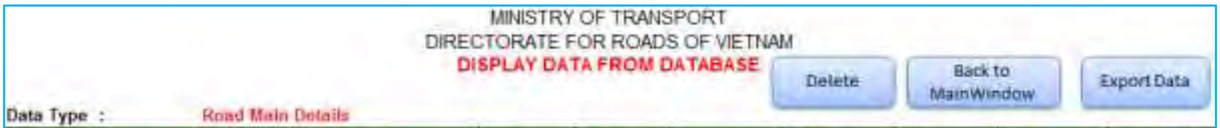
Note: *For searching, displaying, deleting and pringing of maintenance history data, user shall enter* *through maintenace history from the general window.*

(3) Select "**Data Search, Display, Delete & Print**" and Click "**OK**". To exit from Main Window, click "**Cancel**".

(4) Select "**Province**", "**Data Type**" and "**Data Format**" from Data Search and Display Window. List of provinces, data types and data format type are listed-up in the combo box. After selecting Province, Data Type and Data Format, Click "**OK**".



(5) List of Road sections / locations are displayed as shown below with the information as indicated in the below window.



SN	RRMU	Road Name	Route Name	Route Branch No.	Chainage (from)	Chainage (to)	Direction Type	Province (from)	F O Name	Date of Update
1	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Ngược	Lào Cai	VPHT II.03	13/07/03
2	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Xuôi	Lào Cai	VPHT II.03	13/07/03
3	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km38 + 0	Km39 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
4	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km39 + 0	Km40 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
5	Khu QLĐB II	QL 15	Hòa Bình	0	Km0 + 0	Km4 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
6	Khu QLĐB II	QL 15	Hòa Bình	0	Km4 + 0	Km6 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
7	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Xuôi	Hòa Bình	VPHT II.01	13/09/07
8	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 500	Km8 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
9	Khu QLĐB II	QL 15	Hòa Bình	0	Km8 + 0	Km19 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLĐB II	QL 15	Hòa Bình	0	Km19 + 0	Km20 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
11	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km40 + 0	Km43 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
12	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km43 + 0	Km44 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
13	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km44 + 0	Km45 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
14	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km45 + 0	Km50 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07

(6) Select the Road Section / Location of which data displaying is necessary. Selection can be done **either selecting the whole row or just clicking in one of the cells** of the desired data. After selecting proper data, click “**Export Data**” button.

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DISPLAY DATA FROM DATABASE

Delete | Back to MainWindow | Export Data

Data Type : Road Main Details

SN	RRMU	Road Name	Route Name	Route Branch No.	Chainage (from)	Chainage (to)	Direction Type	Province (from)	F O Name	Date of Update
1	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Ngược	Lào Cai	VPHT II.03	13/07/03
2	Khu QLĐB II	QL 4E	Lào Cai	0	Km0 + 0	Km1 + 1	Xuôi	Lào Cai	VPHT II.03	13/07/03
3	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km38 + 0	Km39 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
4	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km39 + 0	Km40 + 0	Xuôi	Hòa Bình	VPHT II.01	13/08/28
5	Khu QLĐB II	QL 15	Hòa Bình	0	Km0 + 0	Km4 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
6	Khu QLĐB II	QL 15	Hòa Bình	0	Km4 + 0	Km6 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
7	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Xuôi	Hòa Bình	VPHT II.01	13/09/07
8	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 500	Km8 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
9	Khu QLĐB II	QL 15	Hòa Bình	0	Km8 + 0	Km19 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLĐB II	QL 15	Hòa Bình	0	Km19 + 0	Km20 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
11	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km40 + 0	Km43 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
12	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km43 + 0	Km44 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
13	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km44 + 0	Km45 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07
14	Khu QLĐB II	QL 6	Hòa Bình - Sơn La	0	Km45 + 0	Km50 + 0	Xuôi	Hòa Bình	VPHT II.01	13/09/07

(7) After clicking “**Export Data**” button as shown in the above window, all stored data of that particular road section or location are exported into Data Display Window as shown below.

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DATA CONFIRMATION

Data Type : Road Main Details

SN	Item		Sub-Item	Unit	Value	Remarks
1.1	General Information		Road ID			
			Road Name		QL.6	
			Route Name		Hòa Bình - Sơn La	
			Route Branch No.		0	
			Road Class		Cấp III	
		Jurisdisction	RRMU No.:		Khu QLĐB II	
			F.O Name		VPHT II.01	
		KM Post	From	km	38	
				m	0	
			To	km	39	
				m	0	
		Date	Kilopost Update	YY	1905/06/29	
			Data Entry	YY	13/08/28	
		Actual Length		km	1000	
1.2	Main Details		Construction Year	YY	1905/06/03	
			Year of Service Operation Open	YY	1905/06/03	
			Terrain Type		Đồng bằng	
		Roadway Lane Details	Direction Type		Xuôi	
			C.W Width	m	3.5	
			Pavement Width	m	3.5	
			Roadbed Width	m	6	
	Road Structures	1. Bridge	Quantity			
			Remarks			
		2. Road Intersection	Quantity			
			Remarks			
		3. Railway Crossing	Quantity			
			Remarks			
		8. Others	Quantity			
			Remarks			
1.3	Remarks					

Back to Select Data | Print | Edit | Check Validity

(8) "**Edit**" and "**Check Validity**" buttons are disabled. Only "**Back to Select Data**" and "**Print**" buttons are active. To select and display another data, click "Back to Select Data", Window shown in step 5 is displayed. If necessary, data can be printed-out from this stage also. To print data, click "Print" button. Print window with default printer is displayed. If the printer is different from the default printer, select proper printer from printer list using drop-down menu. Also, printer properties and page set up can be changed if necessary.

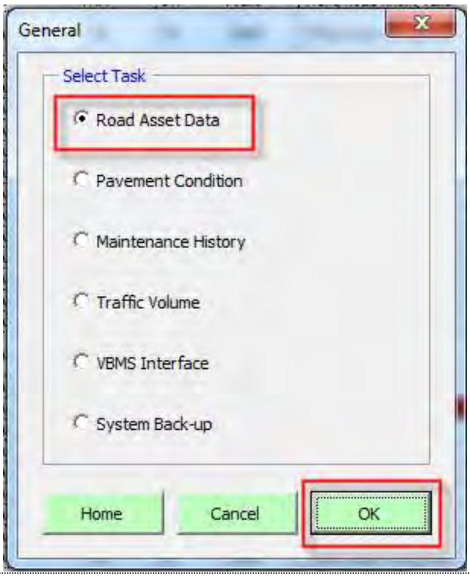
(9) After selecting proper printer and page set up, click "**OK**" to print. Data is printed out in the defined page setup and layout. By default, it is printed in A4 size paper with portrait layout.

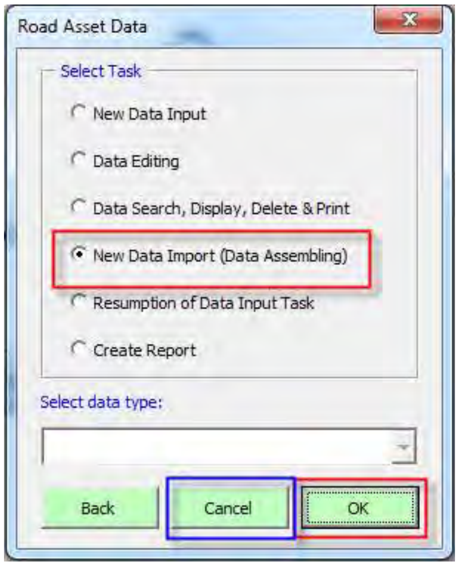
(10) To exit from data display task, click close "**X**" tab of the system interface file located at the top right corner of the excel ribbon.

4.4 NEW DATA IMPORT (DATA ASSEMBLING)

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

(2) Click "**Select the Task**". General Window is appeared as shown below. Required task can be selected from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to the respective data type as shown below.





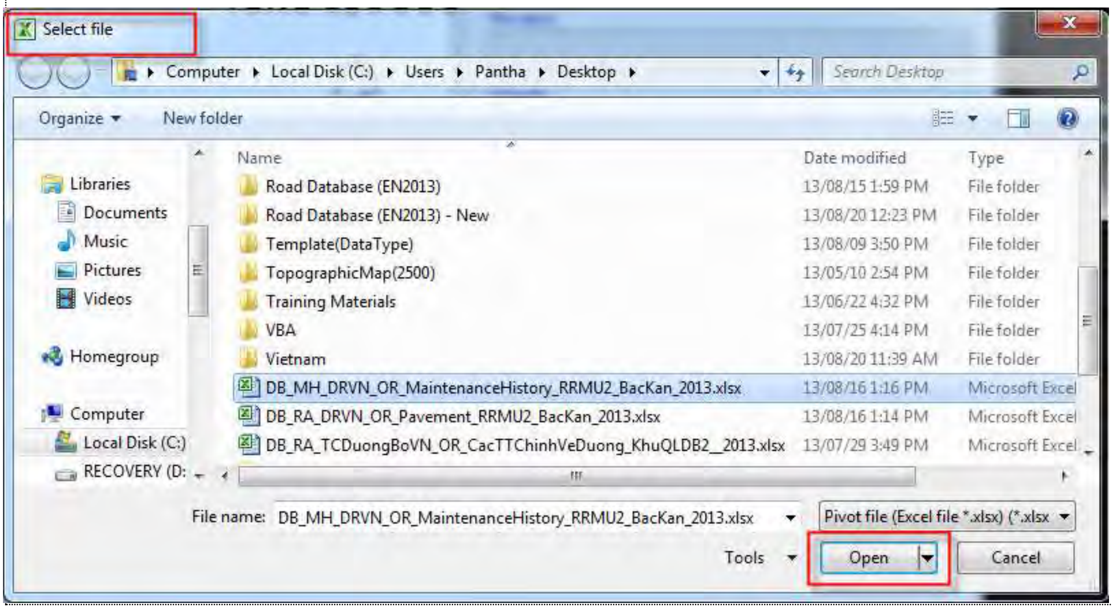
***Note**: For new data import of maintenance history data, user shall enter through maintenace history from the general window.*

(3) Select "**New Data Import (Data Assembling)**" and Click "**OK**". To exit from Main Window, click "**Cancel**".

4.4.1 Importing Inventory Data

(4) Upon selecting "**New Data Import (Data Assembling)** and clicking "**OK**" button, new data import window is appeared. Select "**Inventory**" to import inventory data.

(5) Click "**Browse**" to find the inventory data to be imported. Upon clicking "**Browse**" button, "**Select File**" window is appeared. Select proper file and click "**Open**" or double click on the selected file to upload file in new data importing window.



(6) Since each province has only one inventory data file for each data type, data uploading of a particular file name is allowed only once to prevent duplication of data. However, data uploading of different data type or province can be done in same data uploading window as shown below. Upon selection of uploaded file, province name, file name and location of file from where file was uploaded are displayed in the file uploading window. If

province is not applicable for that particular data type (such as Road Main Details), data type name is displayed instead of province name. Click “**Import**” to import the uploaded file into the database system (i.e. pivot table). Alternatively, user can remove, cancel data importing task and back to previous steps by clicking corresponding buttons provided in the data importing window.

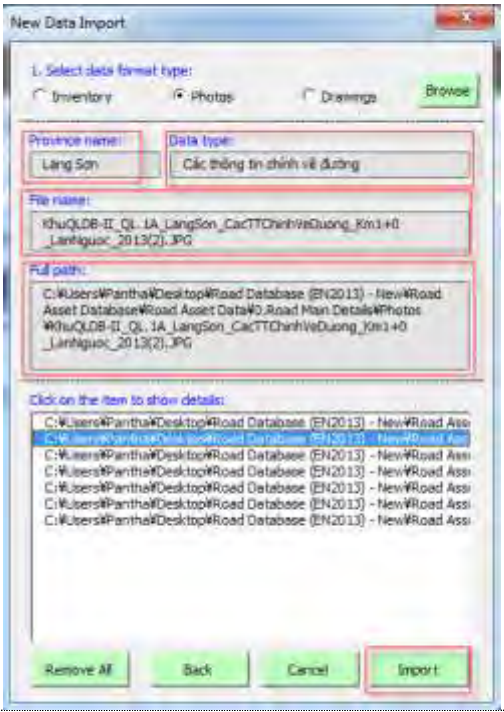
(7) Upon successful importing of data into the pivot table, user can import additional inventory data (if any) also following the same steps as described above. However, if attempt is made to import same data multiple times, the system prompts the message that “**Data of this location has already imported**”.

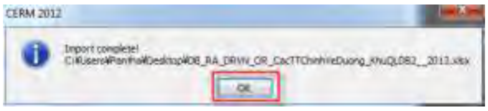
4.4.2 Importing Photos and Video

(8) Upon selecting “**New Data Import (Data Assembling)** and clicking “**OK**” button, new data import window is appeared. Select “**Photos**” to import photo / video data. Videos can import using photo data format type.

(9) Click "**Browse**" to find the photos and videos data to be imported. Upon clicking "**Browse**" button, "**Select File**" window is appeared. Select proper file and click "**Open**" to upload file in new data importing window.

(10) To avoid data duplication, data uploading of a particular file name is allowed only once. However, data uploading of different data type or province can be done in the same data uploading window as shown below. Upon selection of uploaded file, province name, file name and location of file from where file was uploaded are displayed in the file uploading window. Click "**Import**" to import the uploaded file into the database system (i.e. in photo folder located inside the province folder). Alternatively, user can remove, cancel data importing task and back to previous steps by clicking corresponding buttons provided in the data importing window.



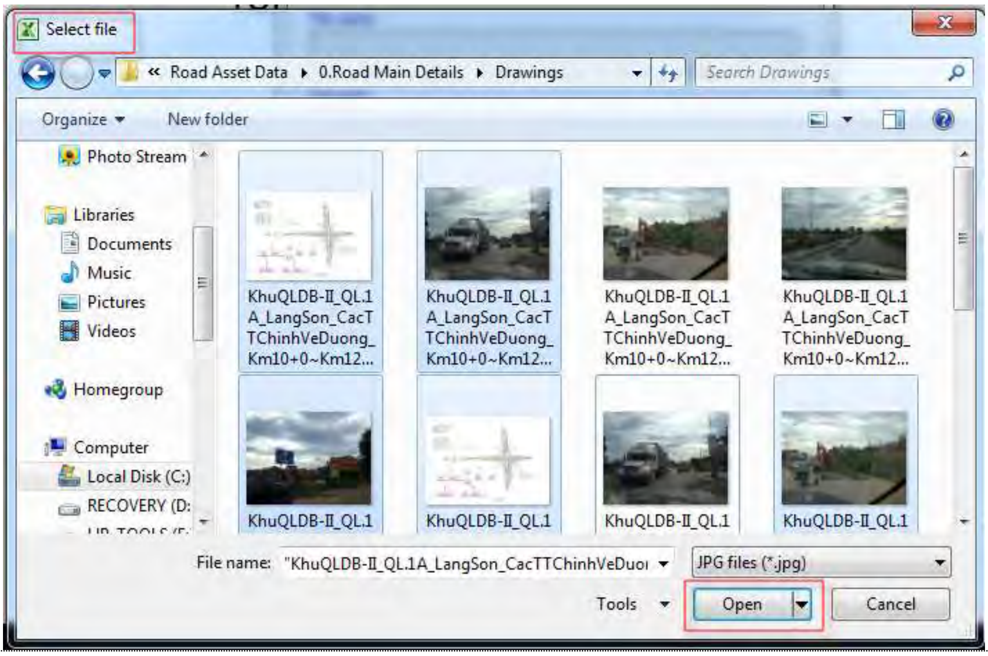


(11) Upon successful importing of data into the photos folder, user can import additional photos / videos (if any) also following the same steps as described above. However, if attempt is made to import same data / file multiple times, the system prompts the message that "**Data of this location has already imported**".

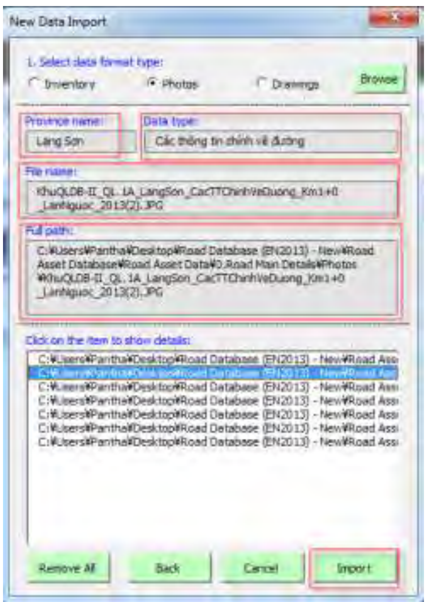
4.4.3 Importing Drawings

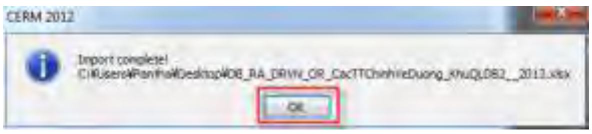
(12) Upon selecting "**New Data Import (Data Assembling)** and clicking "**OK**" button, new data import window is appeared. Select "**Drawings**" to import drawing data.

(13) Click "**Browse**" to find the drawing data to be imported. Upon clicking "**Browse**" button, "**Select File**" window is appeared. Select proper file and click "**Open**" to upload file in new data importing window.



(14) To avoid data duplication, data uploading of a particular file name is allowed only once. However, data uploading of different data type or province can be done in the same data uploading window as shown below. Upon selection of uploaded file, province name, file name and location of file from where file was uploaded are displayed in the file uploading window. Click "**Import**" to import the uploaded file into the database system (i.e. in drawings folder located inside the province folder). Alternatively, user can remove uploaded files, cancel data importing task and back to previous steps by clicking corresponding buttons provided in the data importing window.



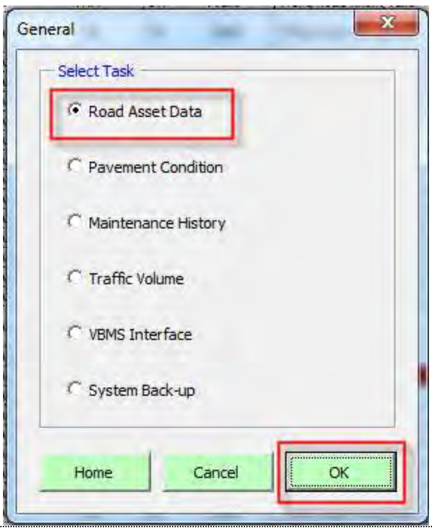


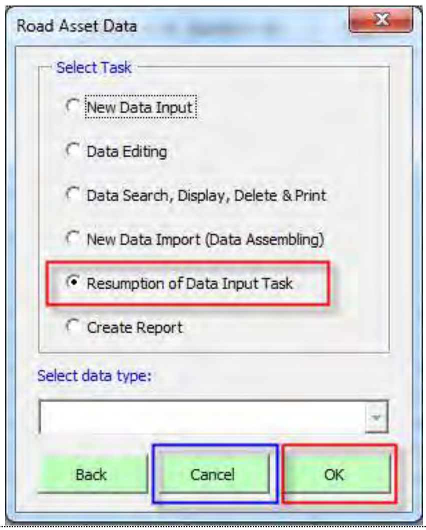
(15) Upon successful importing of data into the drawing folder, user can import additional drawings (if any) also following the same steps as described above. However, if attempt is made to import same data/ file multiple times, the system prompts the message that "**Data of this location has already imported**".

4.5 RESUMPTION OF DATA INPUT TASK

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

(2) Click "**Select the Task**". General Window is appeared as shown below. Required task can be selected from the general window. Upon selection of task and clicking "OK" button, the system prompts the user to the respective data type as shown below.

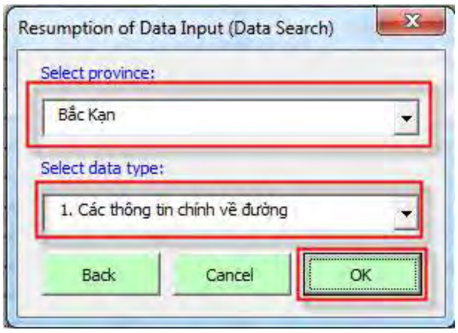




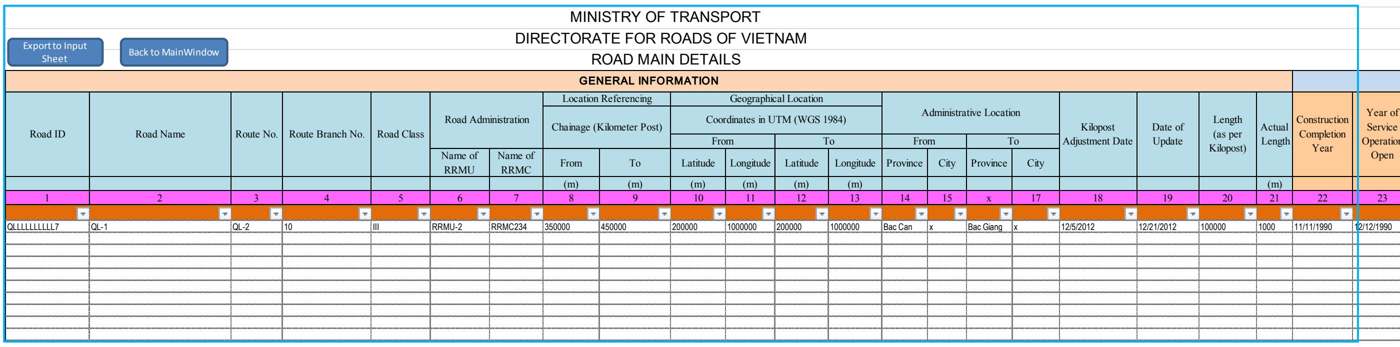
***Note**: For resumption of new data input task of maintenance history data, user shall enter through maintenace history from the general window.*

(3) Select "**Resumption of Data Input Task**" and Click "**OK**". To exit from Main Window, click "**Cancel**".

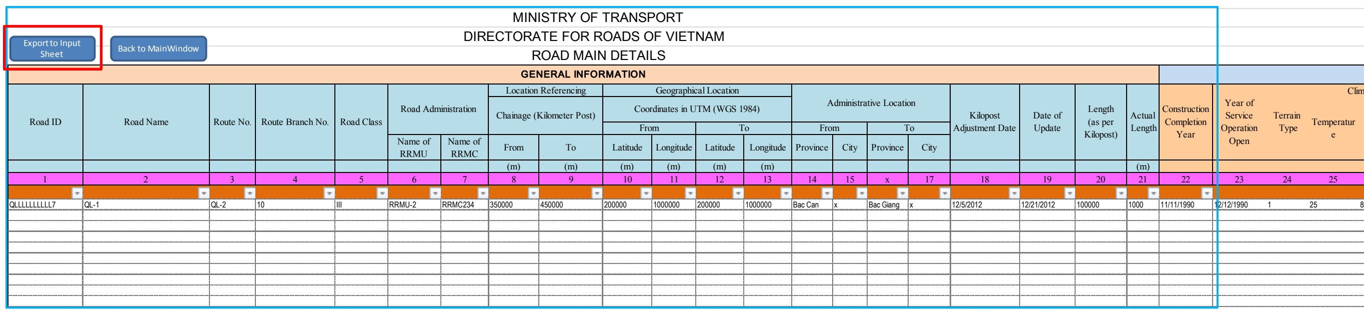
(4) Select "**Province**" and "**Data Type**" from Resumption of Data Input Task Window. List of provinces and data types are listed-up in the combo box. After selecting Province and Data Type, Click "**OK**".



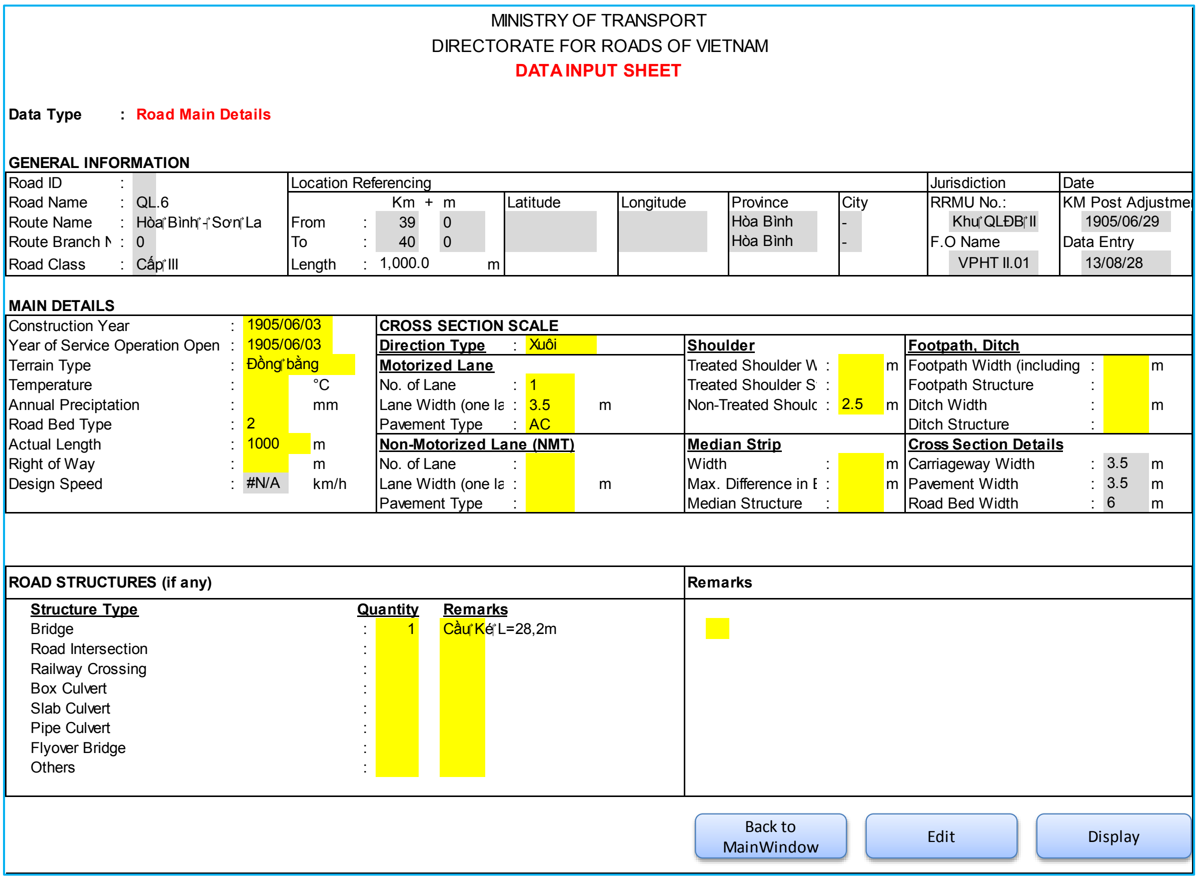
(5) Data are displayed in Pivot Table format (temporary pivot table created within the interface file) as shown below window.



(6) Select the Road Section / Location of which resumption of data input task is necessary. Selection can be done **either selecting the whole row or just clicking in one of the cells** of the desired data. After selecting proper data, click "**Export to Input Sheet**" button.



(7) Data is exported to Data Input Sheet as shown below. Data input work is now resumed and necessary data can be inputted in Data Input Sheet. Data can be inputted only in yellow-colored cells.



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DATA INPUT SHEET

Data Type : Road Main Details

GENERAL INFORMATION

Road ID :		Location Referencing						Jurisdiction	Date
Road Name : QL.6		Km + m		Latitude	Longitude	Province	City	RRMU No.:	KM Post Adjustme
Route Name : Hòa Bình - Sơn La	From :	39	0			Hòa Bình	-	Khu QLĐB II	1905/06/29
Route Branch N : 0	To :	40	0			Hòa Bình	-	F.O Name	Data Entry
Road Class : Cấp III	Length :	1,000.0	m					VPHT II.01	13/08/28

MAIN DETAILS

Construction Year :	1905/06/03		CROSS SECTION SCALE						
Year of Service Operation Open :	1905/06/03		Direction Type :	Xuôi	Shoulder			Footpath, Ditch	
Terrain Type :	Đồng bằng		Motorized Lane		Treated Shoulder W :		m	Footpath Width (including :	m
Temperature :		°C	No. of Lane :	1	Treated Shoulder S :			Footpath Structure :	
Annual Preciptation :		mm	Lane Width (one la :	3.5 m	Non-Treated Shoulc :	2.5	m	Ditch Width :	m
Road Bed Type :	2		Pavement Type :	AC				Ditch Structure :	
Actual Length :	1000	m	Non-Motorized Lane (NMT)		Median Strip			Cross Section Details	
Right of Way :		m	No. of Lane :		Width :		m	Carriageway Width : 3.5	m
Design Speed :	#N/A	km/h	Lane Width (one la :	m	Max. Difference in E :		m	Pavement Width : 3.5	m
			Pavement Type :		Median Structure :			Road Bed Width : 6	m

ROAD STRUCTURES (if any)

Structure Type	Quantity	Remarks
Bridge	1	Cầu Kế L=28,2m
Road Intersection		
Railway Crossing		
Box Culvert		
Slab Culvert		
Pipe Culvert		
Flyover Bridge		
Others		

Remarks

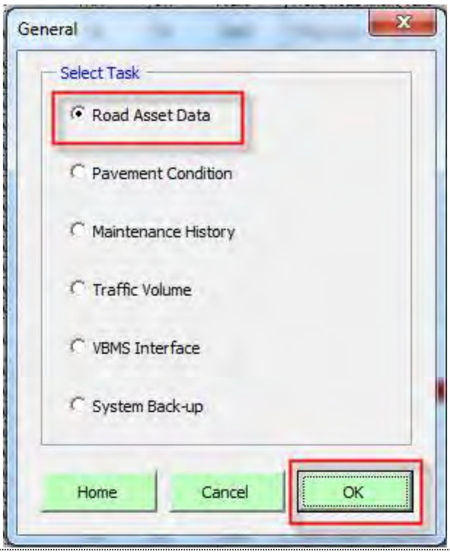
Back to MainWindow | Edit | Display

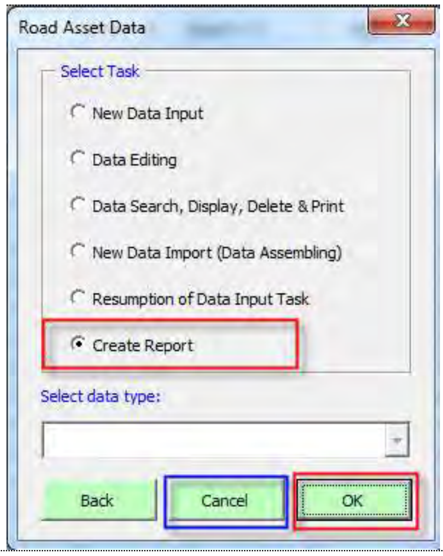
(8) The remaining steps from this point shall follow the same steps as for New Data Input task as explained in **Sub-chapter 4.1** above.

4.6 CREATE REPORT

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

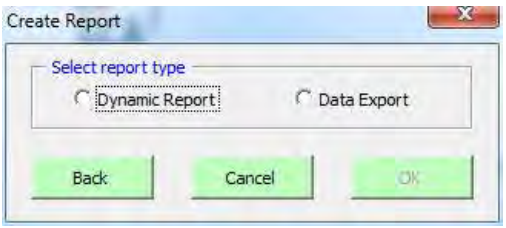
(2) Click "**Select the Task**". General Window is appeared as shown below. Required task can be selected from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to the respective data type as shown below.





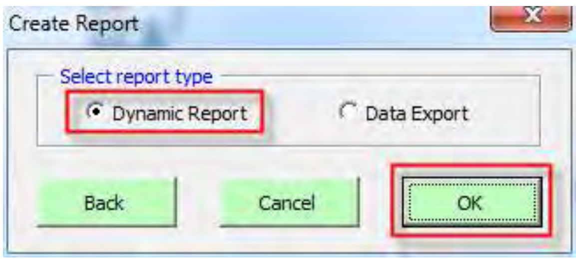
***Note**: For creating report of maintenance history data, user shall enter through maintenace history from the general window.*

(3) Select "**Create Report**" and Click "OK". To exit from Main Window, click "**Cancel**". Upon selecting "**Create Report**" and clicking "**OK**", Create Report window is appeared.

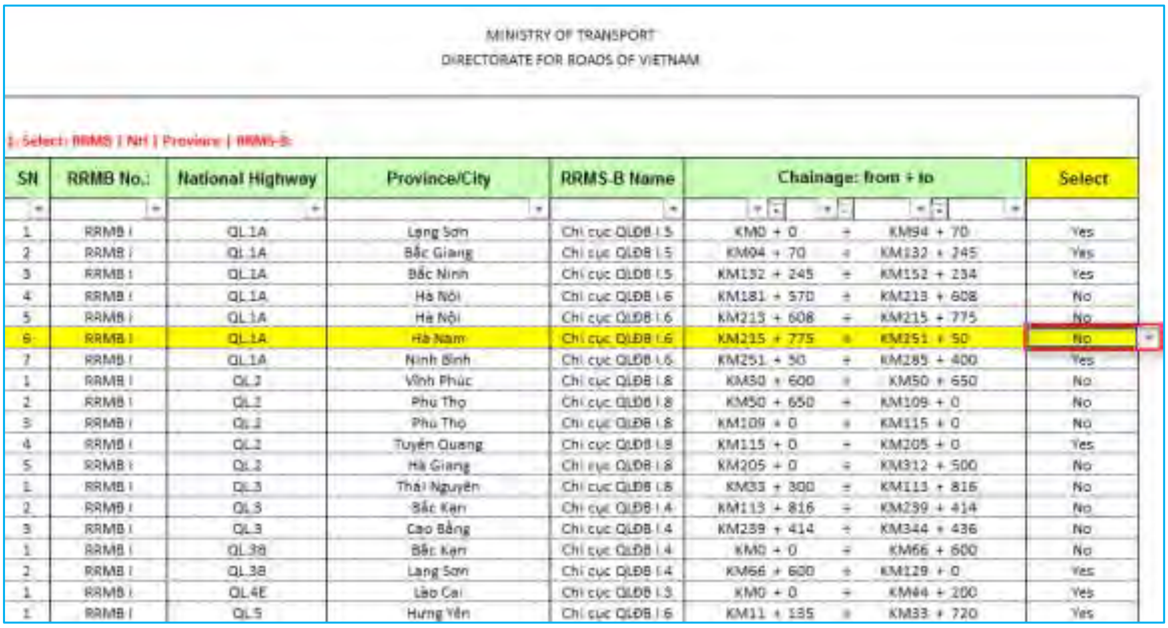


4.6.1 Create Dynamic Report

(1) Select report type as "**Dynamic Report**".



(2) Select Road Section by selecting "**Yes**" or "**No**" from the Select Column.



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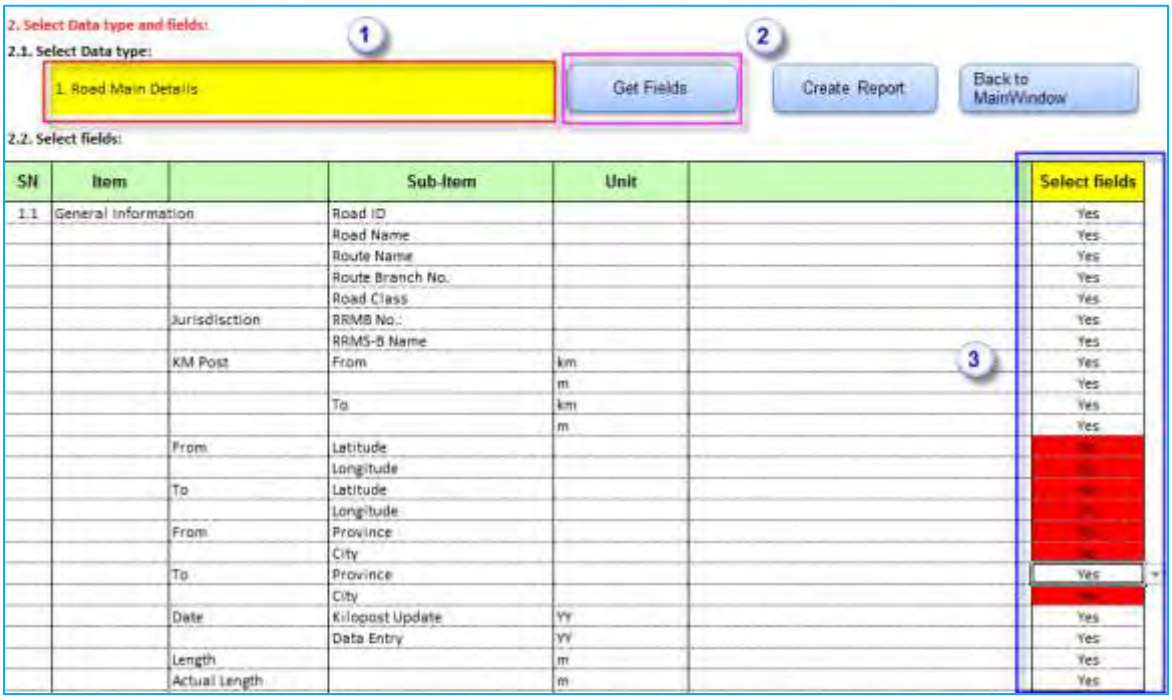
1. Select: RRMB | NH | Province | RRMS-B:

SN	RRMB No.:	National Highway	Province/City	RRMS-B Name	Chainage: from ÷ to			Select
1	RRMB I	QL1A	Lạng Sơn	Chi cục QLĐB I.5	KM0 + 0	÷	KM94 + 70	Yes
2	RRMB I	QL1A	Bắc Giang	Chi cục QLĐB I.5	KM94 + 70	÷	KM132 + 245	Yes
3	RRMB I	QL1A	Bắc Ninh	Chi cục QLĐB I.5	KM132 + 245	÷	KM152 + 234	Yes
4	RRMB I	QL1A	Hà Nội	Chi cục QLĐB I.6	KM181 + 570	÷	KM213 + 608	No
5	RRMB I	QL1A	Hà Nội	Chi cục QLĐB I.6	KM213 + 608	÷	KM215 + 775	No
6	RRMB I	QL1A	Hà Nam	Chi cục QLĐB I.6	KM215 + 775	÷	KM251 + 50	No
7	RRMB I	QL1A	Ninh Bình	Chi cục QLĐB I.6	KM251 + 50	÷	KM285 + 400	Yes
1	RRMB I	QL2	Vĩnh Phúc	Chi cục QLĐB I.8	KM30 + 600	÷	KM50 + 650	No
2	RRMB I	QL2	Phú Thọ	Chi cục QLĐB I.8	KM50 + 650	÷	KM109 + 0	No
3	RRMB I	QL2	Phú Thọ	Chi cục QLĐB I.8	KM109 + 0	÷	KM115 + 0	No
4	RRMB I	QL2	Tuyên Quang	Chi cục QLĐB I.8	KM115 + 0	÷	KM205 + 0	Yes
5	RRMB I	QL2	Hà Giang	Chi cục QLĐB I.8	KM205 + 0	÷	KM312 + 500	No
1	RRMB I	QL3	Thái Nguyên	Chi cục QLĐB I.8	KM33 + 300	÷	KM113 + 816	No
2	RRMB I	QL3	Bắc Kạn	Chi cục QLĐB I.4	KM113 + 816	÷	KM239 + 414	No
3	RRMB I	QL3	Cao Bằng	Chi cục QLĐB I.4	KM239 + 414	÷	KM344 + 436	No
1	RRMB I	QL3B	Bắc Kạn	Chi cục QLĐB I.4	KM0 + 0	÷	KM66 + 600	No
2	RRMB I	QL3B	Lạng Sơn	Chi cục QLĐB I.4	KM66 + 600	÷	KM129 + 0	Yes
1	RRMB I	QL4E	Lào Cai	Chi cục QLĐB I.3	KM0 + 0	÷	KM44 + 200	Yes
1	RRMB I	QL5	Hưng Yên	Chi cục QLĐB I.6	KM11 + 135	÷	KM33 + 720	Yes

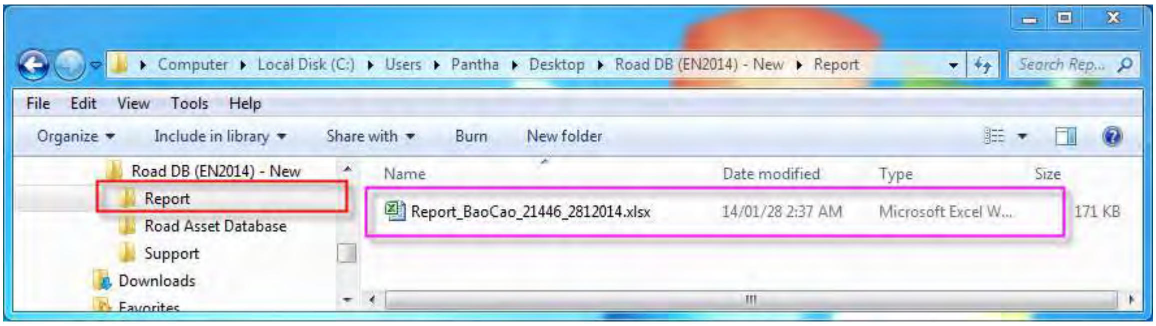
(3) Select Data Type and Click "**Get Field**" to display fields. Then, select fields to be included in the Report by selecting "**Yes**" and "**No".**



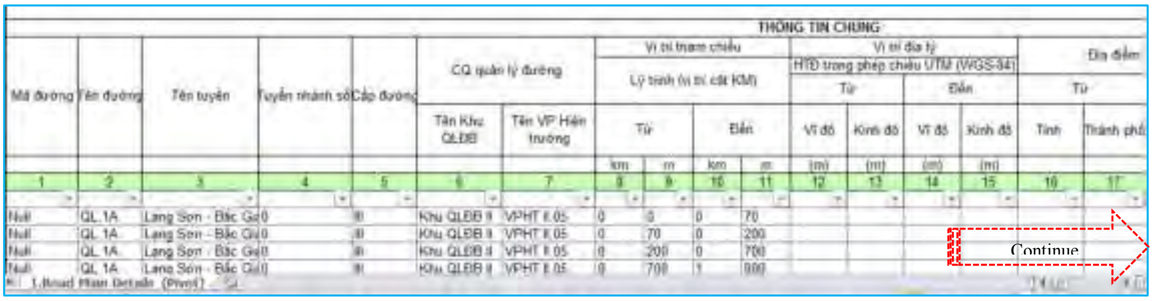
SN	Item		Sub-Item	Unit		Select fields
1.1	General Information		Road ID			Yes
			Road Name			Yes
			Route Name			Yes
			Route Branch No.			Yes
			Road Class			Yes
		Jurisdisction	RRMB No.:			Yes
			RRMS-B Name			Yes
		KM Post	From	km		Yes
				m		Yes
			To	km		Yes
				m		Yes
		From	Latitude			[illegible]
			Longitude			[illegible]
		To	Latitude			[illegible]
			Longitude			[illegible]
		From	Province			[illegible]
			City			[illegible]
		To	Province			Yes
			City			[illegible]
		Date	Kilopost Update	YY		Yes
			Data Entry	YY		Yes
		Length		m		Yes
		Actual Length		m		Yes

(4) Click "**Create Report**" button to export selected data from the Pivot Table.

(5) Open the Report from the "**Report**" folder in the database system

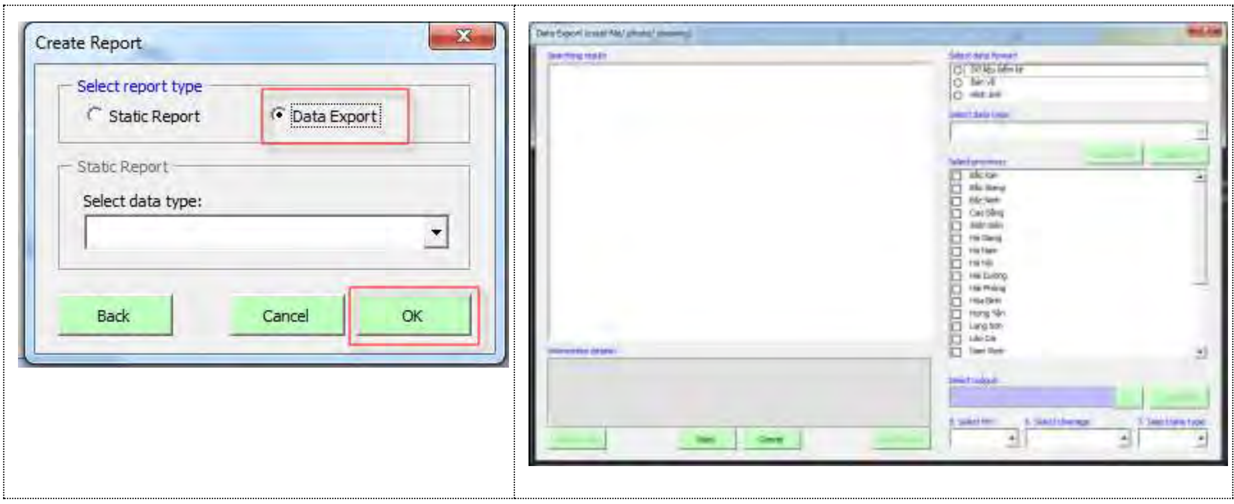


Only selected data items will be selected from the pivot table as shown below. From hereafter, user can customize the report as per their need just by using MS-Excel basic functions.

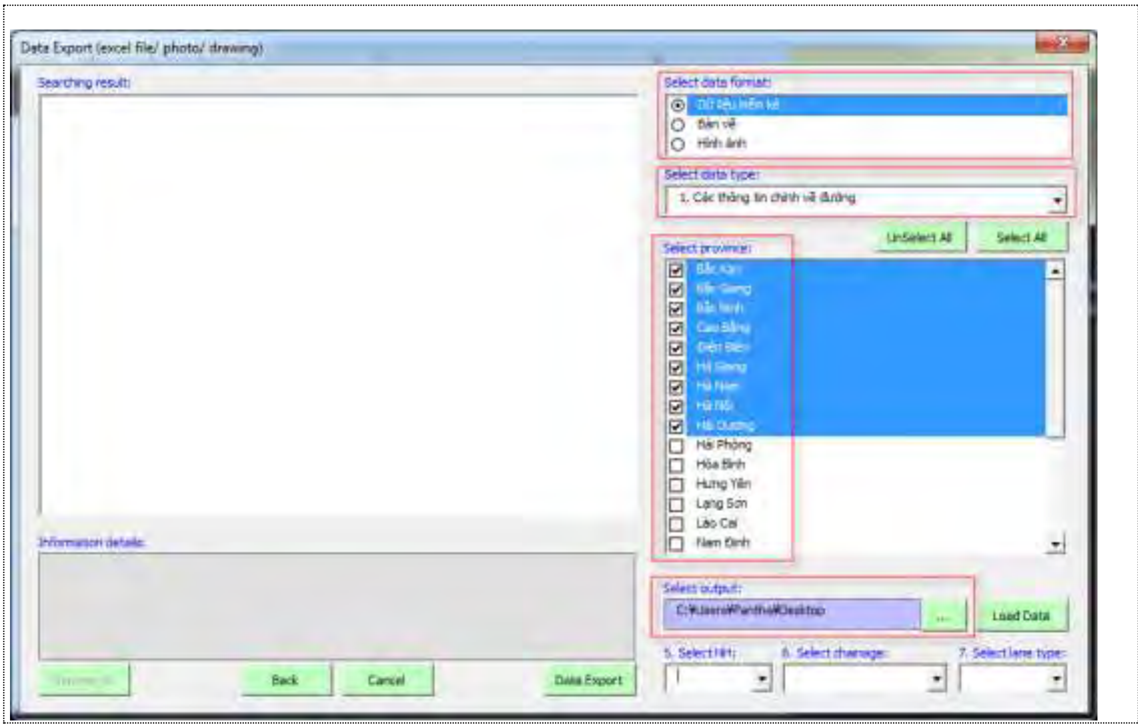


4.6.2 Data Export

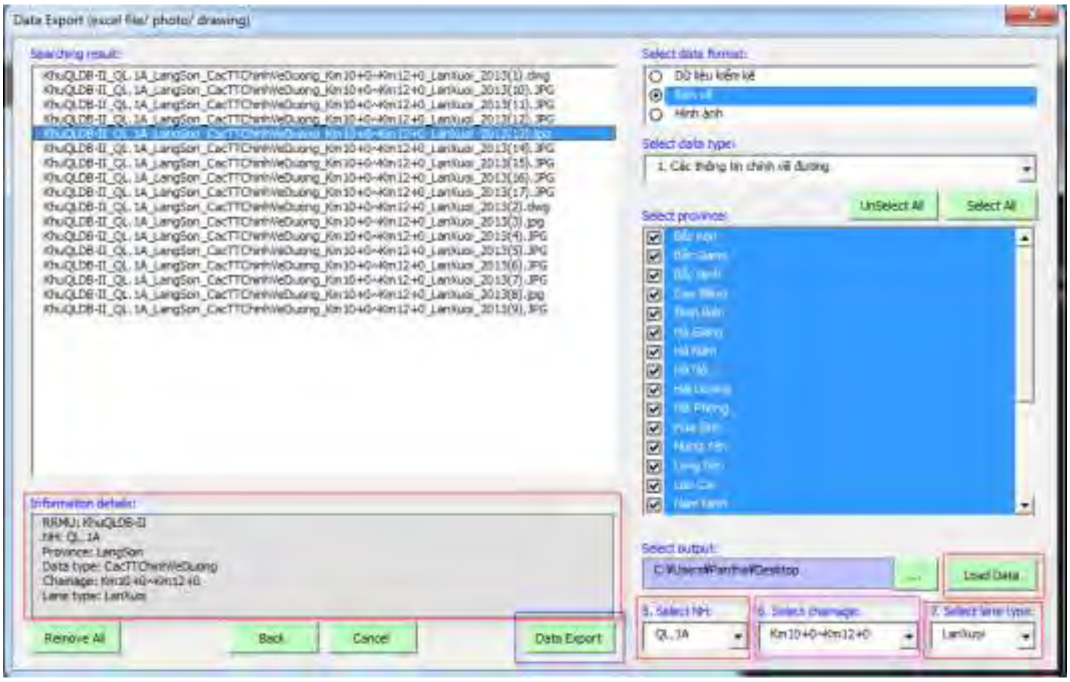
(1) Select report type as "**Data Export**" and click "**OK**". Data export window is appeared.



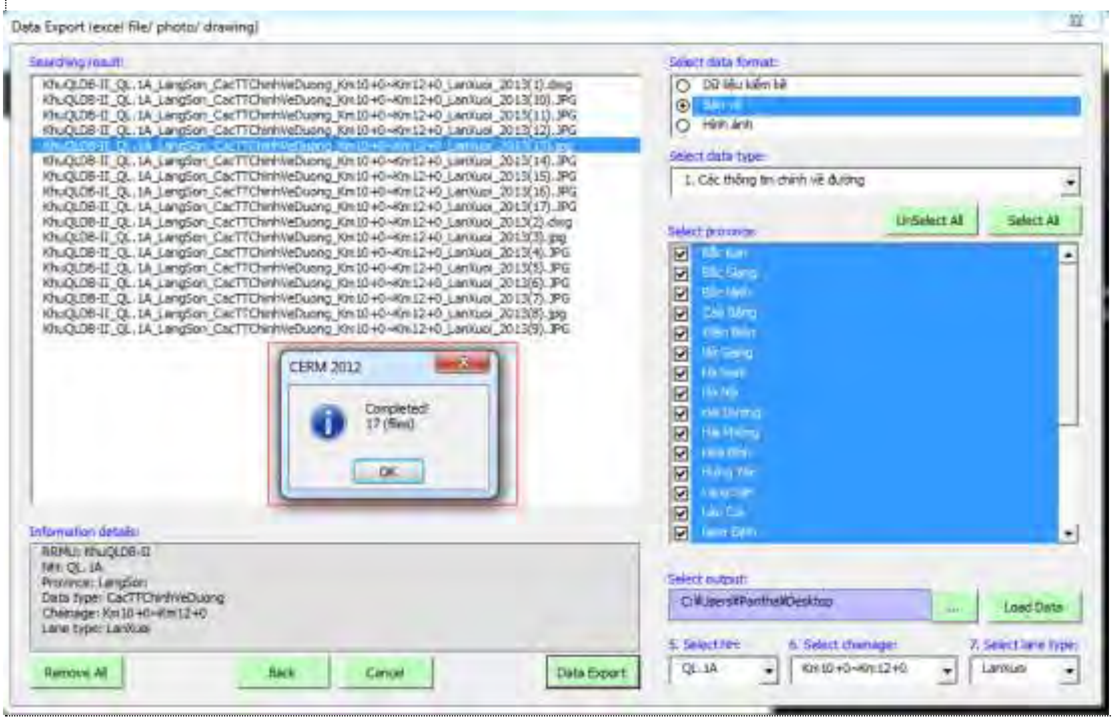
(2) Select data format type (i.e. inventory, photos or drawings), data type, province and browse output folder. Users can select their desired folder as output folder.



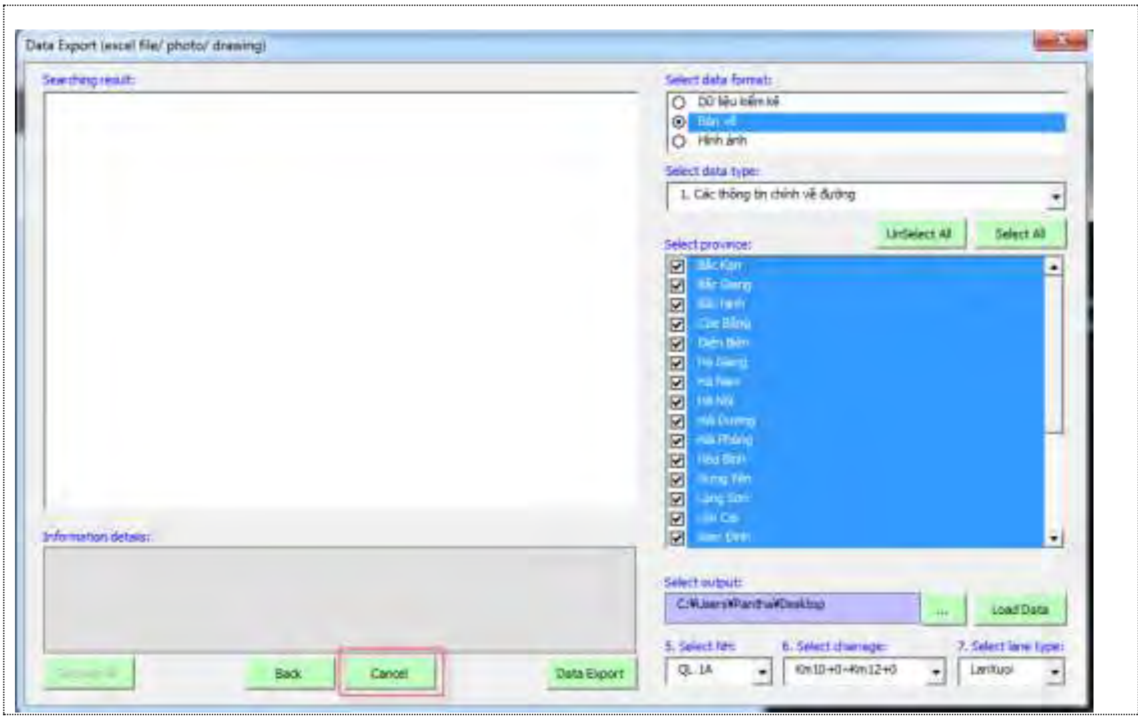
(3) Click "**Load Data**" to search data in database and upload into the data export window. Upon clicking "**Load Data**", all selected files are uploaded in the data export window. Optionally, uploaded files can be sorted by name of National Road, Chainage and lane type. If clicked particular uploaded file, detail information of that particular file are displayed in "Information details" box. Click "**Export Data**" after confirming uploaded files. All data are exported in the destination folder defined by user.



(4) Upon successfully exporting data in the specified destination folder, a confirmation message is appeared. Total numbers of exported files are also notified.



(5) Click "**OK**" to complete the data export of this time. Data export window is still active. Therefore, if any additional data need to be exported, it can be continued by following the step 2 to step 4. To exit from data export task, click "**Cancel**".



4.7 MAIN DETAILS FOR PMS AND PMOS DATASET PREPARATION

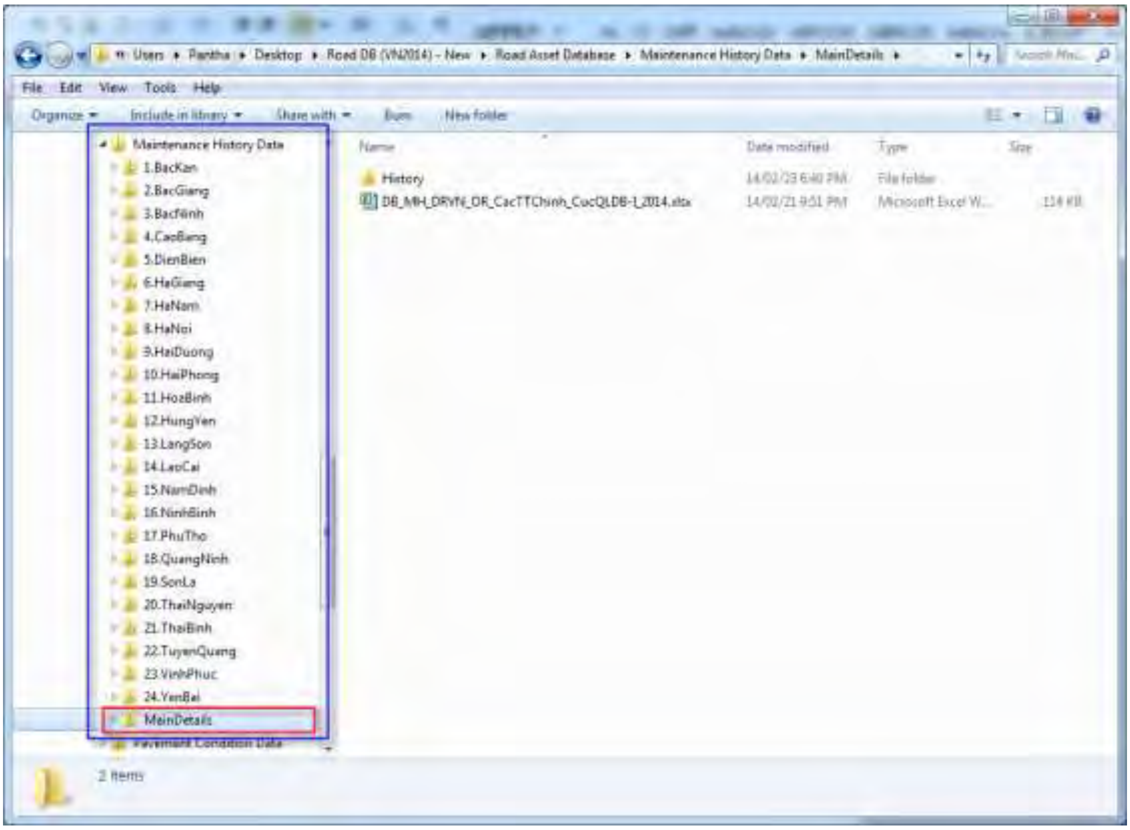
A concept of preparing main details of each data type (i.e. Road Asset, Pavement Condition, Maintenance History and Traffic Volume) has been developed for making data conversion process from road database to PMS and PMoS dataset less complicated. The main details of each data types are prepared separately within the database system.

4.7.1 Main Details of Road Asset Data

The "**Road Main Details**" pivot table itself is the main details of road asset data to be utilized in preparing PMS and PMoS dataset. Therefore, any additional operation and processing is not required for preparing main details of road asset data.

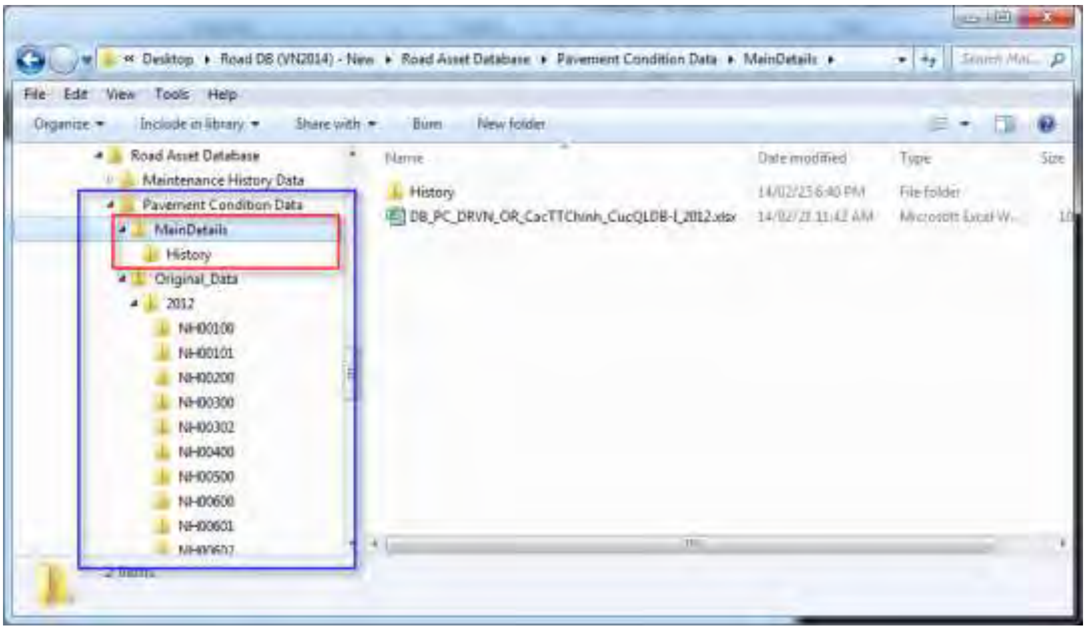
4.7.2 Main Details of Maintenance History Data

Since data input sheet and data input support system has been developed in road database system, main details of maintenance history data is generated in parallel when pivoting the inputted / edited maintenance history data. Maintenance history pivot table is saved inside respective provinces however main details of maintenance history is saved in a common file irrespective of province name. An additional sub-routine is included in the system. Therefore, it is not necessary to do anything by database operator to prepare main details of maintenance history. A separate folder "**Main Details**" is designed inside the "**Maintenance History Data**" Folder. The Main Details folder contains the latest main details of maintenance history data (as file) as well as past data as time series data in history data.



4.7.3 Main Details of Pavement Condition Data

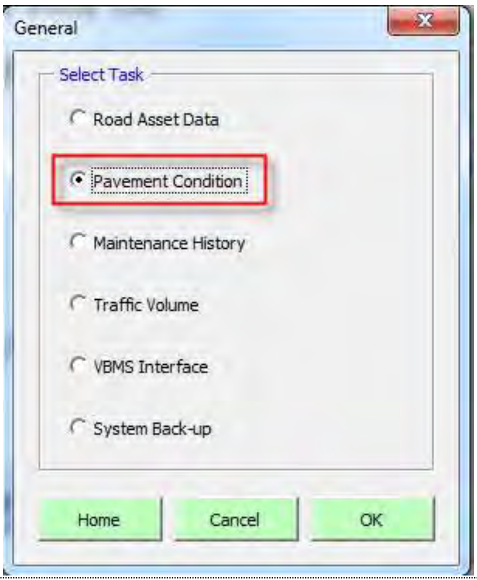
A tool to prepare main details data sheet of pavement condition data by combining all pavement condition data into one file is designed in road database system. It is presumed that pavement condition data submitted (to be submitted) by pavement condition survey team are in several folders by national highway name and stored in "**Original_Data**" folder located inside the database system.



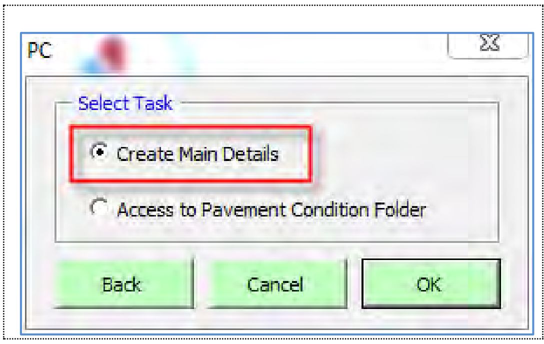
Upon receiving the final output of pavement condition data in the predefined format, the tool will combine all data into a single file. The combined data file contains two different sheets for UP and DOWN direction. In preparing PMS and PMoS dataset, this combined data file will be as an input file for conversion software. The details procedure for preparing main details of pavement condition data are described below.

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

(2) Click "**Select the Task**". General Window is appeared as shown below. Click "Pavement Condition" from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to select next task as shown below.

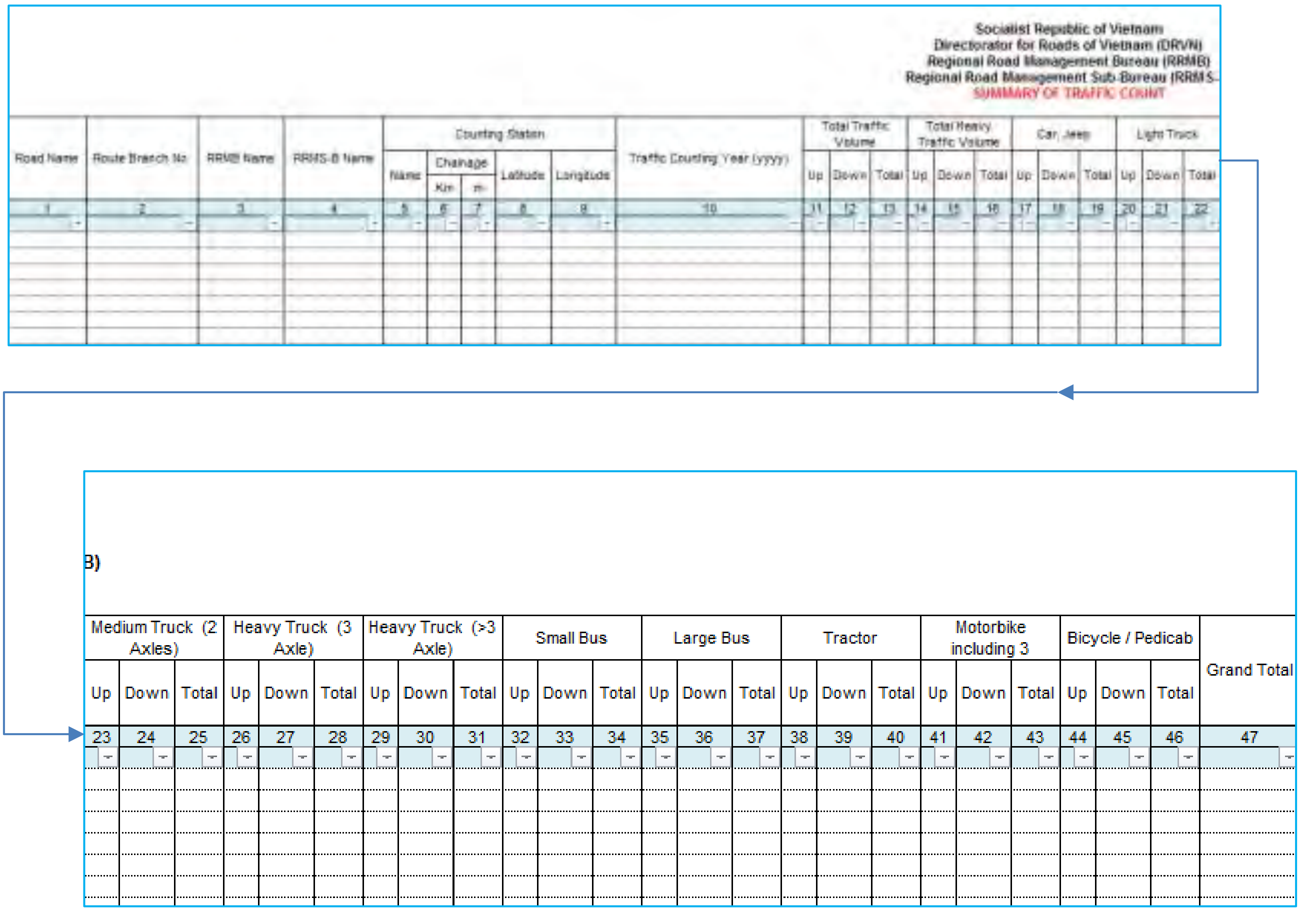


(3) Select "**Create Main Details**" and Click "OK". To exit from Main Window, click "**Cancel**". Upon selecting "**Create Main Details**" and clicking "**OK**", the system automatically combine all individual files of pavement condition data into one.



4.7.4 Main Details of Traffic Volume Data

Traffic volume data are preserved in DRVN format. However, the structure of data format is not in the form that software can extract the information from there without any system error. It presumed that possibility of occurring error is very high if the existing DRVN's format is used as the input file for conversion software. Therefore, main details sheet of traffic volume is prepare for avoiding possible error. DRVN is requested to summarize the annual traffic volume data in the format recommended by JICA Project team.



Socialist Republic of Vietnam
Directorator for Roads of Vietnam (DRVN)
Regional Road Management Bureau (RRMB)
Regional Road Management Sub-Bureau (RRMS-
SUMMARY OF TRAFFIC COUNT

Road Name	Route Branch No	RRMB Name	RRMS-B Name	Counting Station					Traffic Counting Year (yyyy)	Total Traffic Volume			Total Heavy Traffic Volume			Car, Jeep			Light Truck		
				Name	Chainage		Latitude	Longitude		Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total
					Km	m															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

B)

Medium Truck (2 Axles)			Heavy Truck (3 Axle)			Heavy Truck (>3 Axle)			Small Bus			Large Bus			Tractor			Motorbike including 3			Bicycle / Pedicab			Grand Total
Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47

CHAPTER 5 VBMS INTERFACE

5.1 BACKGROUND

Vietnamese Bridge Management System (VBMS) is in operation separately from the road maintenance system. The first version of VBMS was introduced in 1996 and keep on updating. The current VBMS consists of four modules namely bridge inventory module, bridge inspection module, planning module and administrative module.

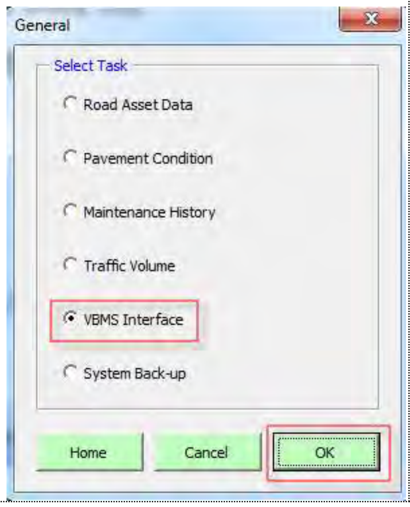
Bridge related information specifically location is needed for Pavement Management System (PMS) and Pavement Monitoring System (PMoS). Though bridge related data are available at www.vbms.vn and can be accessed from any place if user has VBMS user ID and password, it is recommended to download inventory data and save into the road database system. Conversion software is developed for converting data from road database to PMS and PMoS dataset and the software need to collect data from different files. Therefore, to make the conversion procedure convenient and operational even from the internet inaccessible computer, availability of bridge inventory data into the road database system is made.

Interface for VBMS is provided to link the Road Database system and VBMS. The current VBMS interface needs to login manually by inputting VBMS user ID and Password issued by VBMS administrator because automatic login is not allowed because of internet security system of the VBMS. As mentioned above VBMS stores bridge data in four modules and this interface is designed to import bridge inventory data only from the inventory module of VBMS into the Road Database system.

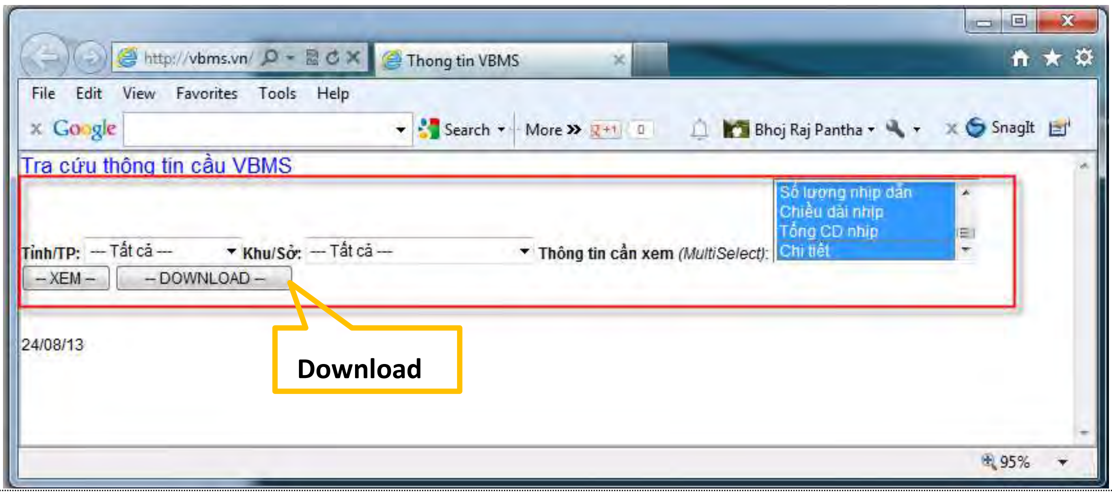
5.2 BRIDGE INVENTORY DATA DOWNLOAD

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

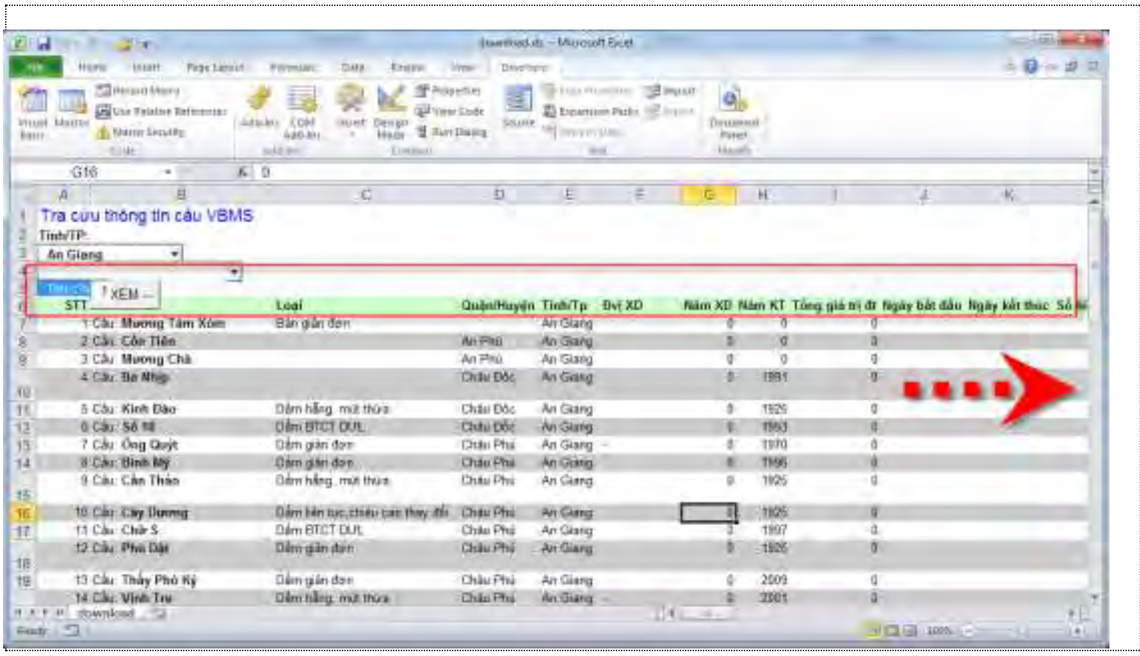
(2) Click "**Select the Task**". General Window is appeared as shown below. Select "**VBMS Interface**" and click "**OK**". The system prompts the user to VBMS website (www.vbms.vn/report/bridge.php). Login window will apprear as shown below. Enter "**User Name**" and "**Password**" Provided by VBMS administrator and click "**OK**".



(3) Bridge Inventory Data will display. Data can be sorted by province, RRMU2 and data field type. There are altogether 49 data fields. Upon sorting, download bridge inventory data.



(4) Upon completion of download, by default file will be named as "download.xls". The downloaded file can be saved in any location. Users are requested to check the data in each field and save the file in the specified format inside database system in Province folder as explained in section 1.5.2.


Tra cứu thông tin cầu VBMS
Tỉnh/TP:
An Giang
XEM

CHAPTER 6 STORING PAVEMENT CONDITION AND TRAFFIC VOLUME DATA IN ROAD DATABASE SYSTEM

6.1 PAVEMENT CONDITION DATA

In designing this road database system, it is presumed that pavement condition data are not inputted using similar type of data input sheet which are designed for road asset data. Since pavement condition data is usually collected by pavement condition survey vehicle and special data analysis software to derive survey data into operational format by data processing, the output of data processing will be in the standard format which can be used directly without further modification. Also, pavement condition data may consist of photos, videos and GPS data. Therefore, road database system allows users to save in "**Pavement Condition Data**" folder by copying from another locations / devices. Users can simply copy the whole folder or part of pavement condition data from the origin folder and paste them into "Pavement Condition Data" folder (destination folder) provided in road database system. At present no tool is inserted in database system to import pavement condition data because the tool may not handle total volume of pavement condition data at once. It is presumed that pavement condition data including photos and videos will be several gigabytes (GB) in volume. While using pavement condition data in formulating PMS and PMoS dataset, conversion software will search and import data from pavement condition data folder.

6.2 TRAFFIC VOLUME DATA

Traffic volume is counted every month and reported in accordance with Technical Norms 2003. Technical Norms 2003 prescribed the standard data input and reporting format. Therefore, traffic data input format is not designed in the database system. DRVN can collect and store data in their own traffic volume reporting format or in any new traffic volume inputting format. Therefore, road database system allows users to save traffic volume data files or folder by copying from another locations / devices. Users can simply copy the whole folder or part of traffic volume data from the origin folder and paste them into "Traffic Volume Data" folder (destination folder) provided in road database system. At present no tool is inserted in database system to import traffic volume data. While using traffic volume data in formulating PMS dataset, conversion software will search and import data from traffic volume data folder.

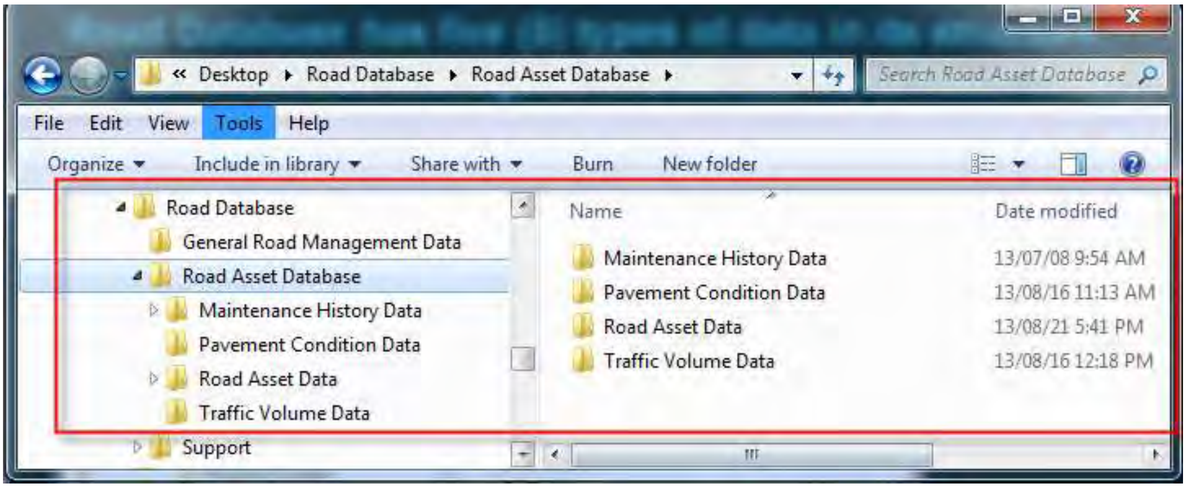
CHAPTER 7 DATABASE SYSTEM UPDATING AND EDITING

7.1 RATIONAL

The main reason of using MS-Excel as a platform for developing this road database system is the easiness in operation and flexibility in its editing, updating and upgrading. System updating can be done easily if the person has sufficient knowledge in MS-Excel and VBA. However, it is not recommended to change database system unless it utmost necessary. Editing and updating can be done in database structure, folder structure, data type, data items, data input sheet and validation criteria.

7.2 DATABASE STRUCTURE

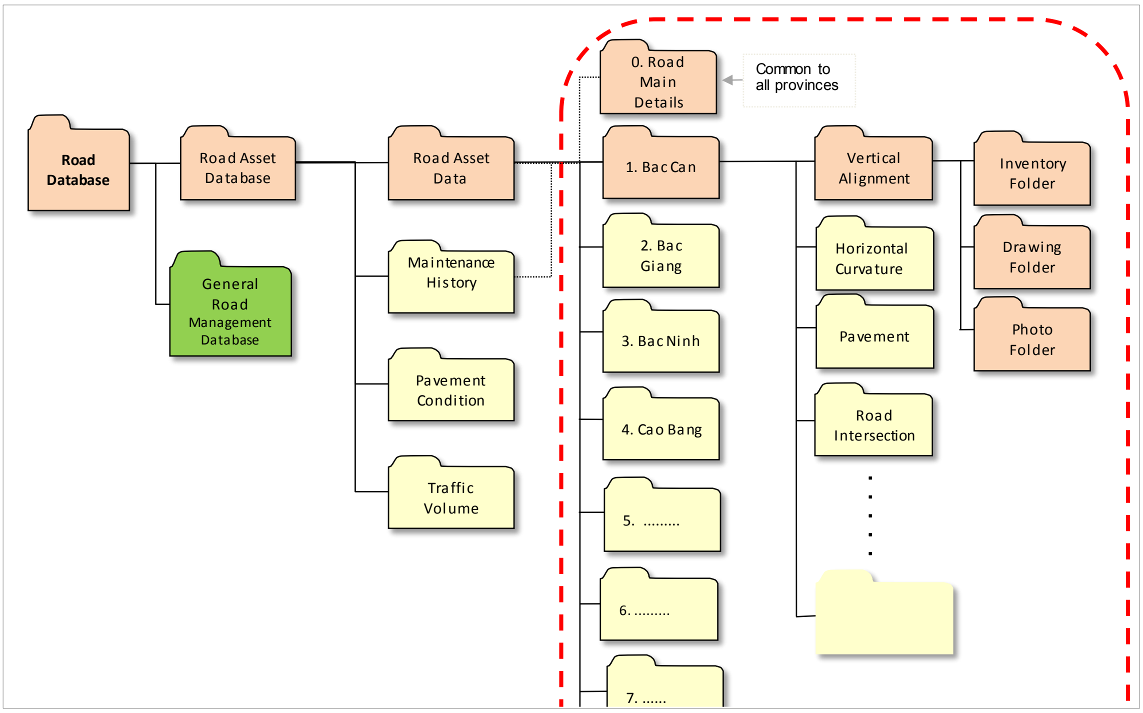
Road database has five (5) types of data in its structure; (1) General Road Management Data (2) Road Asset Data, (3) Maintenance History Data, (4) Pavement Condition Data, and (5) Traffic Volume Data. Road database structure is shown below.



If name or location of the folders in database structure is changed, path defined in the system may lose and system may not function properly. **Therefore, before changing any folder name or relocating sub-folder, it is necessary to check path details and revised them accordingly if modification is utmost necessary.** Please check **Figure 1.4.1** to identify the possible consequences if alteration is made in database structure.

7.3 FOLDER STRUCTURE

The database folder structure is shown in **Figure 1.3.3** and also below. If name or location of the folders is changed, path defined in the system may lose and system may not function properly. **Therefore, before changing any folder name or relocating folder and sub-folder, it is necessary to check path details and revised them accordingly if modification is utmost necessary**. Please check **Figure 1.4.1** to identify the possible consequences if alteration is made in folder structure. Some system path and naming are provided in "**Set.Path**" sheet in system interface file.



7.4 DATA TYPE

Five types of data are included in the database system. If any additional data type is needed to be included, the interface file also needs to be updated to support the added data type. Only adding folder inside "Road Database" folder does not mean that you added data type in the database system. If any data types are to be added in the database system, the intended functions shall be either coded from the beginning or linked with the available code which is already written inside the system. If name of any of the data type including spellings is changed, the system may not recognize undefined words and thus system may not function properly. Therefore, before changing any data type name, please check the defined name inside the system and revise them accordingly if modification is utmost necessary.

7.5 DATA ITEMS

Data input sheets are designed for 29 data items. There are various inter-relations within the interface file and between the interface file and the storage file (pivot table) or folders. If name of data items or file name is changed, the interface system may not work properly. Therefore, it is recommended not change the file name of the data items unless it is utmost necessary. Additionally, if new data items need to be supplemented, properly coding and linking is necessary within the interface file and between interface file and storage file. The inter-relation within the interface file and between interface file and storage file is shown in **Figure 1.4.1**.

7.6 DATA INPUT SHEET

Data input sheets are developed for road asset data (excluding bridge) and pavement maintenance history data using VBA and MS-Excel built-in functions. Data input sheets are protected by password. The specific cells are assigned for data inputting and converting data from individual cell to display mode, validation check sheet and data pivoting by referring these cells. Name of sub-items are fixed in all related sheets / files. If any changes are made in Name of sub-items, it is necessary to revise in all related sheets / files also. The input control is provided in the cells whenever applicable. Drop down menu can be changed easily from "**Set.selectType**" sheet provided in the interface file.

Adding new data sub-items is possible however all related sheets shall be revised accordingly. It is necessary to unlock the sheet before starting any modification in the input sheet by receiving the password from the database administrator. If assigned cells are tried to delete or modify, the links between cells and other sheets may lose and system may not function properly. Therefore, before any changes, please be confirmed about how to revise them accordingly if modification is utmost necessary.

7.7 VALIDATION CRITERIA

Validation check is performed to check section overlap, data format type, blank data and data range. Except for section overlap, validation check is performed by checking the predefined validation criteria presented in the tabular form. The table / sheet for checking validation check is protected by password. If validation criteria need to be revised, it can be done by unprotecting validation check sheet. Desired criteria can be inputted in the validation check table as shown below.

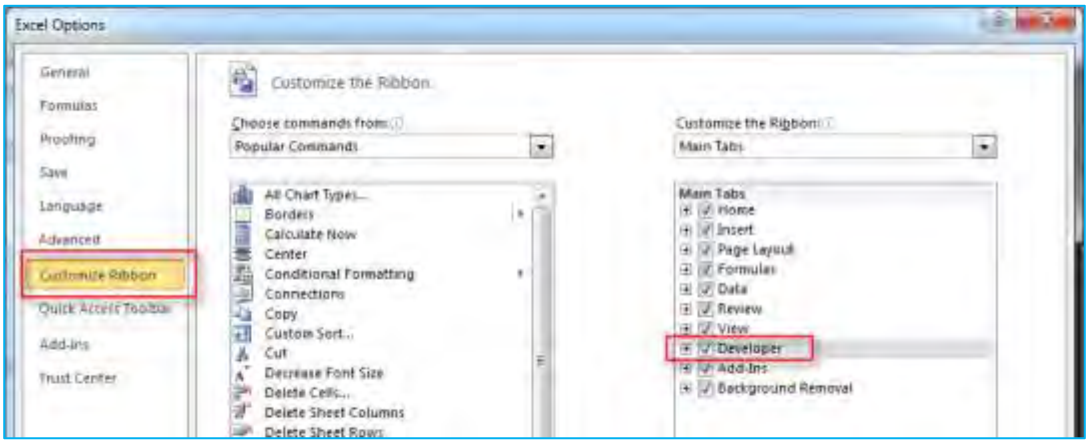
If columns other than criteria are modified, the validation check function may not perform properly. It is highly recommended not to make any changes in the table other than the columns allocated for criteria. Therefore, before changing any column, please be confirm about how to revise them accordingly if modification is utmost necessary.

7.8 VBA CODING

The basic functions of the database system are developed by using Excel VBA. VBA codes are protected by password to prevent from system damage (fully or partially) because if VBA unknown person modify any VBA statement, the system may not work properly. The password is provided to database administrator. If database administrator intends to edit the system by modifying the VBA code, VBA code shall unprotect and necessary modification can be done. The following steps shall perform to edit VBA code.

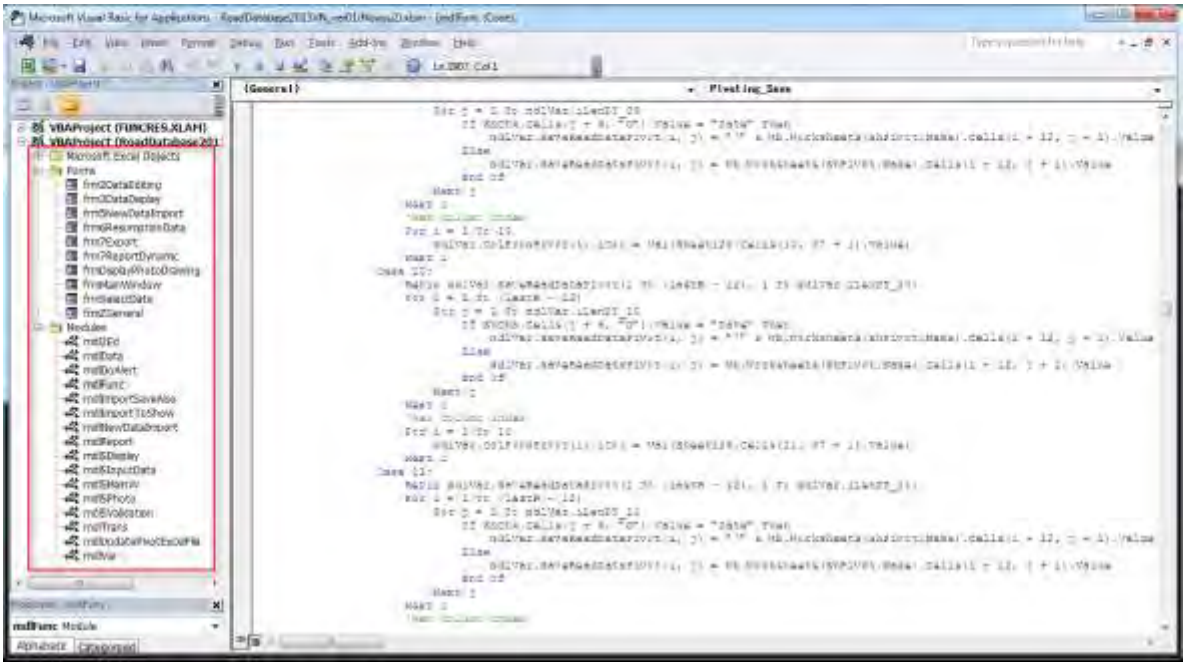
(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

(2) Enable "**Developer**" ribbon of MS-Excel by entering check mark (√) from MS-Excel options if developer ribbon is not appeared in the MS-Excel standard toolbar.



(3) Upon enabling the "**Developer**" ribbon, it appeared in the standard toolbar as shown below. To see VBA code in Visual Basic Editor, click on "**Visual Basic**" tab. Alternately, press "**Alt + F11**" to open Visual Basic Editor.

(4) Enter password to see VBA Object, Modules, Forms and VBA Code. Click "**Microsoft Excel Object**" to see the list of object. Similarly, Click "**Forms**" and "**Modules**" to see list of Forms and Modules inserted in the system respectively. To see detailed VBA code, double click on desired VBA Object or Forms or Modules and VBA codes will appear as shown.



(5) Edit or update VBA Object, Forms or Module as necessary. It is highly recommended not to make any changes in the VBA Code unless modification is utmost necessary.

7.9 SPECIAL NOTES

(1) Updating both English and Vietnam Version Simultaneously

When update VN version of the system is updated, please update EN version also at the same time. It is necessary because if contents in EN and VN are different, international expert may not assist in updating the system in the future.

(2) Handling by Authorized Officials Only

It is highly requested to handle updating or editing the main system only by authorized officials. It is not necessary to disclose password to general user including data inputting person because if anything changes in database structure, data input sheet and pivot table, data inputted in the modified system may not be compatible with original and data importing (data assembling) function may not function properly.

(3) Technical Support

When system updating or editing is required, please refer to user guide or consult with the organization or person who involved in system development (preferably to UTC) or person specialized in similar system development to avoid any trouble in the system.

APPENDICES

APPENDIX - 1 DATA DEFINITION

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
1	Road Main Details	1.1	General Information	Road ID		Character	Road ID According to DRVN Reference System	
				Road Name		Character	Name of Road expressed as per Vietnamese regulation on road naming “36/2005/QD-BGTVT”	Example: National Highway: QL.1A, QL.2 Provincial Road: DT.1
				Route Name		Character	Name of routes generated based on province of starting and ending point (From / To) of particular road section	Example: Lang Son – Bak Giang
				Route Branch No.		Character	Bypass numbering. For main road Route Branch No. is “0” always and for bypass 1, 2, etc.	0 : Main Road or No Bypass 1 : First Bypass 2 : Second bypass
				Road Class		Character	Road Class based on TCVN 4054, Highway Specification for Design, Third Edition, 2005	Expressway, I, II, III, IV, V, VI
				Jurisdiction		Character	RRMB and RRMS-B Number	RRMB: RRMB I, RRMU II, RRMU III, RRMU IV RRMS-B: RRMS-B 1, RRMS-B 2, RRMS-B 3, RRMS-B 4, RRMS-B 5, RRMS-B 6, RRMS-B 7, RRMS-B 8
				From (Kilopost)	km, m	Numeric	Starting chainage of the section	
				To	km, m	Numeric	Ending chainage of the section	
				Latitude		Numeric	Latitude of Starting or Ending Point Measured by GPS	
				Longitude		Numeric	Longitude of Starting or Ending Point Measured by GPS	
				Length	m	Numeric	Sectional Length (To - From)	
				Kilopost Adjustment Date	YY/MM/DD	Date	Date of Kilopost adjustment especially after a big repair work or bypass road construction.	
				Date of Update	YY/MM/DD	Date	Date of Database Updating	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Province		Character	Name of province where the section located	24 Provinces
				City		Character	Name of city where the section is located	
		1.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Year of Construction Completion	YY/MM/DD	Numeric	Completion Year of Construction	
				Year of Service Operation Open	YY/MM/DD	Numeric	Year of Service Operation Open for Traffic	
				Terrain Type		Character	Type of terrain classified by geographical location (as per TCVN 4054)	Flat : Flat Mountainous : Mountainous
				Temperature	Deg. Cel.	Numeric	Annual Average Temperature of the Area	
				Annual Precipitation	mm	Numeric	Average Annual Precipitation	
				Road Bed Type			Type of road bed on which the pavement layers are laid	Cutting : Cutting Embankment : Embankment Both : Both Mostly_Cut : Mostly Cutting Mostly_Embn : Mostly Embankment
				Road Safety Corridor	m	Numeric	Land allocated in each side of road corridor for safety purpose and future expansion of the road	Road Safety Corridor (Up) Road Safety Corridor (Down)
				Design Speed	Km/h	Numeric	Max. speed of vehicle which was considered during design stage (VN Standard)	
				Road Land Width	m	Numeric	Width of carriageway, shoulder, footpath, ditch, median strip	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
							and road safety corridor (equivalent to Right of Way)		
				No. of Road Structure by Type	No.	Numeric	No. of major road structures (which can be identified distinctly) located within the road section considered.	Bridge Road Intersection Railway Crossing Box Culvert Slab Culvert Pipe Culvert Fly-over Bridge Others	
				No. of Motorized Lane	No.	Numeric (Integer)	Total number of lanes which are designed for motorized traffic		
				Width of Motorized Lane	m	Numeric	Width of a lane which is designed for motorized traffic		
				Pavement Type of Motorized Lane		Character	Pavement type of motorized lane categorized as per pavement material	AC AM BP CC MP AP EP Others	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				No. of Non-Motorized Lane		Numeric (Integer)	Number of lanes which are designed for non-motorized traffic such as bicycle, rickshaw, etc.		
				Width of Non-Motorized Lane	m	Numeric	Width of a lane which is designed for non-motorized traffic		
				Pavement Type of Non-Motorized Lane		Character	Pavement type of non-motorized lane categorized as per pavement material	AC AM BP	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration)

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								CC MP AP EP Others	: Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Carriageway Width	m	Numeric	Width of road section covered by motorized traffic lane (excludes shoulder and median strip if any)		
				Pavement width	m	Numeric	Width of road section where pavement has been applied		
				Road Bed Width	m	Numeric	Width between ditch in each side (Pavement width + Shoulder width + footpath + median strip + ditch)		
				Shoulder width	m	Numeric	Width of Shoulder		
				Shoulder Type		Character	Type of Shoulder by material type	AC CC MP AP EP ComP Others	: Asphalt Concrete : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Composite Pavement : Others
				Non-Treated Shoulder Width	m	Numeric	Width of unpaved (non-treated) shoulder		
				Footpath Width	m	Numeric	Width of Footpath		
				Footpath Type (by pavement material type)		Character	Type of footpath by material type	RCC PCC BS CCTS BTS STS GS ES Others	: RCC Surface : PCC Surface : Bitumen Surface : CC Tile Surface : Brick Tile Surface : Stone Tile Surface : Gravel Surface : Earth Surface : Others

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Ditch width	m	Numeric	Top width of drain		
				Ditch Structure		Character	Ditch structure type by material	CC RCC Others	: Cement Concrete : Reinforced Cement Concrete : Others
				Width of Median Strip	m	Numeric	Width of median strip provided between opposite direction road		
				Max. Difference in Elevation	m	Numeric	Max. elevation of median strip from the road surface		
				Median Structure		Character	Median structure type by material type	CC RCC ST Others	: Cement Concrete : Reinforced Cement Concrete : Steel : Others
2	Vertical Alignment	2.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	YY				
				Province					
				City					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
		2.2	Main Elements	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.		
				Gradient	%	Numeric	Value of longitudinal gradient/slope		
				Gradient Type	(+/-)	Symbol	Ascending (+) and Descending (-)	Zero Ascending Descending	: Flat (Zero Gradient) : Ascending (+) : Descending (-)
		2.3	Vertical Curve at End Side	Curve Type		Character	Curve type whether convex or concave	Concave Concave	: Concave : Convex
				Curve Length	m	Numeric	Total Length of Vertical Curve		
				Radius	m	Numeric	Radius of Vertical Curve		
				Chainage of Middle of Curve	km, m	Numeric	Road chainage (Kilometer Station) of Middle of Curve		
				Gradient of Outgoing Gradient (G2)	%	Numeric	Value of outgoing gradient with respect to increasing road chainage		
3	Horizontal Curvature	3.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	YY				
				Province					
				City					
		3.2	Main Elements	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Total Length of Curve	m	Numeric	Actual Total Length of Curve (Main and transition curve)		
				Radius of Main Curve	m	Numeric	Radius of Main Curve		
				Length of Transition Curve (I)	m	Numeric	Length of Transition Curve (Starting side)		
				Length of Transition Curve (II)	m	Numeric	Length of Transition Curve (Ending side)		
				Rate of Super elevation (%)	%	Numeric	Super elevation provided at curve section		
				Turning Direction (L / R)		Character	Turning direction with respect to starting point.	Right Left	: Clockwise with reference to start point : Anticlockwise with reference to starting point
				Angle of Intersection	degree	Numeric	Angle of deflection at the intersection		
				Width of Extra Widening	m	Numeric	Extra width of road provided at curve section		
4	Paveme nt	4.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		4.2	Overall	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.		
				Pavement Type		Character	Pavement Type by Material Type	AC AM BP CC MP AP EP Others	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Max. Pavement Width	m	Numeric	Maximum width of pavement surface		
				Min. Pavement Width	m	Numeric	Min. width of pavement surface		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Pavement Area	m2	Numeric	Area covered by Pavement Surface (length X avg. width)	
				Thickness	cm	Numeric	Total Thickness of Pavement Structure	
		4.3	Roadway Carriageway (Motorized Lane)	Width	m	Numeric	Width of Carriageway	
				Area	m2	Numeric	Area of Carriageway (Length X Width)	
				Pavement Structure Type		Character	Pavement structure of carriageway portion	Flexible : Flexible Pavement Rigid : Rigid Pavement Composite : Composite Pavement Others : Others
		4.3.1	Pavement Loading Capacity	Benkelman Beam Deflection	daN/cm2	Numeric	Pavement Loading Capacity measured by Benkelman Beam on the finished surface	
				Loading Plate	daN/cm2	Numeric	Pavement Loading Capacity measured by Loading Plate on the finished surface	
				FWD	Mpa	Numeric	Pavement Loading Capacity measured by FWD on the finished surface	
		4.3.2	Subgrade Loading Capacity	Loading Plate	daN/cm2	Numeric	Loading capacity of subgrade layer measured by Benkelman Beam	
				FWD	Mpa	Numeric	Loading capacity of subgrade layer measured by FWD	
				CBR	%	Numeric	Loading capacity of subgrade layer measured by CBR Test	
		4.3.3	Subgrade Course	Thickness	cm	Numeric	Thickness of subgrade course	
				Pavement Type		Character	Type of material applied in subgrade course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of subgrade course	
				Binder Type		Character	Type of binder used in subgrade course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size	mm	Numeric	Max. size of aggregate used in subgrade course	
		4.3.4	Sub-Base	Thickness	cm	Numeric	Thickness of sub-base course	
				Pavement Type		Character	Type of material applied in sub-base course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of sub-base course	
				Binder Type		Character	Type of binder used in sub-base course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								Flyash Chemical Mixed Others	: Fly Ash : Chemical Agents : Combined : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in sub-base course		
		4.3.5	Base	Thickness	cm	Numeric	Thickness of base course		
				Pavement Type		Character	Type of material applied in base course	AC AM BP CC MP AP EP Others	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of base course		
				Binder Type		Character	Type of binder used in base course	Cement Lime Emulsion Bitumen Flyash Chemical Mixed Others	: Cement : Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents : Combined : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in base course		
		4.3.6	Binder Course	Thickness	cm	Numeric	Thickness of binder course		
				Pavement Type		Character	Type of material applied in binder course	AC AM BP	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of binder course	
				Binder Type		Character	Type of binder used in binder course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in binder course	
		4.3.7	Wearing Course	Thickness	cm	Numeric	Thickness of wearing course	
				Pavement Type		Character	Type of material applied in wearing course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of wearing course	
				Binder Type		Character	Type of binder material used in	Cement : Cement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
							wearing course	Lime Emulsion Bitumen Flyash Chemical Mixed Others	: Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents : Combined : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate/chips used in wearing course		
		4.3.8	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion year		
				Construction Cost	VND	Numeric	Construction cost of the pavement layers of carriageway portion		
				Service Life	Year	Numeric	Service life of pavement layers (as a whole)		
		4.4	Non-Motorized Traffic Lane	Width	m	Numeric	Width of shoulder		
				Area	m2	Numeric	Area of Shoulder (length X width)		
				Pavement Structure Type		Character	Pavement structure of shoulder portion		
		4.4.1	Pavement Loading Capacity	Benkelman Beam Deflection	daN/cm2	Numeric	Pavement Loading Capacity measured by Benkelman Beam on the finished shoulder surface		
				Loading Plate	daN/cm2	Numeric	Pavement Loading Capacity measured by Loading Plate on the finished shoulder surface		
				FWD	Mpa	Numeric	Pavement Loading Capacity measured by FWD on the finished shoulder surface		
		4.4.2	Subgrade Loading Capacity	Loading Plate	daN/cm2	Numeric	Loading capacity of subgrade layer measured by Benkelman Beam		
				FWD	Mpa	Numeric	Loading capacity of subgrade layer measured by FWD		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				CBR	%	Numeric	Loading capacity of subgrade layer measured by CBR Test	
		4.4.3	Subgrade Course	Thickness	cm	Numeric	Thickness of subgrade course	
				Pavement Type		Character	Type of material applied in subgrade course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of subgrade course	
				Binder Type		Character	Type of binder used in subgrade course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size	mm	Numeric	Max. size of aggregate used in subgrade course	
		4.4.4	Sub-Base	Thickness	cm	Numeric	Thickness of sub-base course	
				Pavement Type		Character	Type of material applied in sub-base course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of sub-base course	
				Binder Type		Character	Type of binder used in sub-base course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in sub-base course	
		4.4.5	Base	Thickness	cm	Numeric	Thickness of base course	
				Pavement Type		Character	Type of material applied in base course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of base course	
				Binder Type		Character	type of binder used in base course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in base course	
		4.4.6	Binder Course	Thickness	cm	Numeric	Thickness of binder course	
				Pavement Type		Character	Type of material applied in binder course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of binder course	
				Binder Type		Character	Type of binder used in binder course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in binder course	
		4.4.7	Wearing Course	Thickness	cm	Numeric	Thickness of wearing course	
				Pavement Type		Character	Type of material applied in wearing course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of wearing course	
				Binder Type		Character	Type of binder material used in wearing course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate/chips used in wearing course	
		4.4.8	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion year	
				Construction Cost	VND	Numeric	Construction cost of the pavement layers of carriageway portion	
				Service Life	Year	Numeric	Service life of pavement layers (as a whole)	
		4.5	Shoulder	Width	m	Numeric	Width of Road Shoulder	
				Area	m2	Numeric	Area of Shoulder	
				Pavement Structure Type		Character	Pavement structure type by material used	
		4.6	Footpath	Width	m	Numeric	Width of footpath portion	
				Area	m2	Numeric	Area of footpath portion	
				Pavement Structure Type		Character	Pavement structure type by material used	RCC : RCC Surface PCC : PCC Surface

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								Bitumen CC_Tile Brick_Tile Stone_Tile Gravel Earth Others	: Bitumen Surface : CC Tile Surface : Brick Tile Surface : Stone Tile Surface : Gravel Surface : Earth Surface : Others
5	Road Intersec tion	5.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage at Center From (Kilopost)	km, m				
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		5.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Intersection System		Character	Type of Intersection in terms of structure type	At-Grade Differential	: Level Crossing : Differential Crossing
				Intersection		Character	Classification of intersection	1	: Intersection with National Road(s) : Intersection with Expressway(s)

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Classification (Express way, National Road etc.)			with respect to main roads	2 : Intersection with Provincial Road(s) 3 : Intersection with District Road(s) 4 : Intersection with Local Road(s) 5
				Intersection Type (by provision of signal)		Character	Intersection type by provision of traffic signal at intersection	Signalized : Signalized Non-Signalized : Non-Signalized
				Intersection Type (by configuration)		Character	Number of intersection legs/branches that are meeting at the intersection	3-Leg : 3-Legs Intersection 4-Leg : 4-Legs Intersection 5-Leg : 5-Legs Intersection Roundabout : Roundabout Flyover : Flyover Viaduct : Viaduct Others : Others
		5.3	Main Road Details	Brach/Leg No.	No.	Numeric	Number of branches or legs that belongs to main road	
				Carriageway Width	m	Numeric	Carriageway with of main road	
				Number of Lane	No.	Numeric	Total number of lanes in man road	
				Median Strip / Traffic Island / Ramp		Character	Existence of median strip / traffic island / ramp on the main road	Yes : Yes No : No
				Footpath		Character	Existence of footpath	Yes : Yes No : No
				Bicycle Lane		Character	Existence of footpath	Yes : Yes No : No
				Pedestrian Crossing		Character	Existence of pedestrian crossing	Yes : Yes No : No
				Traffic Signal		Character	Existence of traffic signal	Yes : Yes No : No
				Lighting		Character	Existence of road lighting	Yes : Yes No : No
				Traffic Regulation / Marking etc.		Character	Provision of Traffic Regulation / Marking	Yes : Yes No : No

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
		5.4	Sub-Main Road (Crossing Road)	Branch / Leg No.	No.	Numeric	Number of branches or legs that belongs to sub-main road		
				Carriageway Width	m	Numeric	Carriageway width of sub-main road		
				Number of Lane	No.	Numeric	Number of lanes in sub-main road		
				Road Name		Character	Road name of the sub-main road		
				Road Classification		Character	Road class of sub-main road		
		5.4.1	Pavement Loading Capacity	Benkelman Beam Deflection	daN/cm2	Numeric	Pavement Loading Capacity measured by Benkelman Beam on the finished shoulder surface		
				Loading Plate	daN/cm2	Numeric	Pavement Loading Capacity measured by Loading Plate on the finished shoulder surface		
				FWD	Mpa	Numeric	Pavement Loading Capacity measured by FWD on the finished shoulder surface		
		5.4.2	Subgrade Loading Capacity	Loading Plate	daN/cm2	Numeric	Loading capacity of subgrade layer measured by Benkelman Beam		
				FWD	Mpa	Numeric	Loading capacity of subgrade layer measured by FWD		
				CBR	%	Numeric	Loading capacity of subgrade layer measured by CBR Test		
		5.4.3	Subgrade Course	Thickness	cm	Numeric	Thickness of subgrade course		
				Pavement Type		Character	Type of material applied in subgrade course	AC AM BP CC MP AP EP	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of subgrade course	
				Binder Type		Character	Type of binder used in subgrade course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size	mm	Numeric	Max. size of aggregate used in subgrade course	
		5.4.4	Sub-Base	Thickness	cm	Numeric	Thickness of sub-base course	
				Pavement Type		Character	Type of material applied in sub-base course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of sub-base course	
				Binder Type		Character	Type of binder used in sub-base course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in sub-base course	
		5.4.5	Base	Thickness	cm	Numeric	Thickness of base course	
				Pavement Type		Character	Type of material applied in base course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of base course	
				Binder Type		Character	type of binder used in base course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in base course	
		5.4.6	Binder Course	Thickness	cm	Numeric	Thickness of binder course	
				Pavement Type		Character	Type of material applied in binder course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of binder course	
				Binder Type		Character	Type of binder used in binder course	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate used in binder course	
		5.4.7	Wearing Course	Thickness	cm	Numeric	Thickness of wearing course	
				Pavement Type		Character	Type of material applied in wearing course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of wearing course	
				Binder Type		Character	Type of binder material used in wearing course	Cement : Cement Lime : Lime Emulsion : Emulsion

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate/chips used in wearing course	
		5.5	Asset Value	Construction/Installation Completion Year (Traffic Lights, Road Lighting and Other Structures)	YY/MM	Date	Construction / installation year of each facility	
				Construction/Installation Cost (Traffic Lights, Road Lighting and Other Structures)	VND	Numeric	Construction / installation cost of each facility	
				Service Life (Traffic Lights, Road Lighting and Other Structures)	YY	Numeric	Service life of each facility	
6	Railway Crossing	6.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				Chainage at Center From	km, m			

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				(Kilopost)					
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		6.2	Crossing	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Crossing Type (Overpass or Underpass or Level Crossing)		Character	Type of railway crossing in terms of structure type	LC DC Others	: Level Crossing : Differential Crossing : Others
				Minimum Clearance Height under Bridge Girder	m	Numeric	The minimum height between bridge girder and surface		
				Railway (Up or Down)		Character	Position of railway	Up Down At_Level	: Railway Up : Railway Down : At the same level
				Length	m	Numeric	Length of crossing (road)		
				Width	m	Numeric	Width of road within crossing		
				Footpath etc. Facility		Character	Existence of Footpath	Yes No	: Yes : No
				Width difference between road and crossing road	m	Numeric	Width difference between crossing section and ordinary road section		
				Pavement Type		Character	Pavement type within crossing section	AC AM BP	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
									(Bituminous surface treatment and Bitumen penetration)
								CC	: Cement Concrete
								MP	: Macadam Pavement
								AP	: Aggregate Pavement
								EP	: Earth Pavement
								Others	: Others
				Distance of adjacent road Intersection from crossing point	m	Numeric	Distance to the nearest road intersection from crossing point (either left or right)		
				Waiting Time	sec	Numeric	Waiting time until traffic allowed to pass through (in case of level crossing)		
		6.3	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion / Installation year		
				Construction Cost	VND	Numeric	Construction completion / Installation cost		
				Service Life	Year	Numeric	Service life of each facility		
7	Median Strip	7.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost	YY				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Adjustment Date				
				Date of Update	m			
				Province				
				City				
		7.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Length of median strip	
				Width	m	Numeric	Width of Median Strip	
				Area	m2	Numeric	Area covered by median strip	
				Median Strip (Barrier like fence)		Character	Existence of barrier for median strip	Yes : Yes No : No
				Length	m	Numeric	Length of Median Strip Barrier	
				Height	m	Numeric	Height of Median Strip Barrier	
				Material Type		Character	Material type of median strip barrier	Flat : Galvanized Steel (Flat Type) Tube : Steel Railing (Tube Type) RCC : RCC Railing Others : Others
				Area	m2	Numeric	Area of median strip barrier (Length x Height)	
				Plantation Zone (Yes / No)		Character	Existence of Plantation Zone	Yes : Yes No : No
				Plantation Area	m2	Numeric	Area covered by plantation zone	
				Guard Fence (Yes / No)		Character	Existence of Guard fence in plantation zone	Yes : Yes No : No
				Guard Fence Type (Material)		Character	Type of Guard Fence by construction material type	Galvanized_Wire : Galvanized Wire Mesh (Gabion wire) Steel_Wire : Stainless Steel Wire Mesh Welded_Wire : Welded Wire Mesh Others : Others

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Shade Fence (Yes / No)		Character	Existence of Shade Fence (Plantation Zone)	Yes No	: Yes : No
				Type of Fence (Material)		Character	Type of Shade Fence (Plantation Zone) by construction material type	RCC_Block CC_Block Polymer_Block Composite_Block Others	: RCC Block : CC Block : Polymer Block : Composite Block : Others
				Length of Fence	m	Numeric	Length of Guard Fence (Plantation Zone)		
				Height of Fence	m	Numeric	Height of Guard Fence (Plantation Zone)		
		7.3	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion of median strip		
				Construction Cost	VND	Numeric	Construction cost of median strip		
				Service Life	Year	Numeric	Service life of median strip		
8	Pedestrian Crossing (Overhead Bridge / Underpass)	8.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage at Center From (Kilopost)	km, m				
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				City				
		8.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Pedestrian Crossing Type		Character	Structural type of pedestrian crossing	Overhead : Overhead Crossing Underpass : Underpass Crossing (Subway)
				Length	m	Numeric	Length of pedestrian crossing	
				Width	m	Numeric	Width of pedestrian crossing	
				Facility to Pass Bicycle		Character	Provision for Bicyclist	Yes : Yes No : No
				Structure Type (Steel or RCC)		Character	Type of pedestrian crossing by material used	RCC : RCC Steel : Steel Composite : Composite Others Others
				Max. Length of Span	m	Numeric	Max. length of span if multiple spans exist	
				No. of Span (in case of Overhead Crossing Bridge)	No.	Numeric	No. of span if multiple spans exist	
				Clearance Height under Bridge Girder	m	Numeric	Clearance height between bridge girder and surface	
				Provision of Hand Rail		Character	Hand Rail provided for pedestrian	Yes : Yes No : No
				Hand Rail Type		Character	Type of Hand Rail	Steel : Steel Railing RCC : RCC Railing
				Height	m	Numeric	Height of Hand Rail	
				Pavement Type		Character	Pavement type on pedestrian crossing	AC : Asphalt Concrete RCC : Reinforced Cement Concrete (RCC) CC : Cement Concrete (CC) Others : Others
				Thickness	cm	Numeric	Thickness of pavement layers	
				Area	m2	Numeric	Pavement area of pedestrian	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
							crossing		
				Lighting		Character	Provision of lighting	Yes No	: Yes : No
				Facility to prevent Slippery		Character	Provision of facility to prevent from slippery	Yes No	: Yes : No
				Facility for Handicapped People		Character	Provision of facility for handicapped people	Yes No	: Yes : No
				Drainage Facility		Character	Provision of Drainage Facility in Pedestrian Crossing	Yes No	: Yes : No
		8.3	Repair History	Repair Year	YY	Date	Date of latest repair		
				Repair Outline		Character	A short description of repair work		
		8.4	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion year of pedestrian crossing		
				Construction Cost	VND	Numeric	Construction cost of pedestrian crossing		
				Service Life	Year	Numeric	Service life of pedestrian crossing (based on main structure)		
9	Tunnel	9.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Length	m			
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		9.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Tunnel Section		Character	Section for which tunnel is provided	Carriageway : Road Carriageway Footpath : Footpath
				Toll Free or Not		Character	Utilization fee of tunnel	Free : Toll Free Non-Free : Not Toll Free
				Tunnel Type		Character	Tunnel type by purpose of construction (Road Tunnel at Mountain, Tunnel for drainage facility or Subway at urban area)	Mountain : Tunnel Built to pass Mountain Water : Tunnel Built to cross Water Bodies Subway : Tunnel Built in City Area (subway) Others : Others
				Traffic Capacity (in terms of Number)	ADT	Numeric	Capacity of tunnel in terms of traffic volume	
				Year of Completion	YY/MM	Date	Construction completion year of tunnel	
				Tunnel Excavation Method		Character	Excavation method of tunnel	Cut&Cover : Cut and Cover Drill&Blast : Drill and Blast Boring_TBM : Tunnel Boring Machine
				Tunnel Cross-Section Type		Character	Cross-section of tunnel in terms of single or double	Single : Single Pair : Double (Pair) Others : Others
				Total Carriageway Width	m	Numeric	Carriageway width within tunnel	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Tunnel Cross-Section Type		Character	Tunnel cross section type in terms of shape	Rectangular Arc Combined Others	: Rectangular : Arc : Combined : Others
		9.3	Thickness of Tunnel Lining	Arc Portion	cm	Numeric	Thickness of lining in arc/circular portion of tunnel		
				Sidewall	cm	Numeric	Thickness of lining in tunnel side wall		
				Invert	cm	Numeric	Thickness of line in tunnel invert		
		9.4	Vertical Alignment	Longitudinal	%	Numeric	Longitudinal slope of road surface within the tunnel section		
		9.5	Horizontal Alignment	Length of Straight Section	m	Numeric	Length of straight section within tunnel		
				Total Curve Length	m	Numeric	Total length of curve section within tunnel		
				Length of Transition Curve (Start Point side)	m	Numeric	Length of transition curve (curve starting side)		
				Radius of Main Curve	m	Numeric	Radius of Main curve provided within the tunnel		
				Length of Transition Curve (End Point side)	m	Numeric	Length of Transition curve (curve ending side)		
		9.6	Soil Cover / Overburden	Thickness of Soil Cover	cm	Numeric	Thickness of soil cover or thickness of overburden soil		
		9.7	Height	Central Height	m	Numeric	Central height of the tunnel		
				Side Wall Type		Character	Type of side wall by structure type		
		9.8	Pavement	Type		Character	Pavement type on road surface	AC AM BP CC	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Thickness	m	Numeric	Thickness of pavement layers with tunnel section	
				Area	m2	Numeric	Area of Pavement Surface	
		9.9	Light	Yes / No		Character	Provision of lighting facility in the tunnel section	Yes : Yes No : No
				Number		Numeric	Number of lighting facility installed	
		9.10	Drainage Facility	Yes / No		Character	Provision of drainage facility in the tunnel section	Yes : Yes No : No
		9.11	Facility for controlling vehicle height etc.	Yes / No		Character	Provision of facility for controlling vehicle height	Yes : Yes No : No
		9.12	Width	No. of Lane	No.	Numeric	No. of lanes in tunnel section	
				Shoulder	m	Numeric	Width of shoulder in tunnel section	
				Carriageway	m	Numeric	Width of carriageway in tunnel section	
				Footpath	m	Numeric	Width of footpath in tunnel section	
				Median Strip / Central Strip	m	Numeric	With of median strip/central strip in tunnel section	
		9.13	Ventilation	Ventilation Method (Natural or Artificial)		Character	Ventilation method in tunnel section	Natural : Natural Artificial : Artificial Both : Both Others : Others
				Number	No.	Numeric	Number of ventilation facility in tunnel section	
		9.14	Tunnel Emergency Facility	Alarming Equipment		Character	Provision of alarming equipment	Yes : Yes No : No
				Number		Numeric	Number of alarming equipment	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Emergency Telephone (SOS)		Character	Provision of emergency telephone	Yes No	: Yes : No
				Number		Numeric	Number of installed emergency telephone		
				Emergency Push Button		Character	Provision of emergency push button	Yes No	: Yes : No
				Number		Numeric	Number of locations where emergency push button installed		
				Fire Alarm Equipment		Character	Provision of Fire Alarm Equipment	Yes No	: Yes : No
				Number		Numeric	Number of fire alarm equipment installed		
				Automatic Reporting System		Character	Provision of automatic reporting system during emergency purpose	Yes No	: Yes : No
		9.15	Emergency Alarming System Facility	Alarming Board		Character	Provision of Alarming board during emergency	Yes No	: Yes : No
				Number		Numeric	Number of alarming board		
				Flicker / Blinker Light		Character	Provision of flicker / blinker light for the emergency purpose	Yes No	: Yes : No
				Number		Numeric	Number of flicker / blinker light		
				Sound Generating Device (Siren)		Character	Provision of sound generating device (i.e. siren)	Yes No	: Yes : No
				Number		Numeric	Number of siren installed in tunnel section		
		9.16	Evacuation Guidance System	Guidance Board		Character	Provision of guidance board for emergency evacuation	Yes No	: Yes : No
				Number		Numeric	Number of installed guidance board		
				Smoke Exhausting System		Character	Provision of smoke exhausting system	Yes No	: Yes : No
				Number		Numeric	Number of smoke exhausting system installed		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Evacuation Path		Character	Provision of evacuation path	Yes No	: Yes : No
				Number		Numeric	Number of evacuation path		
		9.17	Fire Fighting System	Fire Hydrant		Character	Provision of fire hydrant	Yes No	: Yes : No
				Number		Numeric	Number of fire hydrant installed		
				Fire Extinguisher		Character	Provision of fire extinguisher	Yes No	: Yes : No
				Number		Numeric	Number of installed fire extinguisher		
		9.18	Other Facility	Wireless Communication Facility		Character	Provision of wireless communication facility	Yes No	: Yes : No
				Number		Numeric	Number of installed wireless communication facility		
				Radio Broadcasting		Character	Provision of radio broadcasting services	Yes No	: Yes : No
				Number		Numeric	Number of installed radio broadcasting services		
				Miking Facility		Character	Provision of miking facility	Yes No	: Yes : No
				Number		Numeric	Number of installed miking facility		
				Water-Jet Device / Water Spraying machine		Character	Provision of water spraying machine	Yes No	: Yes : No
				Number		Numeric	Number of water spraying machine availed		
				Emergency Power Supply (Yes / No)		Character	Provision of emergency power supply	Yes No	: Yes : No
				Number		Numeric	Number of installed emergency power generation houses/plant		
				Emergency Parking Area		Character	Provision of emergency parking area	Yes No	: Yes : No
				Number		Numeric	Number of emergency parking		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
							area		
				Space for Vehicle Direction Change		Character	Provision of space for vehicle direction change within tunnel section	Yes No	: Yes : No
				Number		Numeric	Number of spaces avail for changing vehicle direction		
		9.19	Asset Value of each facility	Installed Year	YY/MM	Date	Installation year of the facility		
				Installation Cost	VND	Numeric	Installation cost of the facility		
				Service Life	Year	Numeric	Service life of the facility		
10	Culvert [Box and Slab Culvert (L<6m)]	10.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage at Center From (Kilopost)	km, m				
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		10.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Culvert Type (Box or Ordinary)		Character	Type of culvert by structure type	Slab_Culvert : Slab Culvert Box_Culvert : Box Culvert
				Precast or Cast-insitu or other places		Character	Method of construction	Precast : Precast Cast-insitu : Cast-in-situ Combined : Combine Others : Others
				Structure Type (RCC, Steel,…)		Character	Type of structure by material used	RCC : RCC Steel : Steel Others : Others
				Culvert X-Section Type		Character	Type of culvert cross section	Single : Single (Common for both lanes) Double : Double (Lane-wise separate)
				Length	m	Numeric	Length of culvert	
				No. of Lane	No.	Numeric	Number of traffic lanes in culvert section	
				Carriageway Width	m	Numeric	Carriageway width in culvert section	
				Footpath	m	Numeric	Width of footpath in culvert	
				Shoulder	m	Numeric	Width of shoulder in culvert section	
				Median Strip	m	Numeric	Width of median strip in culvert section	
				Clearance Height	m	Numeric	Clearance height in case of box culvert	
				Guardrail (Yes /No)		Character	Provision of guardrail	Yes : Yes No : No
				Guardrail Type		Character	Type of guardrail by construction material type	Steel : Steel Railing RCC : RCC Railing Others : Others
		10.3	Structure in the Stream	Upstream Structure		Character	Type of upstream structure in case of slab culvert	Apron_Concrete : Apron with Cement Concrete Apron_Stone : Apron with Stone Riprap with C/S Mortar Stone_Soling : Stone Soling Aproan_Brick : Brick with Cement Sand Mortar Others : Others
			(Slab Culvert)	Down Stream Structure		Character	Type of downstream structure in case of slab culvert	Apron_Concrete : Apron with Cement Concrete Apron_Stone : Apron with Stone Riprap with C/S Mortar Stone_Soling : Stone Soling Aproan_Brick : Brick with Cement Sand Mortar Others : Others

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Highest Water Level	m	Numeric	Highest water level in the stream	
				Stream Type		Character	Type of stream by discharge in the stream	Perennial : Perennial Stream Non-Perennial : Non-Perennial Stream Gully : Gully Others : Others
		10.4	Abutment and Wing Wall	Abutment Foundation Type		Character	Foundation type of abutment wall	Raft : Raft Foundation Isolated : Isolated Footing Spread : Spread Footing Pile : Pile Foundation Others : Others
				Abutment Wall Type	m	Numeric	Type of abutment wall by construction material	RCC : Reinforced Cement Concrete Stone_Masonry : Stone Masonry Brick_Masonry : Brick Masonry : Others
				Wing Wall Foundation Type		Character	Foundation type of wing wall	Raft : Raft Foundation Isolated : Isolated Footing Spread : Spread Footing Pile : Pile Foundation Others : Others
				Wing Wall Type		Character	Type of wing wall by construction material	RCC : Reinforced Cement Concrete Stone_Masonry : Stone Masonry Brick_Masonry : Brick Masonry Others : Others
		10.5	Overburden	Thickness	m	Numeric	Average thickness of overburden above the slab	
		10.6	Pavement	Type		Character	Type of pavement material above culvert slab	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Thickness	cm	Numeric	Thickness of pavement layers	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Area	m2	Numeric	Area of pavement surface	
		10.7	Light	Light Facility		Character	Provision of light in case of box culvert	Yes : Yes No : No
				Number		Numeric	Number of lighting facility installed	
		10.8	Drainage Facility	Drainage Facility		Character	Provision of drainage facility in box culvert	Yes : Yes No : No
				Drain Type		Character	Type of drain by construction material type	Concrete : Cement Concrete Earthen : Earthen Riprap : Stone Riprap with C/S Mortar Others : Others
		10.9	Repair History	Repair Year	YY	Date	Year of the latest repair	
				Repair Outline		Character	A short description of repair work	
		10.10	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion of culvert	
				Construction Cost	VND	Numeric	Construction cost of culvert	
				Service Life	Year	Numeric	Service life of culvert	
11	Pipe Culvert	11.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				Chainage at Center From (Kilopost)	km, m			
				Latitude				
				Longitude				
				Kilopost Adjustment Date	YY			

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Date of Update	m			
				Province				
				City				
		11.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Usage Type (Sewer pipe, road water…)		Character	Type of pipe culvert by usage	Road : Road Drainage Sewer : Sewer Pipe Irrigation : Irrigation Channel Others : Others
				Diameter	m	Numeric	Diameter of pipe culvert	
				Length	m	Numeric	Length of pipe culvert	
				Structure Type		Character	Type of pipe culvert by construction material type	RCC : RCC Pipe PVC : PVC Pipe Others : Others
		11.3	Overburden	Thickness	cm	Numeric	Thickness of overburden on top of pipe culvert	
		11.4	Repair History	Repaired Year	YY	Date	Year of the latest repair	
				Repair Outline		Character	A short description of repair work	
		11.5	Asset Value	Construction Completion Year	YY/MM	Date	Construction completion year of pipe culvert	
				Construction Cost	VND	Numeric	Construction cost of pipe culvert	
				Service Life	Year	Numeric	Service life of pipe culvert	
12	Slope	12.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		12.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.		
				Slope Classification		Character	Slope classification by construction type	Hill Toe	: Cutting (Hill Side) : Embankment (Toe Side)
				Extent of Slope Monitored	m	Numeric	Width of slope up to where slope is monitored		
				Number of Steps	No.	Numeric	Number of steps (bench) on the slope if slope benches are provided		
				Max. slope height (vertical)	m	Numeric	Max. vertical height of slope		
				Average Slope Gradient / Angle	% or Deg	Numeric	Average slope gradient of slope with reference to horizontal		
				Plantation Condition (Dense, Medium, Nothing)		Character	Plantation condition on the slope	High_Dense Medium_Dense Low_Dense Nothing Others	: High Dense : Medium Dense : Low Dense (Thin) : Nothing : Others

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Slope Surface Condition (Dry, Wet)		Character	Situation of slope surface in terms of dampness	Significant : Highly Wet (Seepage Appear) Noticeable : Wet but no Seepage Appear None : Dry
				Source of Dampness (Surface / Spring Water)		Character	The dominant source of dampness	S_Water : Surface water G_Water : Ground Water Both : Both N/A : N/A
		12.3	Countermeasures	Countermeasure Type		Character	Type of counter measure in terms of purpose	Cut&Fill : Cutting and Filling Bio-Eng. : Bio-Engineering Water_Mgt : Water Management Slope_Strengthening : Slope Strengthening Protection_work : Protection Work Others : Others
				Structure Type		Character	Type of counter measure in terms of structure type	CC_Wall : Cement Concrete Wall Anchoring : Anchoring Rock_Bolting : Rock Bolting Shotcreating : Shotcreting S&C_Stabilizing : Soil Cement Stabilizing Plantation : Vegetation / Plantation Ret_Wall : Retaining Wall Drainage : Surface & Sub-surface Drainage Wire_Net : Wire Netting Geosynthesis : Application of Geosynthetic Others : Others
				Length	m	Numeric	Length of counter measure structure	
				Height / Thickness	m	Numeric	Height or thickness of counter measure	
				Width / Diameter	m	Numeric	Width / diameter of counter measure	
				Area	m2	Numeric	Surface area of counter measure	
		12.4	Slope Surface Drainage Structure (Surface)	Drainage Structure (for draining from slope surface)		Character	Drainage structure type by shape	Rectangular : Rectangular Trapezoidal : Trapezoidal Semicircular : Semi-Circular Triangular : Triangular Others : Others
				Drainage		Character	Drainage structure type by	Open : Open

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Structure Type			coverage (Open or close)	Covered : Covered
				Structure Type		Character	Drainage structure type by construction material	Concrete : Cement Concrete Riprap : Stone Riprap with C/S Mortar Earthen : Earthen Others : Others
				Depth	m	Numeric	Depth of drain at center	
				Width	m	Numeric	Average width of drainage structure	
				Diameter	m	Numeric	Diameter of drainage structure	
				Area	m2	Numeric	Cross-sectional area of drainage structure	
				Length	m	Numeric	Length of drainage structure	
		12.5	Slope Subsurface Drainage Structure	Drainage Structure (for ground water)		Character	Drainage structure type by shape	Rectangular : Rectangular Trapezoidal : Trapezoidal Semicircular : Semi-Circular Others : Others
				Structure Type		Character	Drainage structure type by construction material	PVC_Pipe : PVC Pipe Concrete_Pipe : Concrete Pipe Others : Others
				Depth	m	Numeric	Depth of drain at center	
				Size / Dimension (Width)	m	Numeric	Dimension (width or diameter) of drainage structure	
				Area	m2	Numeric	Cross-sectional area of drainage structure	
				Length	m	Numeric	Length of drainage structure	
		12.6	Road Surface Drainage	Drainage Structure (for surface water)		Character	Drainage structure type by shape	Rectangular : Rectangular Trapezoidal : Trapezoidal Semicircular : Semi-Circular Triangular : Triangular Others : Others
				Drainage Structure Type		Character	Drainage structure type by coverage (Open or close)	Open : Open Covered : Covered
				Structure Type		Character	Drainage structure type by construction material	Concrete : Cement Concrete Riprap : Stone Riprap with C/S Mortar

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								Earthen : Earthen Others : Others
				Length	m	Numeric	Length of drainage structure	
				Depth	m	Numeric	Depth of drain at center	
				Width	m	Numeric	Average width of drainage structure	
				Diameter	m	Numeric	Diameter of drainage structure	
				Area	m2	Numeric	Cross-sectional area of drainage structure	
		12.7	Slope Monitoring Equipment	Slope Monitoring Equipment		Character	Provision of Slope monitoring equipment	Yes : Yes No : No
				Type		Character	Type of monitoring equipment by purpose	GW_Table : Increase in Ground Water Table Slope_Move : Slope Movement (Slow & Fast) GW&Slope : Both of Above Others : Others
				Number		Numeric	Number of equipment	
		12.8	Repair History	Repaired Year	YY	Date	Year of the latest repair	
				Repair Outline		Character	A brief description of repair work	
		12.9	Asset Value of each facility installed	Installed Year	YY/MM	Date	Year of equipment installation	
				Installation Cost	VND	Numeric	Installation cost of the equipment	
				Service Life	Year	Numeric	Service life of installed equipment	
13	Retaining Wall	13.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				From (Kilopost)	km, m			

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				To	km, m			
				Latitude				
				Longitude				
				Length	m			
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		13.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length of Retaining Wall	m	Numeric	Actual Length of the section in the field.	
				Installed Side		Character	Construction side of retaining wall	Hill : Hill Side Toe : Toe Side
				Area	m2	Numeric	Surface area of retaining wall	
				Height	m	Numeric	Height of retaining wall	
				Front Slope	% degree	Numeric	Front slope of retaining wall	
				Type of Retaining Wall		Character	Type of retaining wall by name	Gravity : Gravity Wall Semi-Gravity : Semi-Gravity Cantilever : Cantilever Wall Counterfort : Counterfort Wall Anchored : Anchored Wall Crib : Crib Retaining Wall Others : Others
				Material Type		Character	Type of retaining wall by material type	RCC : Reinforced Cement Concrete CC : Cement Concrete Stone : Stone Masonry Brick : Brick Masonry Dry_Stone : Dry Stone Masonry

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								Gabion Wooden Others	: Gabion : Wooden Retaining Wall : Others
				Precast or Cast-in-situ or other places		Character	Method of retaining wall construction	Precast Cast-insitu Combined Others	: Precast : Cast-in-situ : Combined : Others
		13.3	Repair History	Repair Year	YY	Date	Year of the latest repair		
				Repair Outline		Character	A brief description of repair work		
		13.4	Asset Value of retaining wall	Construction Completion Year	YY/MM	Date	Year of construction completion of retaining wall		
				Construction Cost	VND	Numeric	Construction cost of retaining wall		
				Service Life	Year	Numeric	Service life of retaining wall		
14	Guard Fence	14.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km,m				
				To	km,m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
		14.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Installed Location (Road side or median strip)		Character	Location of Guard Fence installation	Roadside : Roadside Medianstrip : Median Strip Both : Both
				Guard Fence Type		Character	Type of guard fence in terms of structure	Guard_Rail : Guard Rail Guard_Fence : Guard Fence
				Material		Character	Manufacturing material of guard fence	Steel_Pipe : Steel Pipe Galv._Sheet : Galvanized Sheet RCC : Reinforced Cement Concrete Steel_Pipe&Concrete : Steel Pipe and Concrete Welded_Metal : Welded Metal Net Wire_Net : Wire Mesh Net Others : Others
				Surface Coating Material (galvanized type, painting, others)		Character	Surface coating material of guard fence (Galvanized, painting, etc.)	Ordinary : Ordinary Painting Zinc : Zinc Coating Anti-corrosion : Anti-Corrosion Painting other than Zinc Others : Others
				Structure type of installed guard fence section (bridge name, etc..)		Character	Structure type of guar fence installed section (i.e. bridge section, ordinary road section, etc.)	Road : Road Section Bridge : Bridge Culvert : Culvert Tunnel : Tunnel Others : Others
				Installed Objective		Character	Primary Objective of installation of guard fence	TDS : Traffic Direction Separation (Up & Down) MT&NMT_Lane : Separation of Traffic Lane & Footpath NMT&MS : Traffic Lane and Median Strip All : All Above Others : Others
		14.3	Repair History	Repair Year	YY	Date	Year of the latest repair	
				Repair Outline		Character	A brief description of repair work	
		14.4	Asset Value	Installed Year	YY/MM	Date	Year of guard fence installation	
				Installation Cost	VND	Numeric	Installation cost of guard fence	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Service Life	Year	Numeric	Service life of guard fence material		
15	Road Lighting	15.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		15.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Road lighting type (for road, tunnel, etc.)		Character	Type of road lighting by installed location	Roadside Center_Median Both	: Road Side : At Center / Median Strip : Both
				Type of Light Pole		Character	Type of light pole by material and shape	Steel RCC Wooden Others	: Steel : RCC : Wooden : Others
				No. of Pole	No.	Numeric	No. of pole installed within the section		
				Installation Type of Pole		Character	Installation type of pole (foundation / fixing type)	Bolting Ordinary Others	: Bolting with Metal Plate : Ordinary Foundation : Others
				Surface Coating Material (galvanized type, painting, others)		Character	Material used in finishing surface of the pole	Ordinary Zinc Anti-corrosion None Others	: Ordinary Painting : Zinc Coating : Anti-Corrosion Painting other than zinc : Nothing : Others
		15.3	Lamp	Type		Character	Lamp type such al LED, Fluorescent, etc.)	LED Fluorescent Ordinary Others	: LED : Fluorescent : Ordinary : Others
				Model		Character	Model number		
				Number of lamp in each light pole	No.	Numeric	Number of lamp in each light pole		
		15.4	Electric Power Agreement	Contract Type		Character	Power supply arrangement		
				Supply Substation Name		Character	Name of power supply substation		
		15.5	Repair History	Repair Year	YY	Date	Year of the latest repair work		
				Repair Outline		Character	A brief description of repair work		
		15.6	Asset Value for each facility	Installed Year	YY/MM	Date	Installation year of road light		
				Installation Cost	VND	Numeric	Installation cost of road light		
				Service Life	Year	Numeric	Service life of installed light pole		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
16	Road Sign	16.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				Location Change From (Kilopost)	km, m			
				Latitude				
				Longitude				
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		16.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Installation type of Poles		Character	Installation/ fixation type of road sign pole	Bolting : Bolting with Metal Plate Ordinary : Ordinary Foundation Others : Others
				Pole (Strut) Type		Character	Type of pole in terms of shape	Steel_Pipe : Steel Circular Pipe Steel_Strut : Steel Rectangular Strut Concrete : Concrete Pole Wooden : Wooden Pole Others : Others
				Clearance Height	m	Numeric	Clearance height between road surface and road sign board	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Coating Material Type	m	Numeric	Coating material of road sign pole	Ordinary : Ordinary Painting Zinc : Zinc Coating Anti-Corrosion : Anti-Corrosion Painting other than Zinc None : Nothing Others : Others
		16.3	Sign Board	Sign Type		Character	Type of signed written	Route_Info : Route Information Safety_Info : Traffic Safety Information Structure_Info : Road Structure Information Others : Others
				Sign Code (as per VN Standard)		Character	Sign Code assigned by VN Standard	
				Material of Board		Character	Construction material of road sign board	Metalic : Metal / Steel Mixed : Galvanized Iron Sheet with Wooden frame Polymer : Polymer / Plastic Others : Others
				Fixing Type of Board		Character	Fixing type of board (by bolting, welding, …)	Welding : Welding Bolting : Bolting Hanging : Hanging Others : Others
		16.4	Display Outline	Arrow Direction		Character	Displaying of arrows for showing direction of different routes	
				Destination Name		Character	Displaying of destination name	
				Destination Distance		Character	Displaying of destination distance	
				Distance to next intersection		Character	Displaying of distance to next intersection	
				Unit of Distance		Character	Displaying of unit of distance used	
				Route No.		Character	Displaying of Route No.	
		16.5	Repair History	Repair Year	YY	Date	Year of the latest repair	
				Repair Outline		Character	A brief description of repair work	
		16.6	Asset Value	Installed Year	YY/MM	Date	Installation year of road sign board and pole	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Installation Cost	VND	Numeric	Installation cost of road sign board and pole	
				Service Life	Year	Numeric	Service life of road sign board and pole	
17	Paveme nt Markin g	17.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				From (Kilopost)	km, m			
				To	km, m			
				Latitude				
				Longitude				
				Length	m			
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		17.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Marking Line Type		Character	Line type or pavement marking	Solid : Continuous Dotted : Dotted Line Both : Both

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Marking Location (Left, Right , Center)		Character	Location of pavement marking	Center Lane_Separate Both	: Center Line : Lane Separation : Both
				Marking Width	cm	Numeric	Width of pavement marking		
				Marking Thickness	mm	Numeric	Thickness of pavement marking		
				Type of Paint		Character	Type of paint used for pavement marking	Enamel Thermoplastic Cold_Plastic Polymer_Tape Retro_Reflector Others	: Paint (Enamel) : Thermoplastic : Cold Plastic : Polymer Tape : Retro-Reflector : Others
				Marking Date	YY/MM	Date	Date of pavement marking		
		17.3	Repair History	Repair Year	YY	Date	Year of the latest repair		
				Repair Outline		Character	A brief description of repair work		
18	Vehicle Weighing / Measuring Facility	18.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage of Station From (Kilopost)	km, m				
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Date of Update	m			
				Province				
				City				
		18.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Target Vehicle Weight to be Checked		Character	Weight of vehicle which under goes vehicle weight check	
				Max. Axle Load Limit	Ton	Numeric	Max. Axle load which can be measured in the station	
				Site Area (Area covered by Facility)	m2	Numeric	Total land area occupies to vehicle weighing /measuring facility station	
				Building Area	m2	Numeric	Total area covered by service facility building	
				Land Owner		Character	Owner of the land occupied by the facility station	
		18.3	Measuring Items	No. of Equipment for Gross Vehicle Weight		Character	No. of gross weight measuring equipment installed at the station	
				Provision		Character	Model number of the equipment	Yes : Yes No : No
				No. of Equipment for Axle Load		Character	No. of axle load measuring equipment installed at the station	
				Provision		Character	Model number of the equipment	Yes : Yes No : No
				No. of Vehicle Height measuring Equipment		Character	No. of vehicle height measuring equipment installed at the station	
				Provision		Character	Model number of the equipment	Yes : Yes No : No

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				No. of Vehicle Length measuring Equipment		Character	No. of vehicle length measuring equipment installed at the station		
				Provision		Character	Model number of the equipment	Yes No	: Yes : No
		18.4	Repair History	Repair Year	YY	Numeric	Year of the latest repair		
				Repair Outline		Character	A brief description of repair work		
		18.5	Asset Value	Installed Year	YY/MM	Numeric	Year of the facility installed		
				Installation Cost	VND	Numeric	Installation cost of the facility		
				Service Life	Year	Numeric	Service life of the facility		
19	Disaster Response Storage Warehouse	19.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage of Storage Warehouse From (Kilopost)	km, m				
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		19.2	Main Features	Direction Type (Up-Bound,		Character	Up-bound and down-bound (Start Point to End Point	UP: Down	: End to Start : Down: Start to End

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Down-Bound or Both)			{Down}, End Point to Start Point {Up}) Lane	Both : Both Direction Single : Single Lane used for both directions
				Location Name		Character	Name of location where the warehouse installed	
				Site Area	m2	Numeric	Total land area occupies to warehouse facility	
				Outer Dimension of Warehouse	m	Numeric	Outer dimension of the main warehouse in multiple units built	
				Height	m	Numeric	Height of warehouse	
				Storage Capacity		Character	Total storage capacity of the warehouse	
				Number		Numeric	Number warehouse unit	
		19.3	Equipment	Equipment / Device Type		Character	Type of equipment and material in stock	
				Number of Equipment	No.	Numeric	Number of equipment/devices for rescue	
				Material Type		Character	Type of material in stock	
				Quantity of Material	No.	Numeric	Quantity of material in stock for rescue	
		19.4	Asset Value	Construction Completion Year	YY/MM	Date	Year of construction completion of warehouse	
				Construction Cost	VND	Numeric	Construction cost of warehouse	
				Service Life	Year	Numeric	Service life of warehouse and associated facility	
20	Plantation	20.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				From (Kilopost)	km, m			
				To	km, m			
				Latitude				
				Longitude				
				Length	m			
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		20.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Area	m2	Numeric	Area of plantation zone	
			Tall Tree	Number Tall Tree		Character	Approx. No. of tall tree (H>…m)	
				Type		Character	Type of dominant tree	
			Medium Height Tree	Number Medium Height Tree		Character	No. of medium height tree (H>…m)	
				Type		Character	Type of dominant tree	
			Shrub	Area Shrub		Character	Approx. area covered by shrub	
				Type		Character	Type of dominant shrub type	
			Turf	Area Turf		Character	Approx. area covered by turf	
				Type		Character	Type of dominant turf type	
21	Noise barrier	21.1	General Information	Road ID				
				Road Name				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		21.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.		
				Type (Material)		Character	Type of noise barrier by material type	Earthen Concrete Stone_Masonry Brick_Masonry Metal Alloy Polymer Others	: Earthen : Concrete : Stone Masonry : Brick Masonry : Metal : Alloy : Polymer : Others
				Type (Shape)		Character	Type by shape of Noise Barrier	Vertical Vertical&Arc Arc	: Vertical : Vertical and Arc : Arc

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								Vertical&Slant Others	: Vertical and Slant : Others
				Max. Height	m	Numeric	Max. height of noise barrier		
				Min. Height	m	Numeric	Min. Height of noise barrier		
				Length of each Unit	m	Numeric	Length of each one of noise barrier		
		21.3	Repair History	Repair Year	YY	Date	Year of the latest repair		
				Repair Outline		Character	A brief description of repair work		
		21.4	Asset Value	Installed Year	YY/MM	Date	Installation year of the noise barrier		
				Installation Cost	VND	Numeric	Installation cost of the noise barrier		
				Service Life	Year	Numeric	Service life of noise barrier		
22	Shade Fence	22.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Province				
				City				
		22.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Type (Material)		Character	Type shade fence by material	RCC_Block : RCC Block CC_Block : CC Block Polymer_Block : Polymer Block Composite_Block : Composite Block Others : Others
				Type (Shape)		Character	Type by shape of shade fence	Vertical : Vertical Vertical&Arc : Vertical and Arc Arc : Arc Vertical6Slant : Vertical and Slant Others : Others
				Max. Height	m	Numeric	Max. height of shade fence	
				Min. Height	m	Numeric	Min. height of shade fence	
				Length of Each Unit	m	Numeric	Length of one unit of shade fence	
		22.3	Repair History	Repair Year	YY	Numeric	Year of the latest repair	
				Repair Outline		Character	A brief description of repair work	
		22.4	Asset Value	Installed Year	YY/MM	Date	Installation year of shade fence	
				Installation Cost	VND	Numeric	Installation cost of the shade fence	
				Service Life	Year	Numeric	Service life of the shade fence	
23	Kilometer post	23.1	General Information	Road ID				
				Road Name				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				From (Kilopost)	km, m			
				To	km, m			
				Latitude				
				Longitude				
				Length	m			
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		23.2	Main Features	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Total length of section under consideration	
				Type		Character	Type of kilometer post by material type	RCC : Reinforced Cement Concrete CC : Cement Concrete SMCSP : Stone Masonry with Plastering BMCSP : Brick Masonry with Plastering SB : Stone Block only Others : Others
				Size	cmXcm	Numeric	Size of kilo meter post	
				Installation Interval (Distance)	m	Numeric	Installation interval of kilometer post	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Installed Location (Left / Right)		Character	Installation side of kilometer post (with reference to increasing chainage)	Left Right Center	: Left : Right : Center
				Total Number	No.	Numeric	Total number of kilometer post installed within the section		
		23.3	Repair History	Repair Year	YY	Numeric	Year of the latest repair		
				Repair Outline		Character	A brief description of repair work		
		23.4	Asset Value	Installed Year	YY/MM	Date	Year of kilometer post installation		
				Installation Cost	VND	Numeric	Installation cost of kilometer post		
				Service Life	Year	Numeric	Service life kilometer post		
24	Road Damage Inventory	24.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				To	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
		24.2	Damage Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	
				Cause of Damage (Flood, Landslide, cyclone…)		Character	Causes of road damage	Flooding : Flooding Landslide : Landslide Earthquake : Earthquake Thunderstorm : Thunderstorm Typhoon : Typhoon Others : Others
				Occurred Date	YY/MM/DD	Date	Date of damage occurred	
				Damage side (Left / Right)		Character	Side of road where major damage occurred with respect to increasing chainage	Left : Left Right : Right Both : Both
				Traffic Disruption (Yes / No)		Character	Status of traffic movement because of damage	Yes : Yes No : No
				Traffic Disruption Time (Starting Time)		Numeric	Starting point of traffic disruption because of damage	
				Traffic Disruption Time (Ending Time)		Numeric	Ending time of traffic disruption because of damage	
				Traffic Disruption Duration	min	Numeric	Duration of traffic disruption	
				Estimated Cost of Damage	VND	Numeric	Estimated cost of damage	
				Description of Major Damage		Character	Brief description of damage	
				Outline of Immediate Repair (for opening traffic, etc.)		Character	Outline of immediate repair to open traffic at the earliest	
				Recommendation		Character	Recommendation for long-term	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				for Long-term Countermeasure			counter measure	
				Detour (Yes / No)		Character	Provision of detour route	Yes : Yes No : No
25	Overlap Section s of Routes	25.1	General Information	Road ID				
				Jurisdiction				
				Latitude				
				Longitude				
				Length	m			
				Province				
				City				
				No. of Overlapping Roads		Numeric	No. of roads overlapped in a particular section	
				Route No. Adopted for Management Purpose		Character	Route No. adopted for management purpose for the overlapped section	
		25.2	Details of Overlapping Road -1	Road Name		Character		
				Route Name		Character		
				Route Branch No.		Numeric		
				Road Class		Numeric		
				Chainage at Start Point (as per Road-1's Chainage System)		Numeric		
				Chainage at End Point (as per Road-1's Chainage System)		Numeric		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
		25.3	Details of Overlapping Road-2	Road Name		Character			
				Route Name		Character			
				Route Branch No.		Numeric			
				Road Class		Numeric			
				Chainage at Start Point (as per Road-2's Chainage System)		Numeric			
				Chainage at End Point (as per Road-2's Chainage System)		Numeric			
				Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
		25.4	Remarks	Remarks		Character			
26	Submer sible Crossin g Facility (Cause way, Syphon …etc.)	26.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage at Center From (Kilopost)	km, m				
				Latitude					

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Longitude				
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		26.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Name of Facility		Character	Name of facility	Causeway : Causeway Syphon : Syphon Spillway : Spillway Others : Other
				Name of river or stream		Character	Name of river / stream where facility provided	
				Highest Water Level	m	Numeric	Highest water level in the river /stream during flood	
				Lowest Water Level	m	Numeric	Lowest water level in the river / stream during dry season	
				Average Flooding Duration	min	Numeric	Average flooding duration in the river / stream	
				Width	m	Numeric	Width of facility	
				Length	m	Numeric	Length of facility	
				No. Span	No.	Numeric	No. of span if multiple span provided	
				Span Length	m	Numeric	Length of a span	
		26.3	Repair History	Repair Year	YY	Numeric	Year of the latest repair	
				Repair Outline		Character	A brief description of repair work	
		26.4	Asset Value	Installed Year	YY/MM	Numeric	Year of facility installation	
				Installation Cost	VND	Numeric	Installation cost of the facility	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
				Service Life	Year	Numeric	Service life of the facility		
27	River Crossing Facility (Ferry, etc.)	27.1	General Information	Road ID					
				Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				Chainage at Center From (Kilopost)	km, m				
				Latitude					
				Longitude					
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City		364			
		27.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
			Ferry	Ferry Name		Character	Name of ferry		
				Ferry Type		Character	Type of ferry by operation type	Fuel Electric Manual Others	: Engine Driven (By Fuel) : Electric Ferry : Manual Driven : Others
				Ferry Size Capacity of ferry	mXm	Numeric	Max. allowable weight which can be transported via ferry		
				River / Channel Name		Character	Name of river / channel where facility provided		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Max. Width of River (Rainy season)	m	Numeric	Max. width of river / channel during rainy season	
				Min. Width of River (Dry season)	m	Numeric	Min. width of river / channel during dry season	
				Highest Water Level	m	Numeric	Highest water level during rainy season	
				Lowest Water Level	m	Numeric	Lowest water level during dry season	
			Landing	Ferry Landing Type		Character	Ferry landing type by construction material	Metal : Metal Type Wooden : Wooden RCC : RCC Concrete : Concrete Others : Others
				Length of Ferry Landing in Left Bank	m	Numeric	Length of ferry landing in the left bank of the river (chainaging in the increasing order)	
				Length of Ferry Landing in Right Bank	m	Numeric	Length of ferry landing in the right bank of the river	
				Width of Ferry Landing in Left Bank	m	Numeric	Width of ferry landing in the left bank	
				Width of Ferry Landing in Right Bank	m	Numeric	Width of ferry landing in the right bank	
				Other supplemented/auxiliary Facility (passenger room, ticket kiosk, etc.)		Character	Provision of other ancillary facilities available which are related to ferry	
				Operation Time	HH~HH	Character	Ferry operation time	
		27.3	Repair History	Repair Year	YY	Numeric	Year of the latest repair	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Repair Outline		Character	A brief description of repair work	
		27.4	Asset Value	Installation Year	YY/MM	Numeric	Year of ferry installation	
				Installation Cost	VND	Numeric	Installation cost of ferry	
				Service Life	Year	Numeric	Service life of ferry	
28	Pontoo n Bridge	28.1	General Information	Road ID				
				Road Name				
				Route No.				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				Chainage at Center From (Kilopost)	km, m			
				Latitude				
				Longitude				
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		28.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				River/Chanel		Character	Name of River / Channel	
				Max. Width of River (rainy season)	m	Numeric	Max. width of river during rainy season	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Min. Width of River (dry season)	m	Numeric	Min. width of river during dry season	
				Length of Pontoon-Bridge	m	Numeric	Length of pontoon bridge	
				Width of Pontoon-Bridge	m	Numeric	Width of pontoon bridge	
				Pontoon-Bridge type		Character	Type of pontoon bridge by material type	Wooden : Wooden Surface Wooden&Metal : Wooden and Thin Metal Sheet Others : Other Light Density Material Mixed : Composite
				Operational Load	Ton	Numeric	Max. allowed operational load	
		28.3	Repair History	Repair Year	YY	Numeric	Year of the latest repair	
				Repair Outline		Character	A brief description of repair work	
		28.4	Asset Value	Installed Year	YY/MM	Numeric	Year of pontoon bridge installation	
				Installation Cost	VND	Numeric	Installation cost of pontoon bridge	
				Service Life	Year	Numeric	Service life of the pontoon bridge	
29	Maintenance History	29.1	General Information	Road ID		Character	Road ID According to DRVN Reference System	
				Road Name		Character	Name of Road	
				Route Name		Character	Route Name assigned by starting and ending province of the particular road section	
				Route Branch No.		Character	For bypass (if any)	
				Road Class		Character	DRVN's Classification System	
				Jurisdiction		Character	RRMB and RRMS-B Number	
				From (Kilopost)	km, m	Numeric	Starting chainage of the section	
				To	km, m	Numeric	Ending chainage of the section	
				Latitude		Numeric	Latitude of Starting or Ending	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
							Point Measured by GPS	
				Longitude		Numeric	Longitude of Starting or Ending Point Measured by GPS	
				Length	m	Numeric	Sectional Length (To - From)	
				Kilopost Adjustment Date	YY	Date	Date of Kilopost adjustment specially after a big repair work or bypass road construction.	
				Date of Update	YY	Date	Date of Database Updating	
				Province		Character	Name of province where the section located	
				City		Character	Name of city where the section located	
		29.2	General Information of Road Project	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length	m	Numeric	Length of Repair Section as in the field	
				Repair Work ID		Character	Project ID of Repair Work	
				Project Name		Character	Name of Project	
				Repair Component on Cross-Section		Character	Extent of repair in transverse cross-section	100 : Full 75 : ¾ of Cross-Section 50 : ½ of Cross-Section 25 : ¼ of Cross-Section
				No. of Repair Lane		Numeric (Integer)	Total number of lane repaired.	1 2 3
				Total Width of Repair Lane		Numeric	Total Width of Repair Lane	
				Date of Repair Completion	YY/MM	Date	Date of Repair Work Completion	
				Duration of Repair Work	MM	Date	Total Duration of Repair Work	
				Total Repair Cost	Mil VND	Numeric	Total Cost Required for Repair	

SN	Data Type		Item	Sub-Item		Unit	Data Format	Definition	CODE	
								Work		
				Total Pavement Repair Cost		Mil VND	Numeric	Total Cost Required for Pavement Repair Work Only		
				Budget Source			Character	Budget Source of Repair Work		
		29.3	Existing Pavement Condition before Repair Project	Pavement Structure Type			Character	Type of Pavement Structure (Rigid, Flexible, Composite or Other	Flexible Rigid Composite Others	: Flexible Pavement : Rigid Pavement : Composite Pavement : Others
				Pavement Loading Capacity By Benkelmen Beam		daN/cm2	Numeric	Loading Capacity of Pavement measured by Benkelmen Beam		
				Pavement Loading Capacity By Loading Plate		daN/cm2	Numeric	Loading Capacity of Pavement Measured by Loading Plate		
				Pavement Loading Capacity (Mr) by FWD		Mpa	Numeric	Loading Capacity (in terms of resilient modulus) of Pavement Measured by FWD		
				FWD Test Data	D0	µm	Numeric	Deflection at a distance of 0 cm from the center of load		
					D20	µm	Numeric	Deflection at a distance of 20 cm from the center of load		
					D150	µm	Numeric	Deflection at a distance of 150 cm from the center of load		
				Sub-Grade Loading Capacity By Loading Plate		daN/cm2	Numeric	Loading Capacity of Pavement Measured by Loading Plate		
				Sub-Grade Loading Capacity (Mr) by FWD		Mpa	Numeric	Loading Capacity (in terms of resilient modulus) of Pavement Measured by FWD		
				FWD Test Data	D0	µm	Numeric	Deflection at a distance of 0 cm from the center of load		
					D20	µm	Numeric	Deflection at a distance of 20 cm from the center of load		
					D150	µm	Numeric	Deflection at a distance of 150		

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
							cm from the center of load	
				Sub-Grade Loading Capacity By CBR	%	Numeric	Loading Capacity of Pavement Measured by CBR Test	
				Surface Performance Pavement Distress (Cracking)	%, cm/m2	Numeric	Area of cracking expressed in percentage of total pavement area for Asphalt Concrete/Cement Concrete	
				Surface Performance Pavement Distress (Rutting)	mm	Numeric	Surface depression in the wheel-path (Average or Maximum)	
				Surface Performance Pavement Distress (IRI)	m/km	Numeric	International Roughness Index (IRI)	
				Surface Performance Skid Resistance (Specify Method)		Numeric	Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface	
		29.4	Repair Method	Reason to Repair		Character	Main Reason of Repair.	
				Repair Classification		Character	Repair classification by scale of repair work	Routine Maintenance Medium Repair Big Repair
				Repair Type		Character	Type of Repair Work based on Scale and Method of Repair Work	SBST : SBST-Single Bituminous Surface Treatment DBST : DBST-Double Bituminous Surface Treatment TBST : TBST-Triple Bituminous Surface Treatment BPM : BPM-Bituminous Penetrated Macadam ASOL : ASOL- Asphalt Concrete Overlay SOL : Rep- Structural Overlay (Replacement) CS : Crack Seal GPR : GPR- Gravelling Pavement Repair PR : PR- Patching Repair Type EBR : EBR-Edge Break Repair Type Others : Others
				Pavement Type (Rigid / Flexible /		Character	Pavement Type by Structure Type	Flexible : Flexible Pavement Rigid : Rigid Pavement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Composite)				Composite : Composite Pavement Others : Others
				Pavement Type (by Material		Character	Pavement Type by Material Type Used in Repair Work	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Thickness of Cutting	cm	Numeric	Thickness of Pavement Cut for Repair Work	
				Foundation (Sub-Grade Course) Thickness	cm	Numeric	Thickness of Sub-grade Course Layer	
				Pavement Type		Character	Material Used in Sub-grade Course	AC : Asphalt Concrete AM : Asphalt Macadam APM : Asphalt Penetration Macadam CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Grain Size of Aggr.	mm	Numeric	Max. Grain Size of Aggregate Used in Sub-grade Course	
				Actual Compaction	%	Numeric	Compaction Coefficient of Sub-grade Course	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Coefficient				
				Foundation (Sub-Base Course) Thickness	cm	Numeric	Thickness of Sub-base Course	
				Pavement Type		Character	Material Used in Sub-base Course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Grain Size of Aggr.	mm	Numeric	Max. Grain Size of Aggregate Used in Sub-base Course	
				Actual Compaction Coefficient	%	Numeric	Compaction Coefficient of Sub-base Course	
				Foundation (Base Course) Thickness	cm	Numeric	Thickness of Base Course	
				Pavement Type		Character	Material Used in Base Course	AC : Asphalt Concrete AM : Asphalt Macadam BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								MP AP EP Others	: Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement Lime Emulsion Bitumen Flyash Chemical Mixed Others	: Cement : Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents : Combined : Others
				Max. Grain Size of Aggr.	mm	Numeric	Max. Grain Size of Aggregate Used in Base Course		
				Actual Compaction Coefficient	%	Numeric	Compaction Coefficient of Base Course		
				Surface (Binder Course) Thickness	cm	Numeric	Thickness of Binder Course		
				Pavement Type		Character	Material Used in Binder Course	AC AM BP CC MP AP EP Others	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement Lime Emulsion Bitumen Flyash Chemical Mixed	: Cement : Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents : Combined

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								Others	: Others
				Max. Grain Size of Aggr.	mm	Numeric	Max. Grain Size of Aggregate Used in Binder Course		
				Actual Compaction Coefficient	%	Numeric	Compaction Coefficient of Binder Course		
				Surface (Wearing Course) Thickness	cm	Numeric	Thickness of Wearing Course		
				Pavement Type		Character	Material Used in Wearing Course	AC AM BP CC MP AP EP Others	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement Lime Emulsion Bitumen Flyash Chemical Mixed Others	: Cement : Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents : Combined : Others
				Max. Grain Size of Aggr.	mm	Numeric	Max. Grain Size of Aggregate Used in Wearing Course		
				Actual Compaction Coefficient	%	Numeric	Compaction Coefficient of Wearing Course		
				Surface (Others) Thickness	cm	Numeric	Thickness of Other Course		
				Pavement Type		Character	Material Used in Other Course	AC AM	: Asphalt Concrete : Asphalt Macadam

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								BP : Bituminous Pavement (Bituminous surface treatment and Bitumen penetration) CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement : Cement Lime : Lime Emulsion : Emulsion Bitumen : Bitumen Flyash : Fly Ash Chemical : Chemical Agents Mixed : Combined Others : Others
				Max. Grain Size of Aggr.	mm	Numeric	Max. Grain Size of Aggregate Used in Other Course	
				Actual Compaction Coefficient	%	Numeric	Compaction Coefficient of Other Course	
		29.5	Technical Work Effects	Loading Capacity (Finished Surface) By Benkelmen Beam	daN/cm2	Numeric	Loading Capacity of Pavement Measured by Benkelmen Beam after Repair Work Completion	
				Loading Capacity (Finished Surface) By Loading Plate	daN/cm2	Numeric	Loading Capacity of Pavement Measured by Loading Plate after Repair Work Completion	
				Loading Capacity (Resilient Modulus (Mr)) By FWD	Mpa	Numeric	Loading Capacity in terms of resilient modulus of Pavement Measured by FWD after Repair Work Completion	
				FWD Test Data			Loading Capacity of Pavement Measured by FWD after Repair Work Completion.	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				D0 D20 D150	µm	Numeric	**D0**: Deflection at a distance of 0 cm from the center of load **D20**: Deflection at a distance of 20cm from the center of load **D150**: Deflection at a distance of 150cm from the center	
				Surface Performance (Roughness) Smoothness by 3m Straight Ruler		Numeric	Roughness of Finished Surface Measured by 3m Long Straight Ruler	
				Surface Performance (Roughness) Roughness (IRI)	m/km	Numeric	Roughness of Finished Surface Measured in Terms of IRI	
				Surface Performance (Surface Texture) Macro-Texture Depth	mm	Numeric	Surface Texture of Finished Surface after Repair Work Measured in Terms of Macro-Texture Depth	
				Surface Performance (Surface Texture) Skid Resistance by Pendulum Friction Coefficient		Numeric	Surface Texture of Finished Surface after Repair Work Measured in Terms of Skid Resistance	
				Others			Any Other Parameter Used for Measuring Technical Work Effects	
30	Pavement Condition	30.1	General Information	Road ID				
				Road Name				
				Route Name				
				Route Branch No.				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Road Class				
				Jurisdiction				
				From (Kilopost)	km, m			
				To	km, m			
				Latitude				
				Longitude				
				Length	m			
				Kilopost Adjustment Date	YY			
				Date of Update	m			
				Province				
				City				
		30.2	Main Details	Direction Type (Up-Bound, Down-Bound or Both)		Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane	UP: : End to Start Down : Down: Start to End Both : Both Direction Single : Single Lane used for both directions
				Actual Length		Numeric	Sectional Length (To - From)	
				Analysis Area	m2	Numeric	Pavement area used for pavement condition analysis	
				No. of Lane		Numeric (Integer)	Total number of lanes (one lane is equivalent to approx. 3.75m)	
				Road Structure Type		Character	Location of road structures	Bridge : Bridge Road_Intersection : Road Intersection Railway_Crossing : Railway Crossing Slab_Culvert : Slab Culvert Box_Culvert : Box Culvert Pipe_Culvert : Pipe Culvert Shade_Fence : Shade Fence Tunnel : Tunnel Others : Others
				Road Crossing Type			Location of road crossings	Signalized : Signalized Intersection Non-Signalized : Non-Signalized Intersection 3-Leg : 3-Leg Intersection

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								4-Leg : 4-Leg Intersection 5-Leg : 5-Leg Intersection Roundabout : Roundabout Flyover : Flyover Viadust : Viaduct Others : Others
		30.3	Condition Data	Surveyed Date		Date	Date of survey carried out to collect the pavement condition data	
				Lane Surveyed		Numeric (Integer)	Lane number survey for collecting pavement condition	
				Pavement Structure Type (CC, AC, BS, Gravel, Earthen)		Character	Type of pavement structure categorized	AC : Asphalt Concrete AM : Asphalt Macadam APM : Asphalt Penetration Macadam CC : Cement Concrete MP : Macadam Pavement AP : Aggregate Pavement EP : Earth Pavement Others : Others
				Cracking Ratio (for AC) Total	%	Numeric	A total area of cracking/patching expressed in percentage of total pavement area for Asphalt Concrete	
				Cracking	%	Numeric	Area of patching expressed in percentage of total pavement area for Asphalt Concrete	
				Patching	%	Numeric	Area of cracking expressed in percentage of total pavement area for Asphalt Concrete	
				Pothole	%	Numeric	Unrepaired potholes	
				Cracking Index (for CC) Total	cm/m2	Numeric	Total length of cracking/patching expressed in length/area for cement concrete	
				Cracking	cm/m2	Numeric	Total length of crack expressed in length/area for cement concrete	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Patching	cm/m2	Numeric	Total length of patching expressed in length/area for cement concrete	
				Pothole	cm/m2	Numeric	Unrepaired potholes	
				Max. Rutting Depth	mm	Numeric	Surface depression in the wheelpath. Max depth of depression of the section	
				Average Rutting Depth	mm	Numeric	Surface depression in the wheelpath. Average of depth of depression of the section	
				IRI	mm/m	Numeric	International Roughness Index (IRI)	
				Patching	%	Numeric	An area of pavement that has been replaced with new material to repair the existing pavement. A patch is considered a defect no matter how well it performs. An area of pavement that has been replaced with new material to repair the existing pavement. A patch is considered a defect no matter how well it performs.	
				Pothole	No./km	Numeric	Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the surface layer down to the base course	
				Texture	mm	Numeric	Pavement Surface Texture (macro-texture)	
				Small Crack	%	Numeric		
				Large Crack (Edge Break)	m2/km	Numeric		
				Raveled Area	%	Numeric	The progressive disintegration of an pavement layer from the	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
							surface downward as a result of the dislodgement of aggregate particles.	
		30.4	Pavement Loading / Structural Capacity	Skid Resistance		Numeric	Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface	
				Loading Capacity (Resilient Modulus (Mr)) By FWD	Mpa	Numeric	Loading Capacity in terms of resilient modulus of Pavement Measured by FWD after Repair Work Completion	
				FWD Test Date	YY/MM	Date	Year and Month of the FWD test conducted.	
				FWD Test Data			Loading Capacity of Pavement Measured by FWD after Repair Work Completion.	
				D0 D20 D150	μm	Numeric	**D0**: Deflection at a distance of 0 cm from the center of load **D20**: Deflection at a distance of 20cm from the center of load **D150**: Deflection at a distance of 150cm from the center	
				Loading Plate	daN/cm2	Numeric	Pavement loading capacity measured by loading plate	
31	Traffic Volume	31.1	General Information	Road Name				
				Route Branch No.				
				Jurisdiction				
				Counting Station: Name			Name of counting station	
				Counting Station: Km			Chainage of counting station km+m	
				Counting Station: M				
				Counting Station: Latitude				
				Counting Station: Longitude				

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Traffic Counting Year			Traffic counted year	
		31.2	Total Traffic Volume	24hr Traffic	AADT		Total traffic volume in UP direction, DOWN direction and TOATL of (UP and DOWN)	
		31.3	Heavy Traffic Volume	24hr Traffic	AADT		Total heavy traffic [Light truck, medium truck (2 axle, 6 wheels), Heavy truck (3 axle), Heavy truck (> 4 axle) and Big bus (> 20 seats)] volume in UP direction, DOWN direction and TOATL of (UP and DOWN)	
		31.4	Traffic Volume by Traffic Category (Annual Average)	Car				
				Light Truck				
				Medium Truck (2 Axles 6 Wheels)				
				Heavy Truck (3 Axle)				
				Heavy Truck (>4 Axle)				
				Small Bus				
				Large Bus				
				Tractor				
				Motorbike (3 wheeled motorbike)				
				Bicycle, Pedicab				
				Grand Total			Annual Total of all vehicle types	

APPENDIX - 2 VBMS DATA DEFINITION

In order to manage the bridge data, VBMS software is modulized into four (4) different management modules to manage information in accordance with different requirements and purposes. These modules include:

- Inventory Module
- Bridge Inspection Module
- Planning Module
- Administration Module

A2.1 INVENTORY MODULE

Since VBMS is in operation separately, only inventory related information are included in the Road Database System. Information which are saved in Inventory Module of VBMS system are imported to the Road Database system using interface system file developed to import information from VBMS to the Road Database. Details of Inventory Data Items based on information provided by VBMS team are shown in the table hereafter.

(1) Registration information and management information

SN	Data Items	Data Format Type	Unit	Remarks
1	Bridge Number	Character		
2	Work Number			
3	Bridge Name	Character (Unicode)		
4	Route Number	Numeric		
5	Station	Numeric		
6	Province	Numeric		
7	District	Numeric		
8	Longitude	Numeric		
9	Latitude	Numeric		
10	Altitude	Numeric		
11	Route Type	Numeric		
12	Passing Subject	Numeric		
13	Construction Year	Time		
14	Owner	String		
15	Management Department Section	Numeric		
16	Management Company	String		

(2) Functional Information and Exploitation

SN	Data Items	Data Format Type	Unit	Remarks
1	A number of lanes in bridge and under bridge			
2	Traffic Flow			
3	Traffic Flow Year			
4	Design Load			
5	Sign Load			
6	Media Strip in the Middle of Bridge			
7	Inclination			
8	Navigation Request			
9	Vertical Navigation			
10	Cross Navigation			
11	Exploitation State: Opened, Closed, Speed Limited, Load …..			

12	Testing Function in and under the Bridge			

(3) Information on Type of Structure, Design, Construction and Materials

SN	Data Items	Data Format Type	Unit	Remarks
1	Type of Primary Structure			
2	Type of Approach Span			

(4) Span and Geometry Information

SN	Data Items	Data Format Type	Unit	Remarks
1	Number of Primary Spans			
2	Number of Approach Spans			
3	Cross Clearance (allow big vehicles to pass in or under the Bridge)			
4	Length of the Longest Span			
5	Overall Length of Spans			
6	Total Bridge Length			
7	Width of Pedestrian Lane			
8	Width of Bridge Deck			
9	Width of Bridge Deck with Ballast Coating			
10	Min. Clearance (Vertical)			
11	Min. Clearance of Span (vertical, Route Code, Clearance Length)			
12	General Layout and Section			

(5) Survey Data

SN	Data Items	Data Format Type	Unit	Remarks
1	Bridge Floor			
2	Bridge Deck			
3	Beam / Primary Truss			
4	Cross Bracing System			
5	Flexible Joint			
6	Bearing			
7	Abutment			
8	Pier			
9	Railing			
10	Drainage System			
11	Approaching Road			
12	Anti-impact with Pier, Abutment			
13	Flow			

(6) Bridge Rating Data

SN	Data Items	Data Format Type	Unit	Remarks
1	Rating, Assessment Method (Load factor method, allowable stress method, load and resistance factor method, load test, etc.)			
2	Allowable Load based on Assessment Result			

(7) Bridge Conditions State Data

SN	Data Items	Data Format Type	Unit	Remarks
1	Evaluating Structure			
2	Geometry of Bridge Floor			
3	Clearance Span (Vertical and Cross)			
4	Sign Load			

5	Recommending Solution MRR			
6	Estimated Repair Cost			
7	Period between 2 Latest Periodic Inspection			
8	Special Inspection			
9	Special Inspection Time			

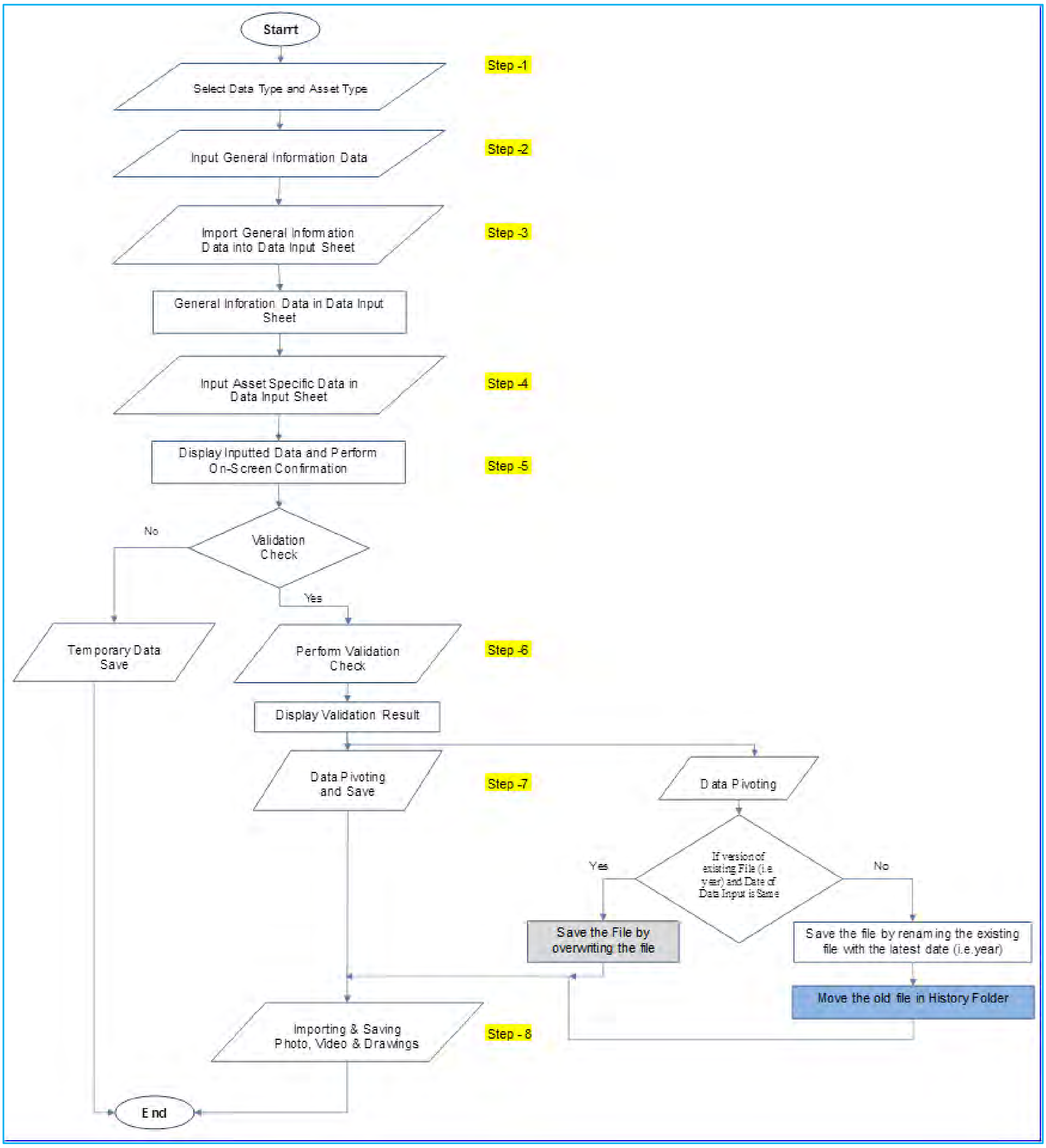
(8) Data on Repair, Enhancement and Replacement

SN	Data Items	Data Format Type	Unit	Remarks
1	Times			
2	Items			
3	Actual Expenses			
4	Note			
5	Attached File			

APPENDIX - 3 FLOW CHART OF BASIC FUNCTIONS

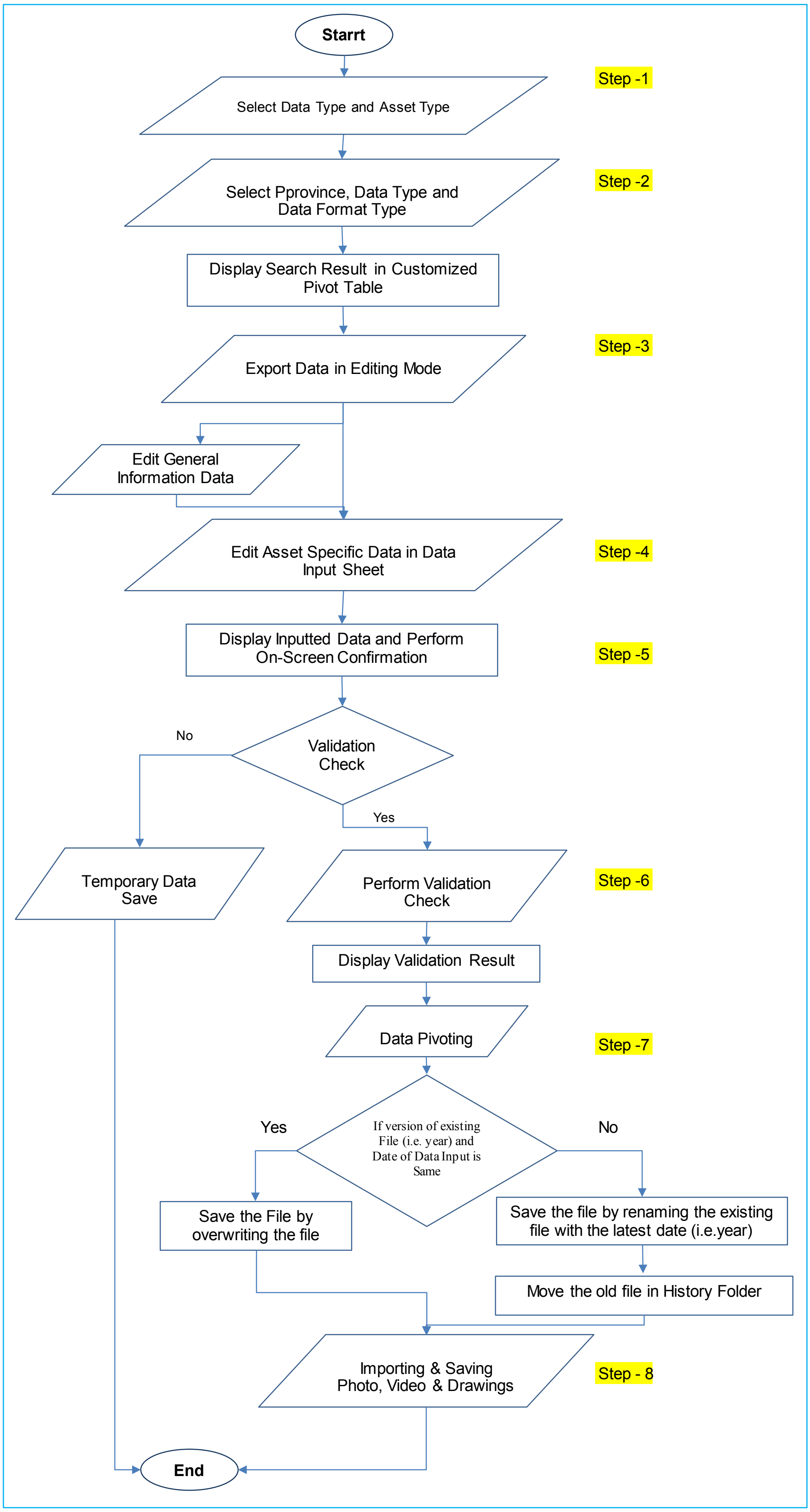
A3.1 NEW DATA INPUT

The general flowchart of new data input is shown below.



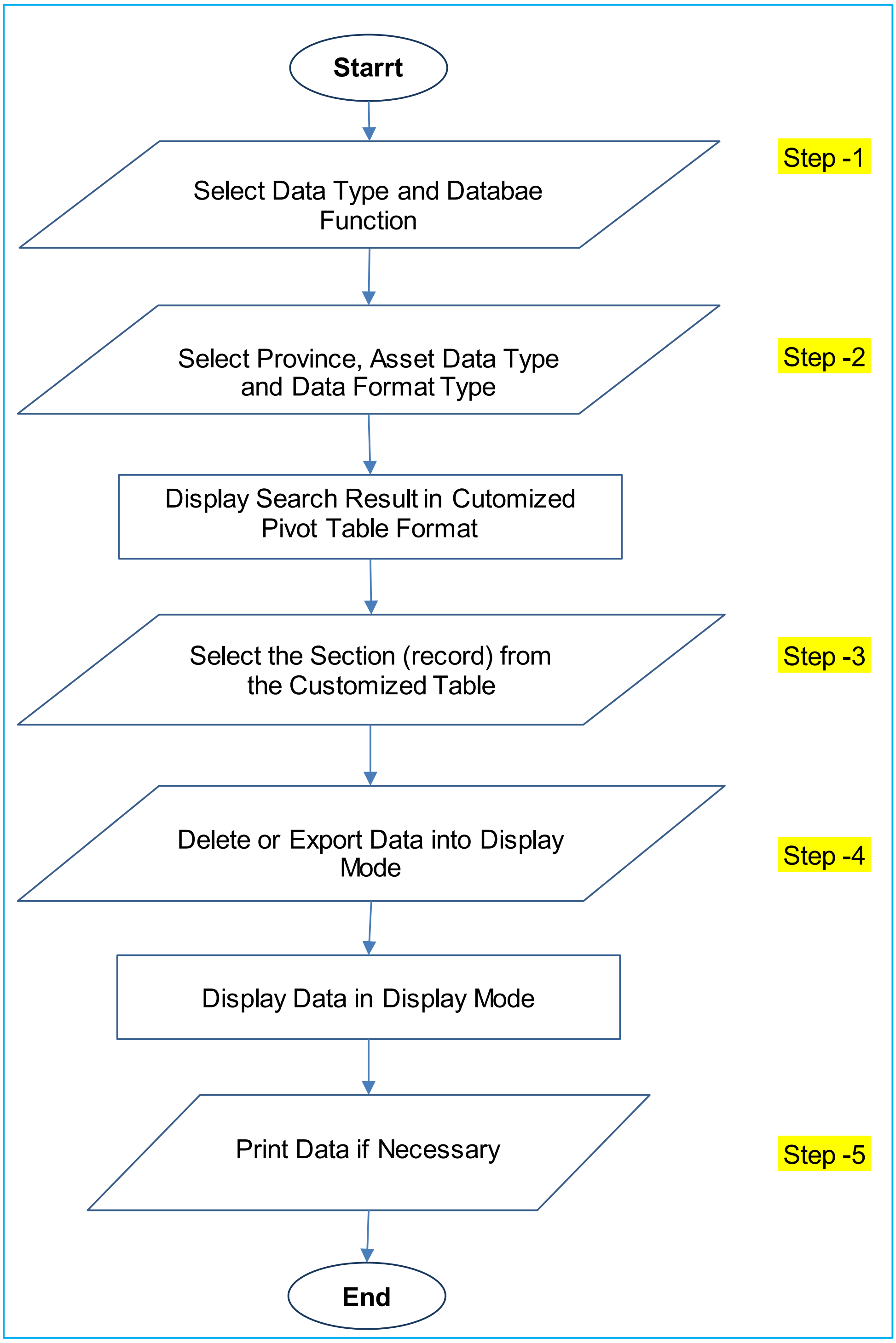
A3.2 DATAEDITING

The general flowchart of new data editing is shown below.



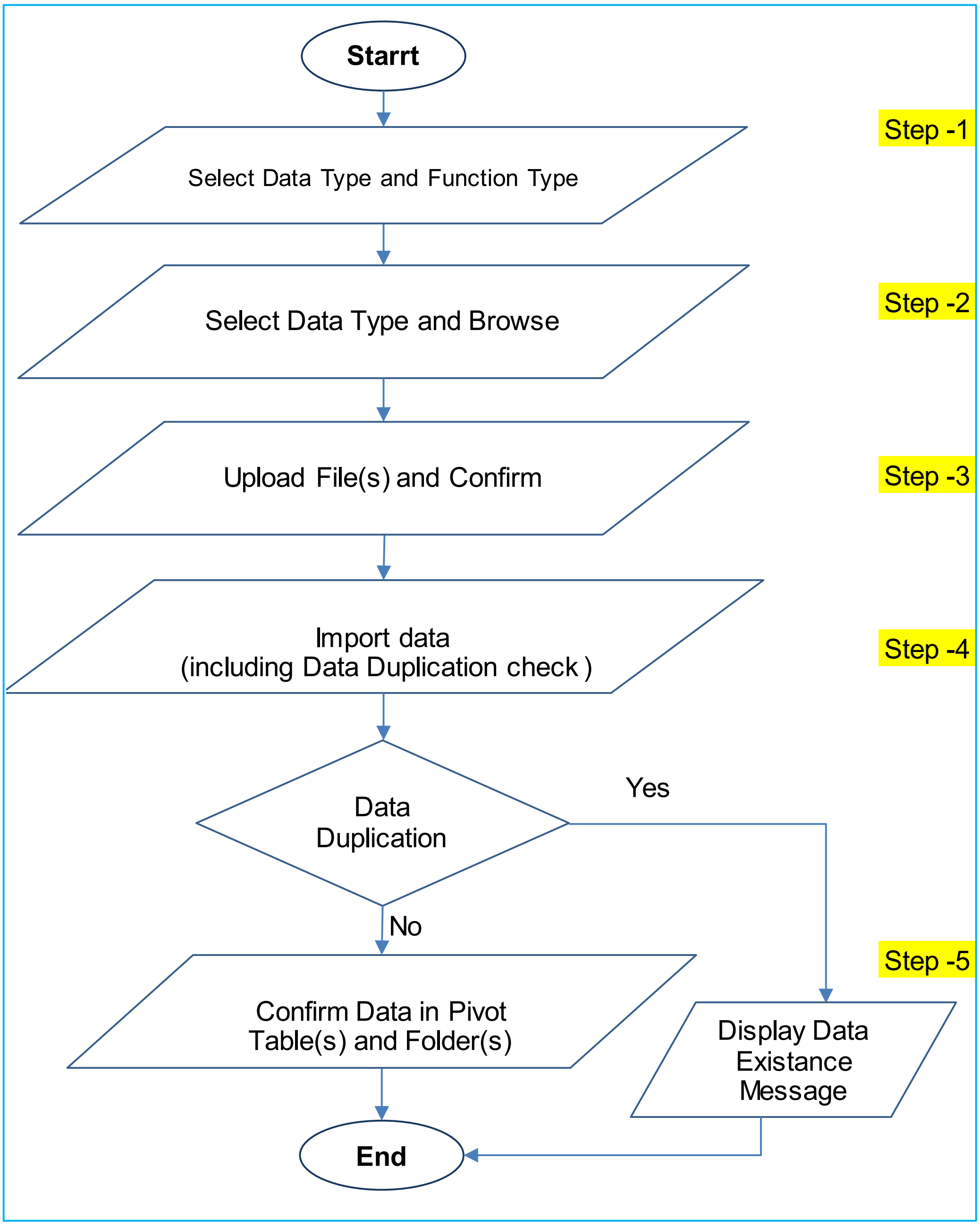
A3.3 DATA SEARCH, DISPLAY, DELETE & PRINT

The general flowchart of new data search, display, delete and print function is shown below.



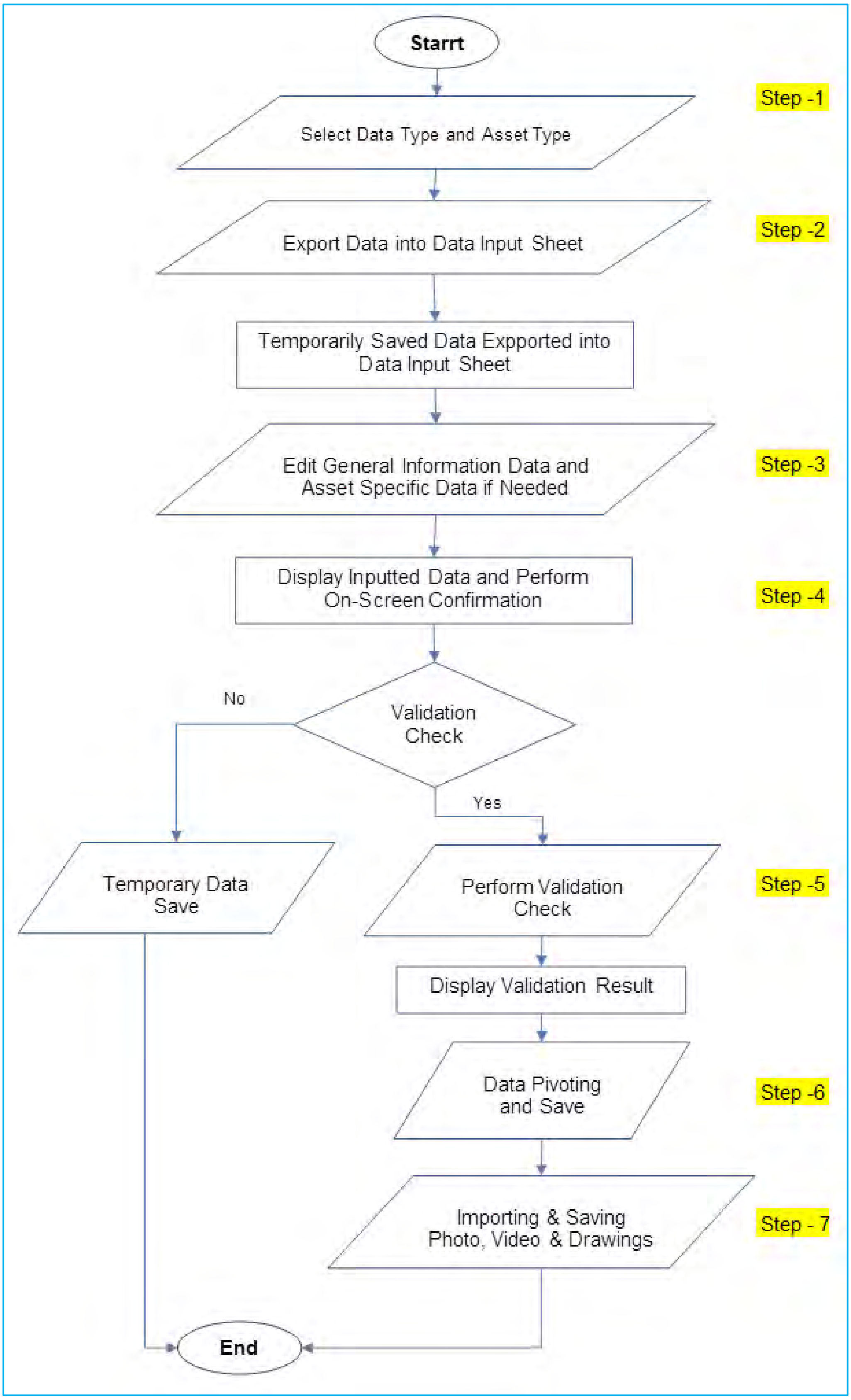
A3.4 NEW DATA IMPORT (DATA ASSEMBLING)

The general flowchart of new data import (data assembling) function is shown below.



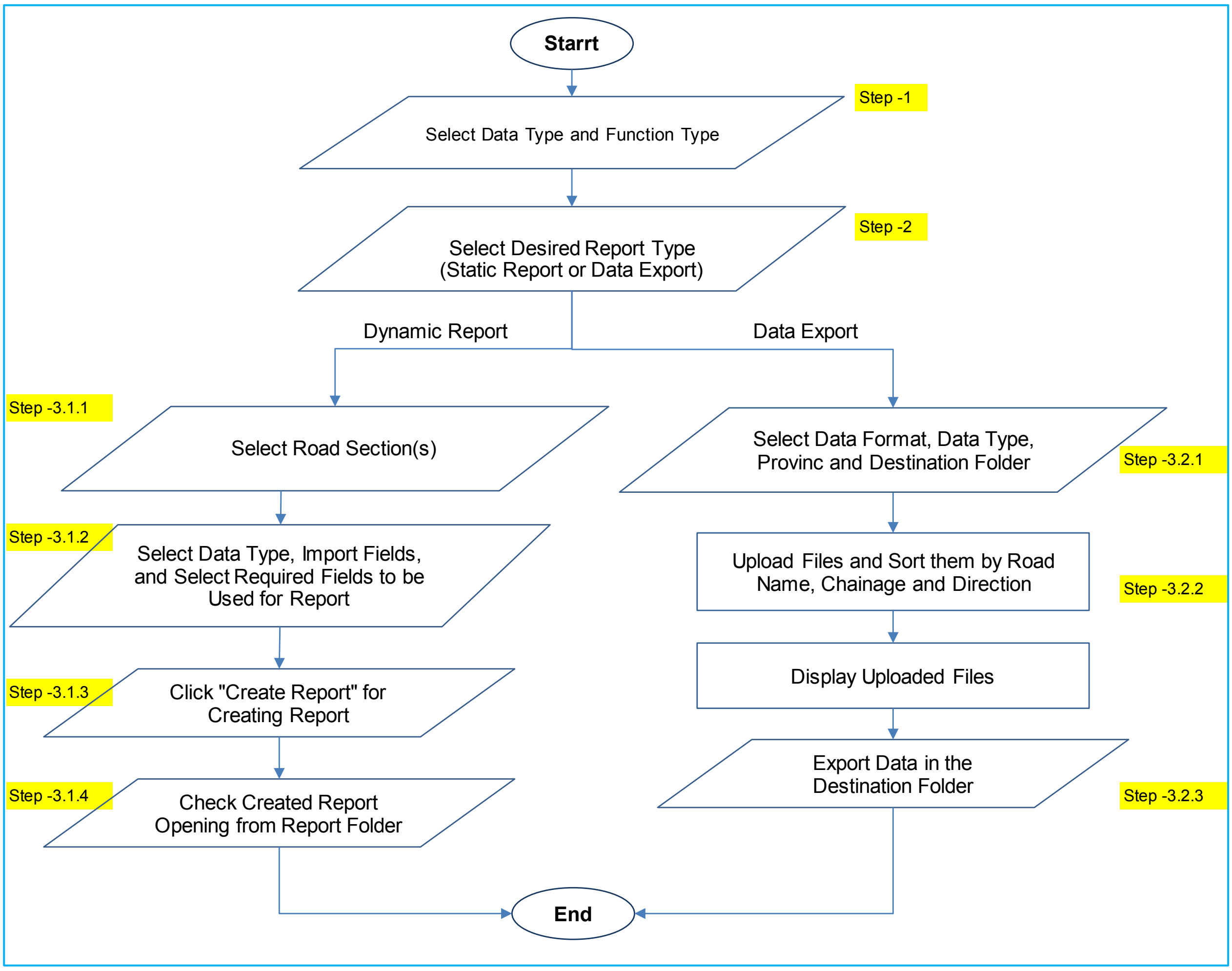
A3.5 RESUMPTION OF DATA INPUT TASK

The general flowchart of resumption of data input task is shown below.



A3.6 CREATE REPORT

The general flowchart of create report function is shown below.



APPENDIX - 4 SAMPLE DATA INPUT SHEET

General Information

MINISTRY OF TRANSPORT
DIRECTORATE FOR ROADS OF VIETNAM
DATA INPUT SHEET

Back to MainWindow | Export to Data Input Sheet

Data Type : Road Main Details

Inputting Road General Information

Road ID	:	
Road Name	:	QL.1A
Tên Tuyến	:	Lạng Sơn - Bắc Giang
Route Branch No.	:	
Road Class	:	

Location Referencing

	Km + m	Latitude	Longitude	Province	City
From :	+			Lạng Sơn	-
To :	+			Lạng Sơn	-
Length :	0.0 m				
Within Section :	KM0+0 -:- KM94+70				

Jurisdiction

RRMB No.: RRMB I
RRMS-B Name: Chi cục QLĐB I.5

Date

KM Post Adjustment Date (yyyy/mm/dd)
Data Entry (yyyy/mm/d 2014/1/30

Select National Highway

SN	RRMB No.:	National Highway	Route Name	Chainage: from ÷ to	Province: from ÷ to	District: from ÷ to	RRMS-B Name
1	RRMB I	QL.1A	Lạng Sơn - Bắc Giang	KM0 + 0 ÷ KM94 + 70	Lạng Sơn ÷ Lạng Sơn	- ÷ -	Chi cục QLĐB I.5
2	RRMB I	QL.1A	Bắc Giang - Bắc Ninh	KM94 + 70 ÷ KM132 + 245	Bắc Giang ÷ Bắc Giang	- ÷ -	Chi cục QLĐB I.5
3	RRMB I	QL.1A	Bắc Ninh - Hà Nội	KM132 + 245 ÷ KM152 + 234	Bắc Ninh ÷ Bắc Ninh	- ÷ -	Chi cục QLĐB I.5
4	RRMB I	QL.1A	Pháp Vân - Cầu Giẽ	KM181 + 570 ÷ KM213 + 608	Hà Nội ÷ Hà Nội	- ÷ -	Chi cục QLĐB I.6
5	RRMB I	QL.1A	Hà Nội - Hà Nam	KM213 + 608 ÷ KM215 + 775	Hà Nội ÷ Hà Nội	- ÷ -	Chi cục QLĐB I.6
6	RRMB I	QL.1A	Hà Nam - Ninh Bình	KM215 + 775 ÷ KM251 + 50	Hà Nam ÷ Hà Nam	- ÷ -	Chi cục QLĐB I.6
7	RRMB I	QL.1A	Ninh Bình - Thanh Hóa	KM251 + 50 ÷ KM285 + 400	Ninh Bình ÷ Ninh Bình	- ÷ -	Chi cục QLĐB I.6
1	RRMB I	QL.2	Vĩnh Phúc - Phú Thọ	KM30 + 600 ÷ KM50 + 650	Vĩnh Phúc ÷ Vĩnh Phúc	- ÷ -	Chi cục QLĐB I.8
2	RRMB I	QL.2	Phú Thọ - Tuyên Quang	KM50 + 650 ÷ KM109 + 0	Phú Thọ ÷ Phú Thọ	- ÷ -	Chi cục QLĐB I.8
3	RRMB I	QL.2	Phú Thọ - Tuyên Quang	KM109 + 0 ÷ KM115 + 0	Phú Thọ ÷ Phú Thọ	- ÷ -	Chi cục QLĐB I.8
4	RRMB I	QL.2	Tuyên Quang - Hà Giang	KM115 + 0 ÷ KM205 + 0	Tuyên Quang ÷ Tuyên Quang	- ÷ -	Chi cục QLĐB I.8
5	RRMB I	QL.2	Hà Giang	KM205 + 0 ÷ KM312 + 500	Hà Giang ÷ Hà Giang	- ÷ -	Chi cục QLĐB I.8
1	RRMB I	QL.3	Thái Nguyên - Bắc Kạn	KM33 + 300 ÷ KM113 + 816	Thái Nguyên ÷ Thái Nguyên	- ÷ -	Chi cục QLĐB I.8
2	RRMB I	QL.3	Bắc Kạn - Cao Bằng	KM113 + 816 ÷ KM239 + 414	Bắc Kạn ÷ Bắc Kạn	- ÷ -	Chi cục QLĐB I.4
3	RRMB I	QL.3	Cao Bằng	KM239 + 414 ÷ KM344 + 436	Cao Bằng ÷ Cao Bằng	- ÷ -	Chi cục QLĐB I.4

MINISTRY OF TRANSPORT

DIRECTORATE FOR ROADS OF VIETNAM

DATA INPUT SHEET

Data Type : Road Main Details

General Information

GENERAL INFORMATION

Road ID :		Location Referencing					Jurisdiction	Date
Road Name : QL.1A		Km + m	Latitude	Longitude	Province	City	RRMB No.:	KM Post Adjustmen
Route Name : Lạng Sơn - Bắc Giang	From :	0 0			Lạng Sơn	-	RRMB I	2014/1/30
Route Branch N : 0	To :	1 0			Lạng Sơn	-	RRMS-B Name	Data Entry
Road Class : I	Length :	1,000.0 m					Chi cục QLĐB I.5	2014/1/30

Asset Sepecific Data

MAIN DETAILS

Construction Year :		
Year of Service Operation Oper :		
Terrain Type :		
Temperature :		°C
Annual Preciptation :		mm
Road Bed Type :		
Actual Length :		m
Road Safety Corridor :		m (up)
:		m (down)
Design Speed :	#N/A	km/h

CROSS SECTION SCALE

Direction Type :	**Shoulder**		**Footpath, Ditch**	
Motorized Lane	Treated Shoulder W : m	Footpath Width (including curb) : m
No. of Lane :	Treated Shoulder S :	Footpath Structure :
Lane Width (one la : m	Non-Treated Shoulc : m	Ditch Width : m
Pavement Type :		Ditch Structure :
Non-Motorized Lane (NMT)	**Median Strip**	**Cross Section Details**
No. of Lane :	Width : m	Carriageway Width : 0 m
Lane Width (one la : m	Max. Difference in I : m	Pavement Width : 0 m
Pavement Type :	Median Structure :	Road Bed Width : m
		Road Land Width : m

ROAD STRUCTURES (if any)

Structure Type	Quantity	Remarks
Bridge :		
Road Intersection :		
Railway Crossing :		
Box Culvert :		
Slab Culvert :		
Pipe Culvert :		
Flyover Bridge :		
Others :		

Remarks

Back to Select Data | Edit | Display

APPENDIX - 5 DATA VALIDATION CHECK

A5.1 BACKGROUND

The data validation function in database is a key function to input and store proper data in proper format. Checking validity of the data enhances the reliability of the data and can be used with higher confident in the management work. By learning the lesson from RosyBASE, much attention has been paid in data validation check function while designing road database system.

A5.2 OBJECTIVES

The objectives of data validation check function are indicated below.

- ✓ To check the validity of the data items while inputting new data or editing / updating existing data.
- ✓ To enhance the reliability of database as a whole.

A5.3 VALIDATION ITEMS TO BE CHECKED

The following validation items are checked before storing the data in database.

A5.3.1 Section Overlap

Since physical and structural characteristics of road and its installed facilities vary section-by-section, it is almost impossible to segregate the sections in equal interval. Therefore, segregating the sections based on their characteristics, regardless of length of the sections, is most effective and efficient from the view point of convenience in data management, reducing volume of data input work and future utilization of data.

A5.3.2 Blank Data

The existence of void data in the database may consider as either there is no data or data is not inputted in the database properly. Therefore, either interpretation might be wrong in many cases. For example, if void data is considered as "no data available" though there is data but inputted improperly only, it misleads the information and may affect in many ways when that data is used for planning and management.

A5.3.3 Data Format Type

In computing science, the difference between number and text is very high and sensitive as well though the meaning might be same. If text is inserted instead of number or vice-versa, computation will be interrupted. Therefore, it is very important to check data type before storing data into database. Under this validation check, check to identify whether the entered data is number or text is necessary.

A5.3.4 Data Range

Some road and facility condition indicators are defined based on qualitative observation and measured in specific scale and thus will be specific data range. Also, it is very high possibility of inserting data mistakenly as a typo error while data inputting though other validation criteria are met. Therefore, checking data range of particular data items is very much important and plays important role in many cases for storing more accurate and reliable data in the database. For example, value of IRI is rarely exceeds 20 m/km. If IRI value is mistakenly inputted 200 or 0.02, theses value should be treated as incorrect because these figures are strangers or out of range for defining IRI.

A5.4 VALIDATION CHECK

A5.4.1 Criteria Settings

Criteria for validation check are set during the system development because setting criteria from the beginning during data inputting is almost impossible by considering various reasons such as data inputting operator might not be familiar with the particular criteria and time consuming to set criteria in every data input. Those data items which are not eligible for validation check are indicated as N/A. For example, only few data items might be eligible for section overlap and data range validation check whereas validation check for blank data and data format type might be applicable for all data items.

A5.4.2 Conditions for Validation Check

1) Section Overlap

Section overlap is checked by using three parameters as;

- ✓ Route No. (A)
- ✓ Route Branch No. (B)
- ✓ Chainage (From / To) (C)
- ✓ Lane Type (D)

Above four (4) items are selected to check the section overlap because in exclusion of any of the above items validation check for section overlap might not correct. The following conditions are set to check the validity of the data under section overlap check.

Route No. (A)	Branch No. (B)	From / To (C)	Lane Type (D)	Result
A_S	B_S	C_S	D (Up, Down, Both)$_S$	Invalid
			D(Up, Down)$_D$ with Both	Invalid
			D(Up, Down)$_D$ without Both	Valid
		C_D	D (Up, Down, Both)$_S$	Valid
			D(Up, Down)$_D$ with Both	Valid
			D(Up, Down)$_D$ without Both	Valid
	B_D	C_S	D (Up, Down, Both)$_S$	Valid
			D(Up, Down)$_D$ with Both	Valid
			D(Up, Down)$_D$ without Both	valid
		C_D	D (Up, Down, Both)$_S$	Valid
			D(Up, Down)$_D$ with Both	Valid
			D(Up, Down)$_D$ without Both	Valid
Note: Subscript "$_S$" stands for "Same" and subscript "$_D$" stands for "Different".				

2) Blank Data

A specified cell is assigned for each data item. Therefore, the check to examine whether a particular cell is empty or not is carried-out and the conditions are shown below.

Criteria	Inputted Data	Result
Not Blank (Fill)	Fill	Valid
	Blank	Invalid

3) Data Format Type

Since every data item is defined either as number or text (or combination of both), data shall be inputted in proper format. Therefore, data format type (i.e. number and text) is checked for each data item. If text format data is inputted in number format cell or vice-versa, result of validation check shall display "Invalid". Similarly, if inputted data format and assigned data format is same, result of validation check shall display "Valid".

Inputted Data	Criteria	Result
Text	Text	Valid
	Number	Invalid
Number	Text	Invalid
	Number	Valid

4) Data Range

Validity check for checking data range for the number format type data items, which are applicable for data range check, is performed. The inputted number data value is checked with the criteria set beforehand (i.e. specified data range). If inputted data falls under the data range, result of validation check shall display "Valid" otherwise "Invalid".

Criteria	Inputted Data	Result
Defined Range	Within Defined Range	Valid
	Out of Defined Range	Invalid

A5.5 DISPLAYING RESULT OF VALIDATION CHECK

Upon completion of validation check of individual validation check item, results of validation check are displayed as validation check item-wise (individual) result and total validation check result (i.e. considering the results of all four validation check items). Unless the total validation result is all "Valid", data are not saved in Pivot Table.

Validation Check Results				Total Validation Check Results
Section Overlap	**Blank Data**	**Data Format Type**	**Data Range**	
Valid	Valid	Valid	Valid	Valid
			Invalid	Invalid
		Invalid	Valid	Invalid
			Invalid	Invalid
	Invalid	Valid	Valid	Invalid
			Invalid	Invalid
		Invalid	Valid	Invalid
			Invalid	Invalid
Invalid	Valid	Valid	Valid	Invalid
			Invalid	Invalid
		Invalid	Valid	Invalid
			Invalid	Invalid
	Invalid	Valid	Valid	Invalid
			Invalid	Invalid
		Invalid	Valid	Invalid
			Invalid	Invalid

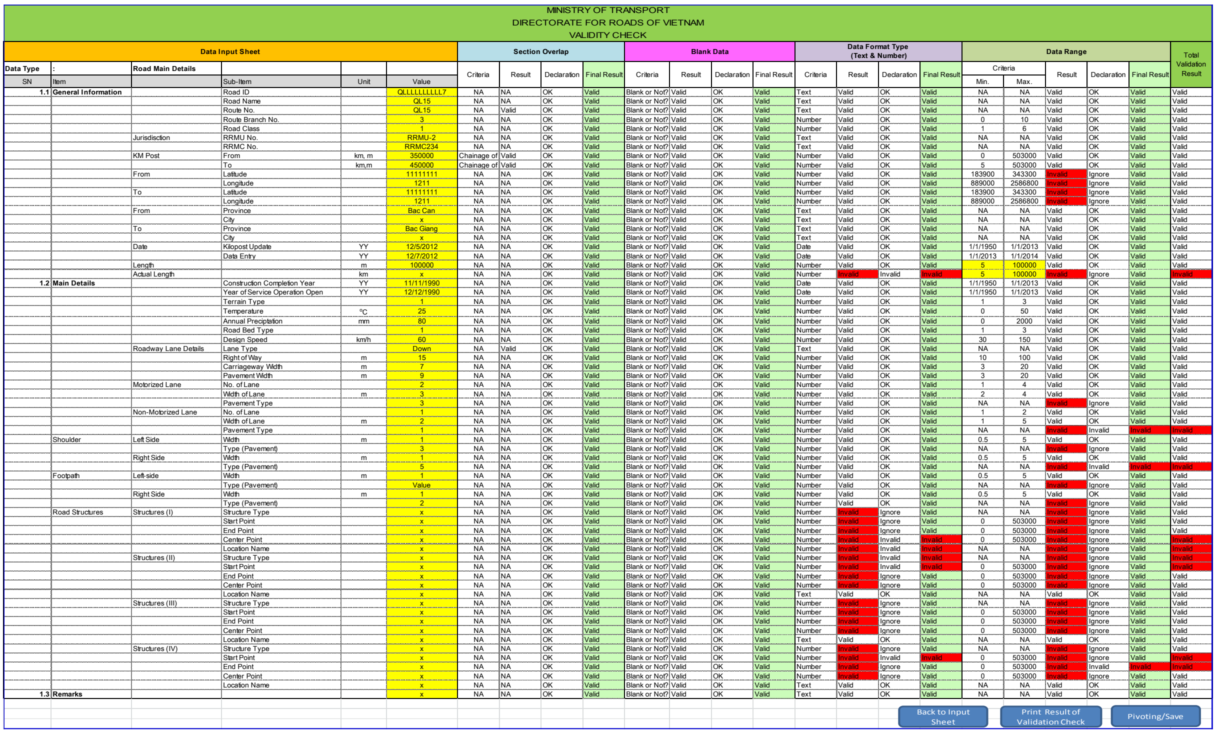


Figure 1 1-1 Display of Results of Data Validation Check

A5.6 HANDLING INVALID DATA

In order to handle invalid data, a declaration option is introduced to declare the invalid results either “Ignore” or “Invalid”. If invalid result is considered as “Ignore”, the ultimate results will be valid (i.e. “Ignore” is equivalent to “Valid” while checking total validity). This option is particularly required to deal with the data items which are invalidated by validation check for blank data because there is a high possibility of being unable to collect some asset data (inventory data) of already constructed roads. If it is set a mandatory condition that have to pass validity check of blank data and blank data are not allowed to store in pivot table, many of other data which are available might also be either lost or kept without inputting into the database. An example of handling invalid data as described above is illustrated below.

Validation Check Results					Total Validation Check Results
Section Overlap	Blank Data		Data Format Type	Data Range	
Valid	Invalid				
	Invalid	Ignore			
	To be declared by declaration button)				
		Ignore	Valid	Valid	Valid
	Invalid		Valid	Valid	Invalid

VOL. II

DATA CONVERSION SOFTWARE
USER'S MANUAL

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 IN THE SOCIALIST REPUBLIC OF VIETNAM

DATA CONVERSION SOFTWARE USER'S MANUAL

APRIL 2014

JICA PROJECT TEAM

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

Data Conversion Software (hereinafter referred to as "the Conversion Software") has been developed under Activity-2: Enhancement of Planning Capacity in Road Maintenance of the JICA Project on **Capacity Enhancement in Road Maintenance in Vietnam**. This User Manual has been prepared to provide a reference for the potential users of this conversion software. The most potential users of the Conversion Software are the users of Pavement Management System (hereinafter referred to as "PMS") and Pavement Monitoring System (hereinafter referred to as "PMoS"). Therefore, this user manual can be best utilized by PMS and PMoS operator.

The maintenance planning system under the scope of the JICA Project is focused mainly on road pavement. However, road database has been developed by incorporating data related to road assets, pavement condition, pavement maintenance history and traffic volume of the Vietnamese national roads. Required data for PMS and PMOS are stored in Road database however these data are not integrated into a single file. Therefore, the Conversion Software has been developed to create PMS and PMOS datasets automatically by the computer software to import and data from road database and integrate them into a single file. Data conversion by computer software helps to eliminate the manual data inputting into the PMS and PMOS, and eventually prevent from occurring the error which may generally happen if data inputting is done by manually.

1.2 ORGANIZATION OF CONVERSION SOFTWAREE USER MANUAL

This conversion software user's manual consists of four (4) chapters followed by two (2) appendices. Details of each chapter and appendix are shown below.

Chapter 1: Introduction

Chapter 2: Installation of Software and Environment Setting

Chapter 3: Main Functions

Chapter 4: Operation of Conversion Software

Appendix - 1: Main Details for PMS and PMOS Dataset Development

Appendix – 2: PMS and PMoS Dataset

1.3 DATABASE STRUCTURE AND DATA IMPORTING

The Road Database structure comprises five (5) types of data; general road management, road asset (road inventory), pavement condition, maintenance history and traffic volume data. However, data required for PMS and PMoS are stored in Road Asset Database, Maintenance History Database, Pavement Condition Database and Traffic Volume Database. The interrelation between database structure, the Conversion Software, and PMS and PMoS is shown in Error! Reference source not found..

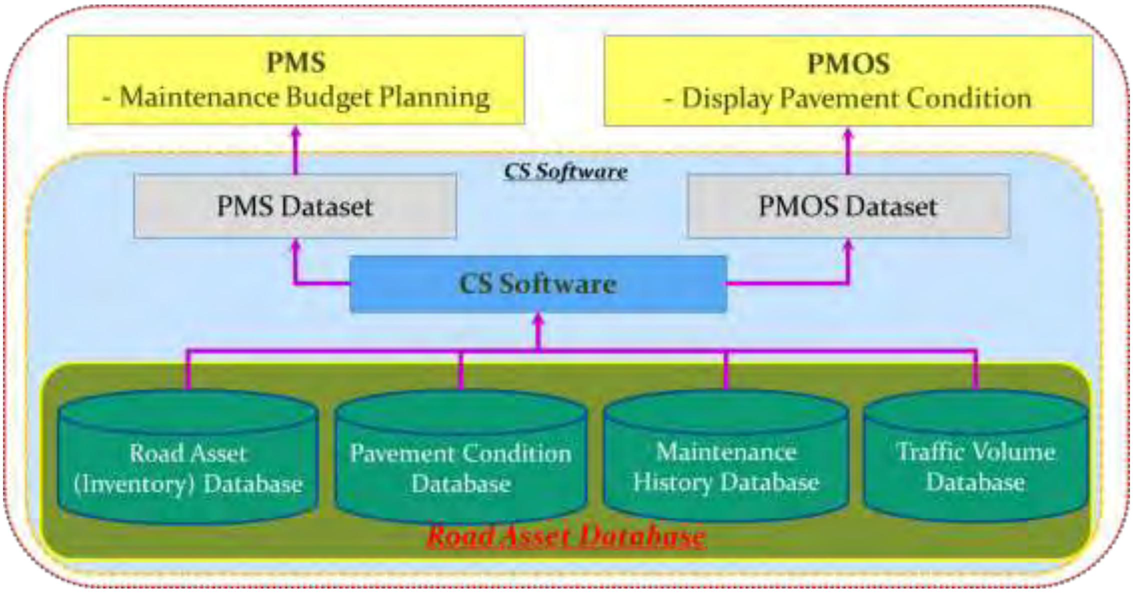


Figure 1.3.1 Road Database, Conversion Software and PMS & PMOS

Under each database, main details folder is created and it consists of data specifically required for PMS and PMoS only. Database system has functions to create these main details pivot table. The input files for conversion software are the main details pivot tables including history data stored in "Main Details" folder inside the Road Asset, Maintenance History, Pavement Condition and Traffic Volume databases as shown in **Figure** 1.3.2.

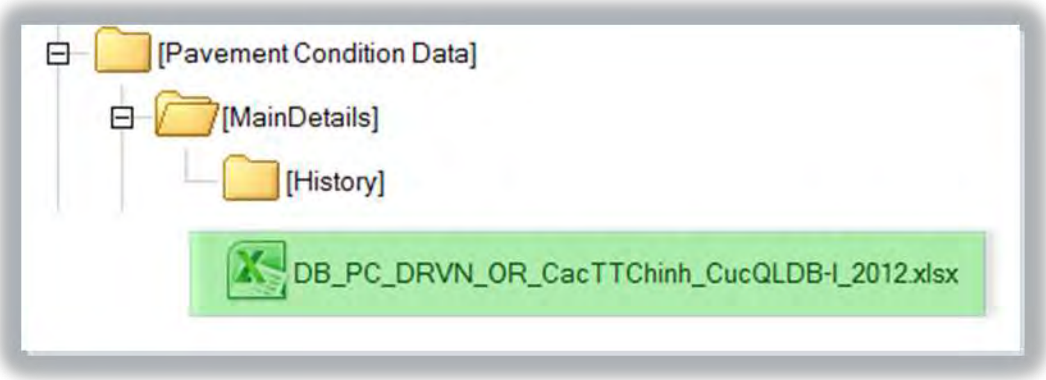


Figure 1.3.2 Main Details Folder and Pivot Table

1.4 PRE-REQUISITE CONDITIONS

i. It is required to have updated main details pivot tables of road asset database, maintenance history database, pavement condition database and traffic volume database. Details of updating main details of each database are described in **Appendix-1**.

ii. Structure of main details pivot table should not be changed unless proper modification has been made in the conversion software. If structure of pivot table structure of main details are changed and conversion software is used for data integration conversion either may import different data taking into account of the original pivot table structure or may display error message.

iii. If location and file name of main details in road database changed, conversion software should also updated accordingly otherwise system may display system error.

iv. The conversion software is a kind of Excel VBA Add-Ins application. For this reasons, VBA Enabled state must be set for Excel environment.

CHAPTER 2 INSTALLATION OF SOFTWARE AND ENVIRONMENT SETTING

2.1 SYSTEM REQUIREMENT

If Microsoft Office 2007 or later version of MS-Office is installed in the computer, there is no other specific requirement to install the Conversion Software provided that sufficient free space is available in the computer to store the data.

The CS application is in VBA Add-Ins format of Microsoft Excel and can be put in any place of installed computer. In order to launch this application in Excel environment, the Security setting has to be configured as "Macro Enabled"

Table 2.1.1 System Requirements for Conversion Software

System Requirements	Description
Operation System	Windows 7-32 bit or higher version of Windows (32 bit and 64 bit).
Hardware	CPU: Pentium IV 1.8GHz or higher Memory: 512 MB or higher
Microsoft Office	MS-Excel 2007 (SP1) or higher with VBA support. Excel Macro shall be enabled while working on the database system.
Anti-virus software	It is recommended to install anti-virus software in the computers to protect from harmful computer viruses.
System Operation	The system shall be operable by officers of DRVN, RRMB and RRMS-B administration and engineering staff. The system shall be simple and necessary manuals shall be provided with sufficient explanation.
System Flexibility	The system shall be a flexible which supports future system upgrade and system expansion. The system upgrade and expansion need to be manageable by DRVN. Only for critical technical problems, technical supports from IT specialized agencies such as UTC, RTCs, and private IT companies shall be taken.
Collaboration with DRVN during System Development	The system development is carried out in close collaboration with DRVN and JICA Project Team by taking account of effective technology transfer, system sustainability, etc.

2.2 INSTALLATION OF THE CONVERSION SOFTWARE

The Conversion Software can install just by copying the system interface file. The location of input file and output file can be browsed by the operator.

2.3 PROGRAMMING LANGUAGE / VERSION OF MS-EXCEL

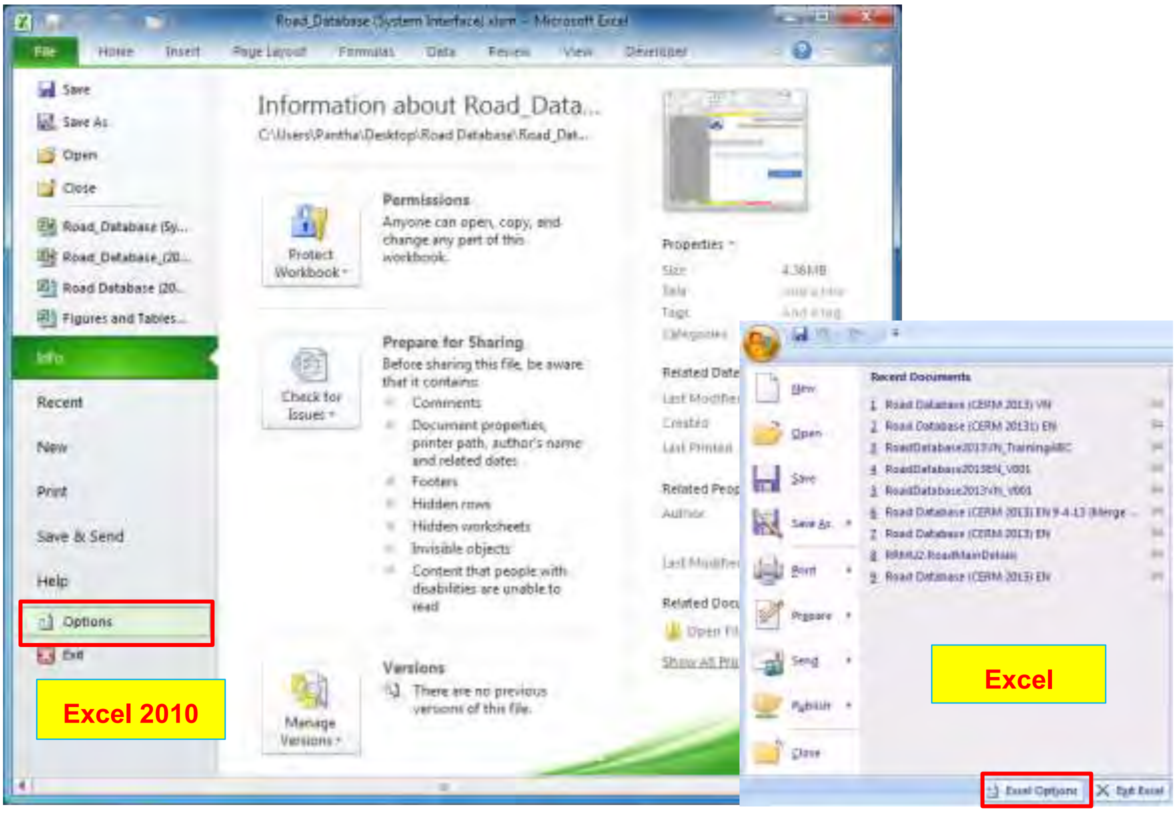
The Conversion Software has been developed in MS-Excel platform using Excel Visual Basic Application (hereinafter referred to as “Excel VBA”). Only Excel VBA programming language has been used while inserting various functions and modules. Also, some built-in tools / functions of MS-Excel are used. Therefore, i**t is necessary to enable macro in the Conversion Software program file (interface file) while working in the Conversion Software to ensure that all functions are working properly.** Enabling macro in MS-Excel 2010 and MS-Excel 2007 is slightly different. Procedure of enabling macro in different version of MS-Excel is explained in **section 2.3.1** and **2.3.2**.

2.3.1 Enabling Macro in Microsoft Excel 2007 and 2010

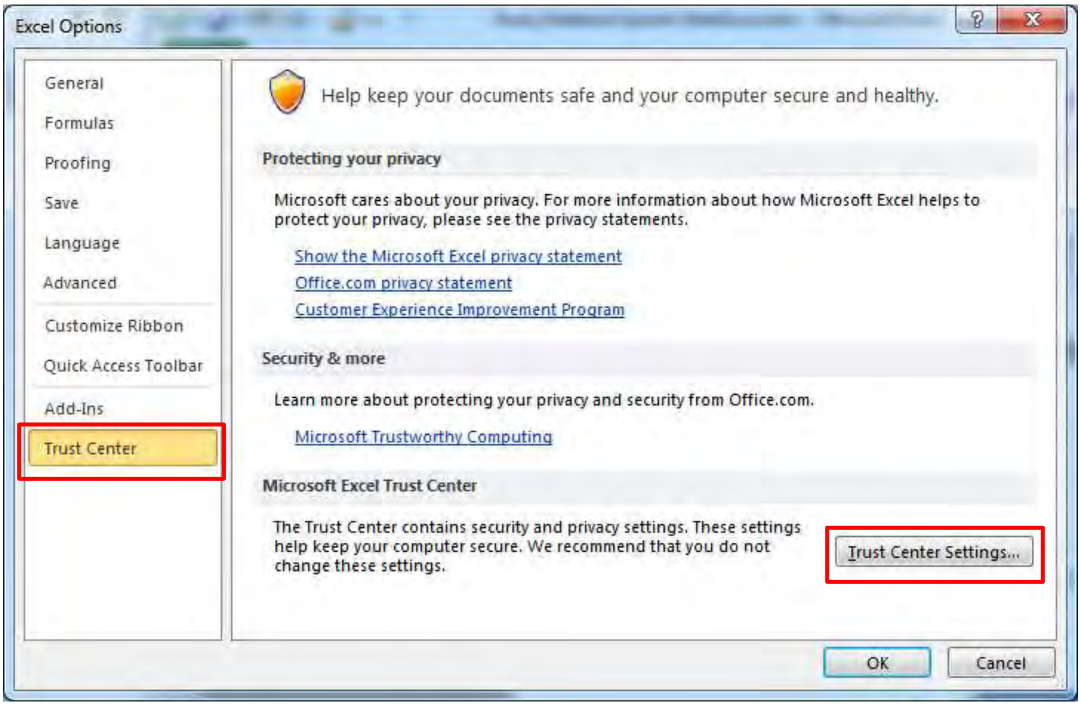
In Microsoft Excel 2007 and 2010, macro can be enabled by two ways;

(1) Using Microsoft Excel’s “Options” Setting Option

(1) Click the Microsoft Office Button, and then click **Options**.

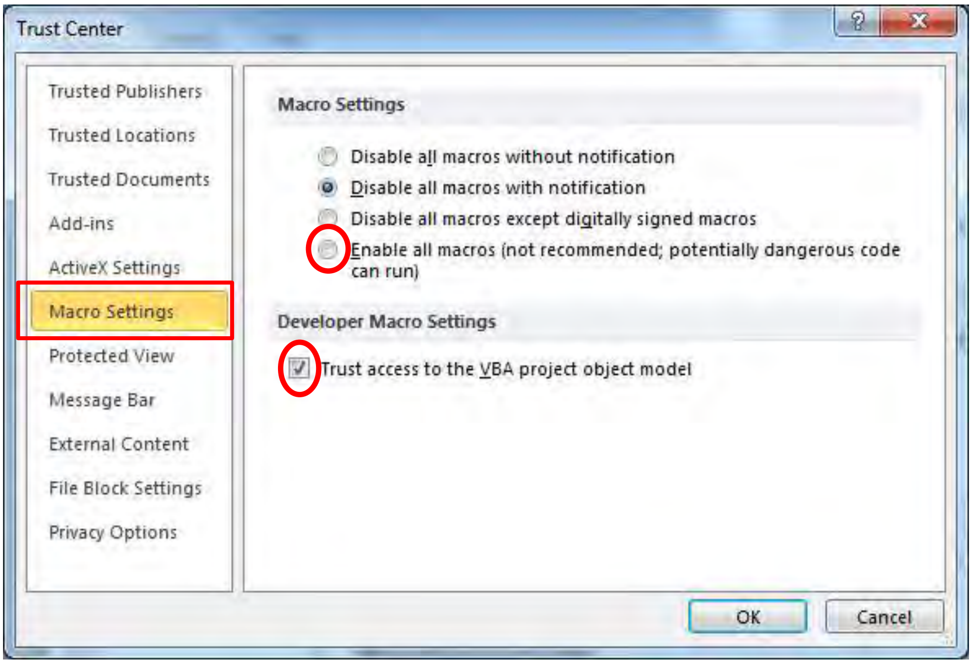


(2) Click “**Trust Center** “and Click “**Trust Center Settings”**.



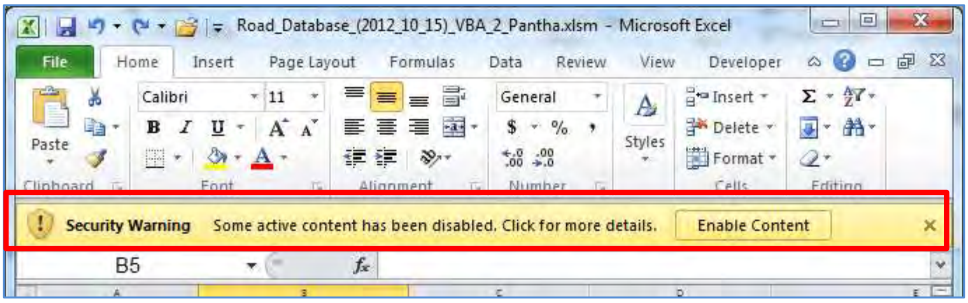
(3) Click **Macro Settings**. Click the options that you want:

- Disable all macros without notification.
- Disable all macros with notification (**Recommended**).
- Disable all macros except digitally signed macros.
- Enable all macros (not recommended, potentially dangerous code can run).
- Click **Trust access to the VBA project object model**.



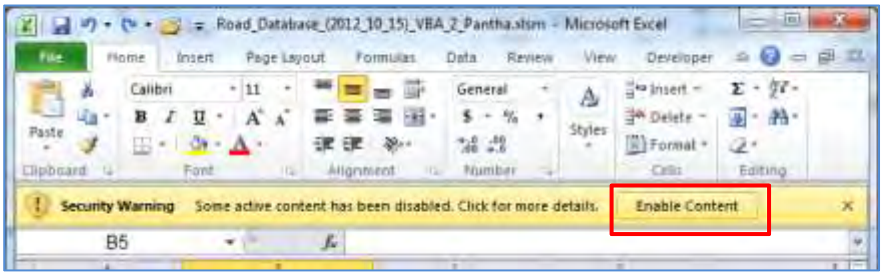
(2) Following "Security Warning" Alerts

If system interface file is opened without enabling macro, "**Security Warning**" will appear with the following message.

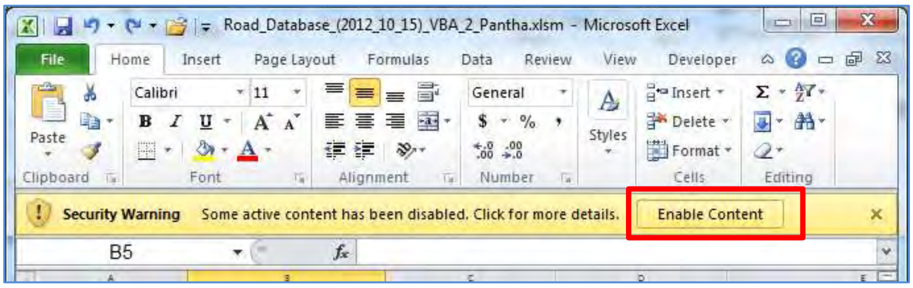


In this case, macro can be enabled by two ways;

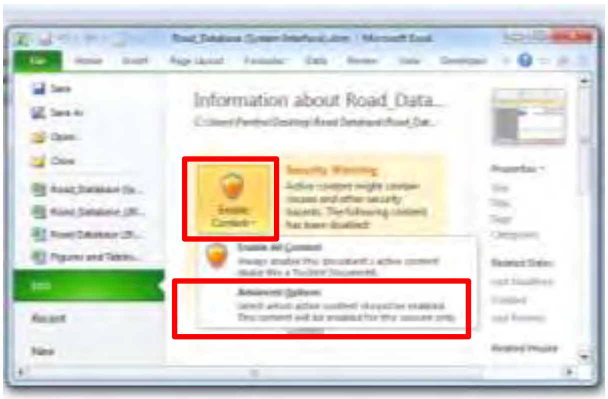
(1) Click **Enable Content** appeared at the warning message bar.



(2) Click **for more details** in the error message bar.



(3) Click **Enable Content** and then click **Advanced Options.**



(4) Click option **Enable content for this session**.

CHAPTER 3 MAIN FUNCTIONS

3.1 DATA IMPORTING FROM ROAD DATABASE

This function extracts the selected data items of PMS and PMOS from the main details pivot table of Road Asset, Maintenance History, Pavement Condition and Traffic Volume. The data structure (i.e. pivot table), file name, and location of main details of each data type are already fixed inside the road database structure. If main details pivot table of any of the data type is not created using the latest data, users shall update the main details pivot table using the tools available in road database system.

3.2 LOCATION SYNCHRONIZATION AND SECTIONING

Data in road database are not in homogenous sections. Moreover, traffic volume data are stored as point data. Synchronization of location referencing and preparing data in homogenous section (i.e. 100m) is done in this stage internally by the system. Location synchronization is done based on kilometer post. Point (station) traffic volume data are also projected into section data.

3.3 VALIDATION CHECK OF IMPORTED DATA

To prevent from any system error in the PMS and PMOS by the reason of improper data, validation check is performed to ensure that data to be extracted into PMS / PMOS dataset are in proper format and structure. This function will check the validation of data at source file (i.e. CS input file).

3.4 DATA DISTRIBUTION TO OUTPUT DATASET STRUCTURE

Upon synchronization among road asset data, maintenance history, pavement condition, and traffic volume and homogeneous sectioning, these four types (i.e. RA, MH, PC, and TV) of data are distributed to common output dataset structure which is already fixed and stored inside the system. Output dataset structure for PMS dataset and PMOS dataset are different.

3.5 FINAL VALIDATION CHECK OF DISTRIBUTED DATA

The final confirmation of data (i.e. right data distributed in right column) is carried-out before exporting the dataset as an output of the conversion software.

3.6 FINAL OUTPUT DATASET (PMS / PMOS)

If final validation of data in output dataset is passed, output can be exported as PMS and PMOS dataset. The output file can be saved in the user's desired location.

The system window which shows various function buttons and features of the system is shown in **Figure** 3.6.1**.**

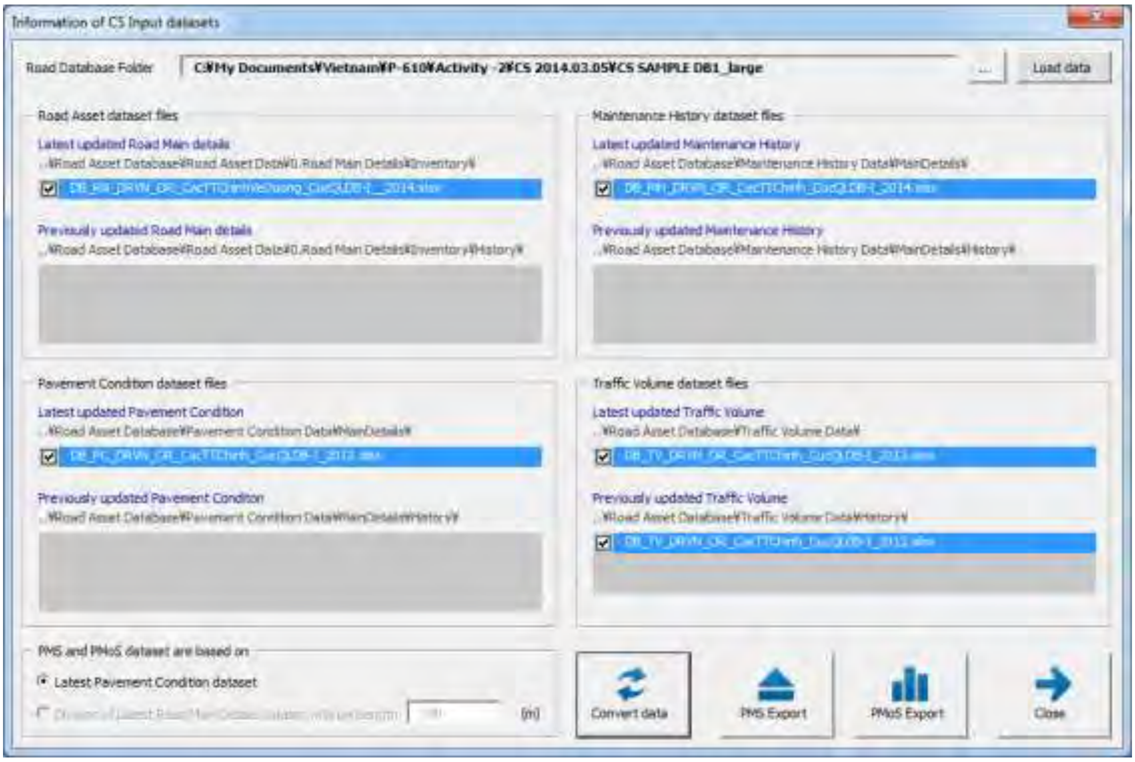


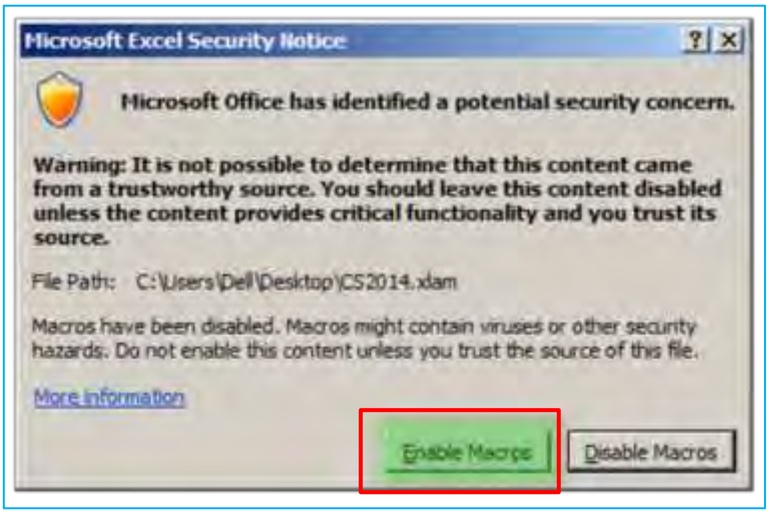
Figure 3.6.1 System Window

CHAPTER 4 OPERATION OF CONVERSION SOFTWARE

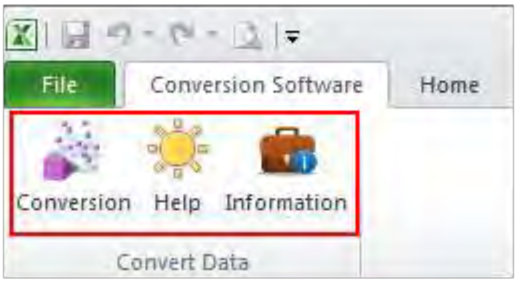
4.1 STEP – 1: LAUNCH THE APPLICATION

(1) Click on Conversation Software program file (**CS2014.xlam**) to run the program.

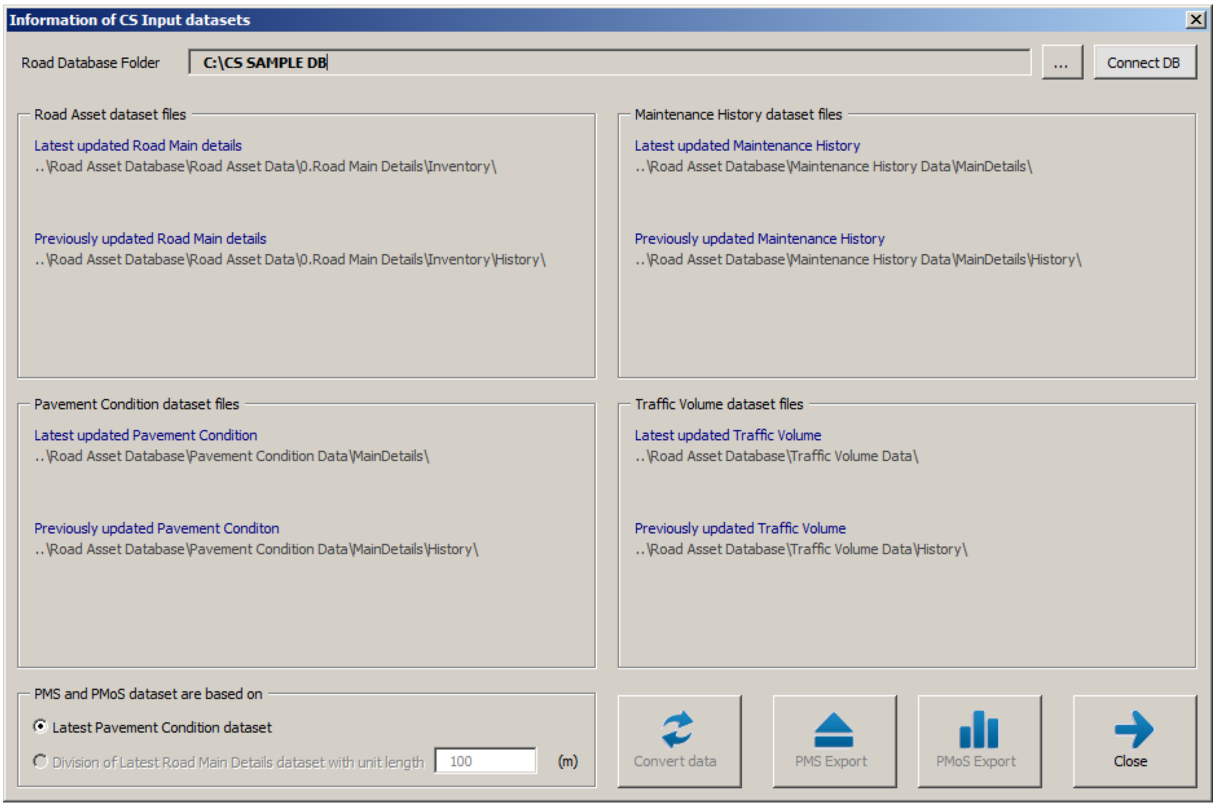
(2) Excel application will start and load that selected Add-Ins (users can fist run Excel and then open that Add-Ins). When the program is loaded in Excel, there is usually a message shown to ask the user to enable Macro VBA or not. From the message window, click on "**Enable Macros**" to active the Add-Ins.



(3) Ribbon menu of the program will be loaded and displayed in Excel as follows:

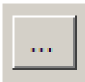


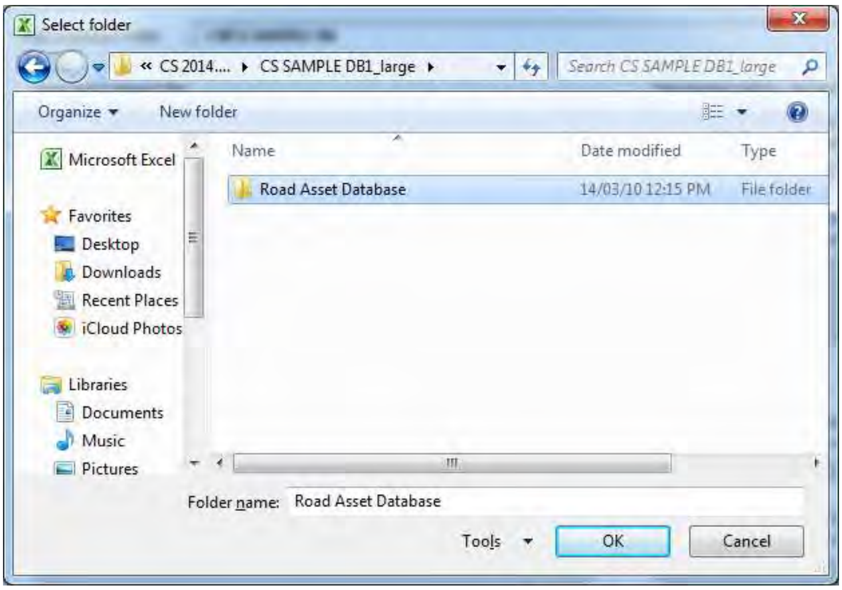
(4) To show the main window of Conversion Software, click on the button "**Conversion**" of Ribbon Tab. As a result, the main window will be shown like following picture:



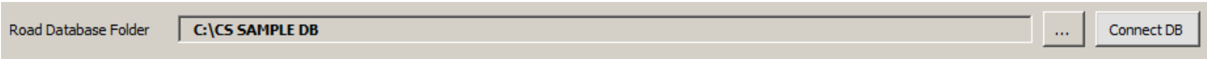
(5) For help and further information about the conversation software click on "**Help**" and "**Information**" button respectively.

4.2 STEP – 2: CONNECT TO ROAD DATABASE

(6) From the main window, click the button  for locating input data files.



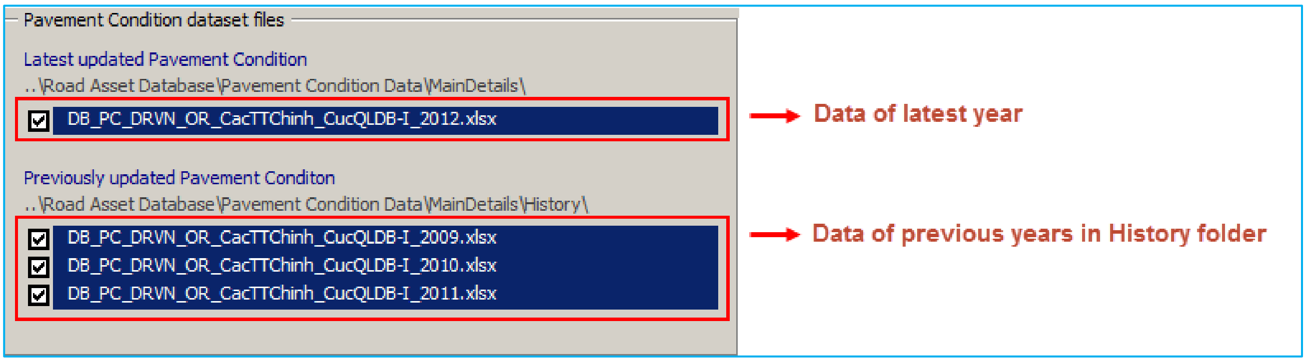
(7) Upon selection of Road Asset Database folder, the path of selected folder will be displayed as follows:



4.3 STEP – 3: CONNECT THE PROGRAM TO THE ROAD DATABASE

(8) Select the button "**Connect DB**" for connecting the program to Road Database folder.

(9) Upon connecting the Road Database folder, the main window will show the available files in Road Database folder with classification based on type of data (RA – Road Asset, MH – Maintenance History, PC – Pavement Condition, and TV- Traffic Volume). Data files of each kind will be grouped by latest year and previous years.



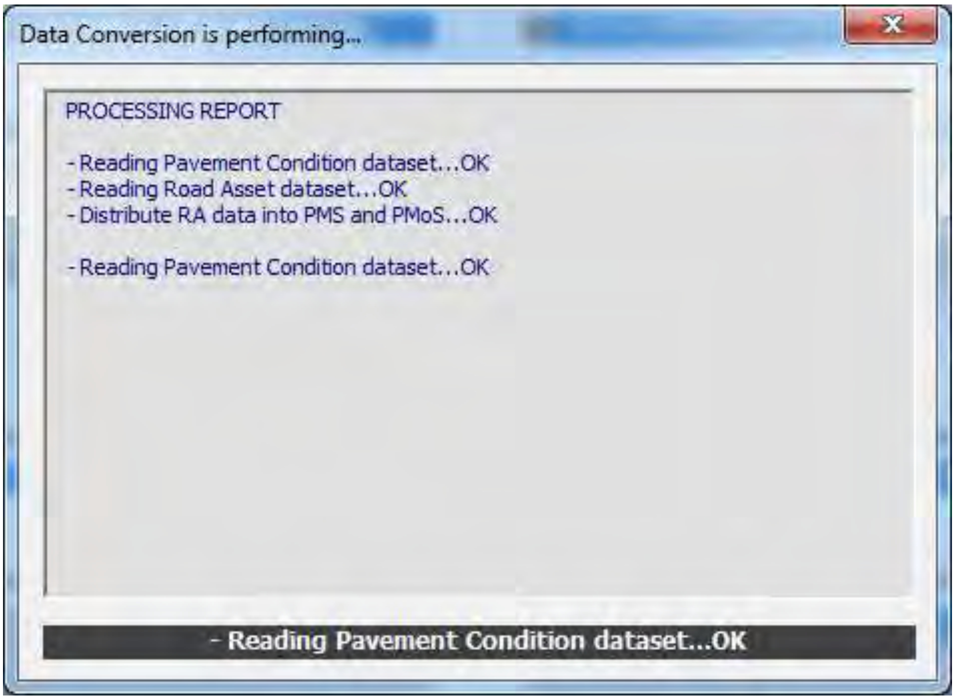
4.4 STEP 4 – SELECT FILES CONTRIBUTING DATA

(10) From the list of files, choose needed file in data distribution. Selection can be done by using check mark (√).

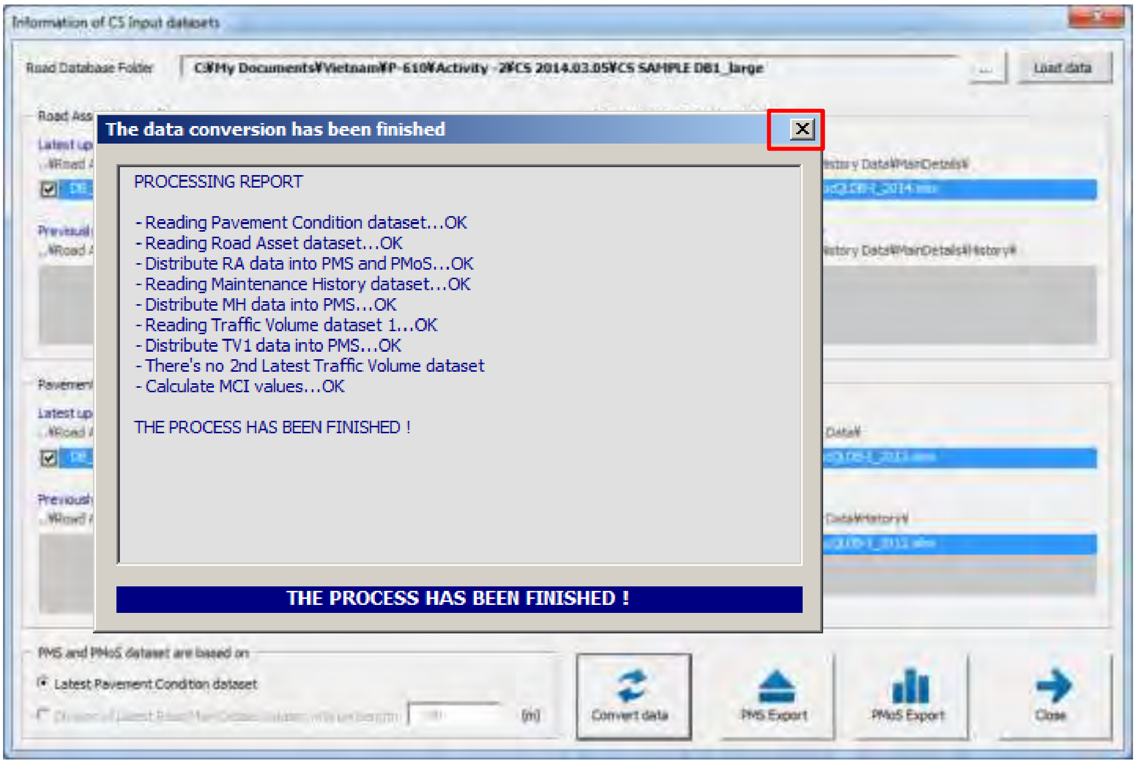
4.5 STEP 5 – LOAD AND PERFORM DATA CONVERSION

(11) Click on the button "**Convert Data**" in the main window. After that, the data conversion will be performed.

(12) During the conversion process, a small window will be displayed to present what is happening and allow the user to know when the process is finished.



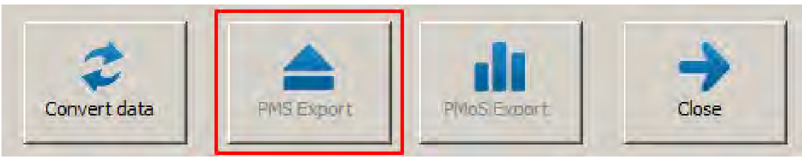
(13) When the process window shows that the data conversion completed, close (**X**) it to turn back the main window. Then the button "**PMS Export**" and "**PMoS Export**" will be enabled and get ready to export the results.



4.6 STEP 6 –EXPORT THE RESULT TO FILES

(1) Exporting PMoS file

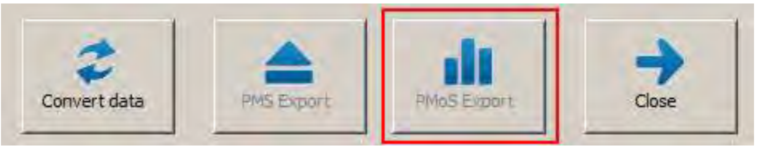
(14) In the main window, click on “**PMS Export**” in order to export PMS Dataset file.



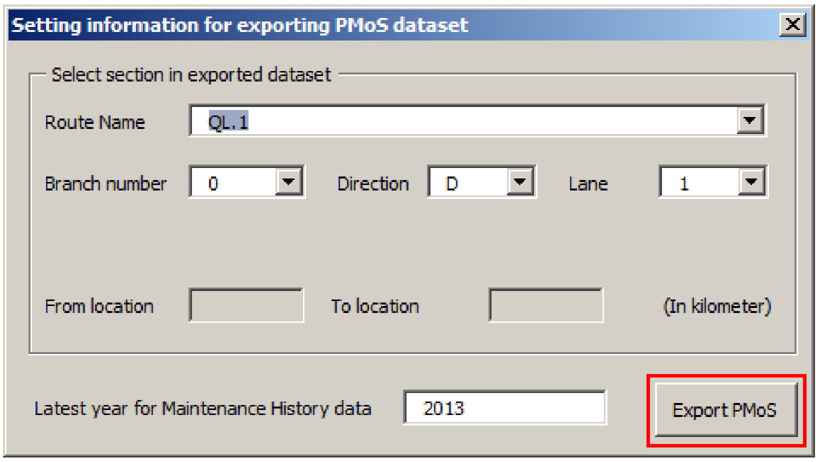
(15) In this step, the user will be asked to input the file name as well as the location to save PMS Dataset.

(2) Exporting PMoS file

(16) In the main window, click on the button “**PMoS Export**” in order to export PMoS Dataset file.



(17) Upon clicking “**PMoS Export**”, a new window will be displayed asking user to set information for exporting as follows:



i. Choose the route from "**Route Name**" list box

ii. Choose the branch from "**Branch number**" list box

iii. Choose the direction from "**Direction**" list box

iv. Choose the lane from "**Lane**" list box

v. Input the latest year of Maintenance History in the corresponding text box (with this data, data of five latest year will be exported, i.e. if inputted year is 2013, the data of Maintenance History in PMoS dataset will be in accordance with years: 2013, 2012, 2011, 2010, 2009)

(18) Upon inserting required information for exporting file, Click on "**Export PMoS**" button of this window, and then the user will be asked to input the file name as well as location of PMoS dataset. Upon inputting file name and destination location, click "**Save**" to save the exported file in your desired location.

(19) When the user would like to make PMoS with filtered information, just go back to that setting information window (step 17), set the needed parameters (route name, branch, direction, lane, and year of latest repair) and click the button "**Export PMoS**" again. In other words, there is no necessity to run conversion process from the beginning.

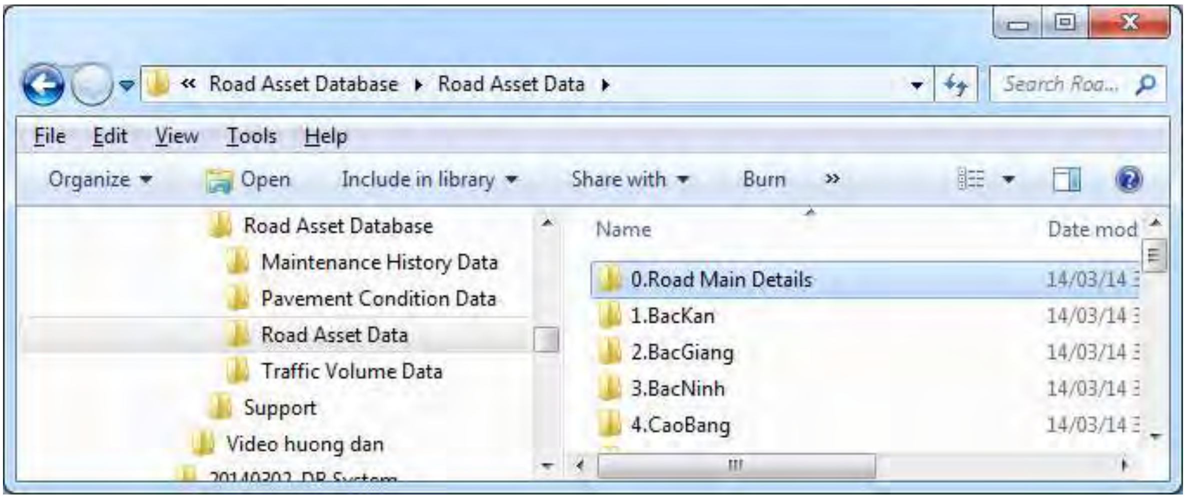
APPENDIX - 1 MAIN DETAILS FOR PMS AND PMOS DATASET DEVELOPMENT

A1.1 MAIN DETAILS FOR PMS AND PMOS DATASET PREPARATION

A concept of preparing main details of each data type (i.e. Road Asset, Pavement Condition, Maintenance History and Traffic Volume) has been developed for making data conversion process from road database to PMS and PMoS dataset less complicated. The main details of each data types are prepared separately within the database system.

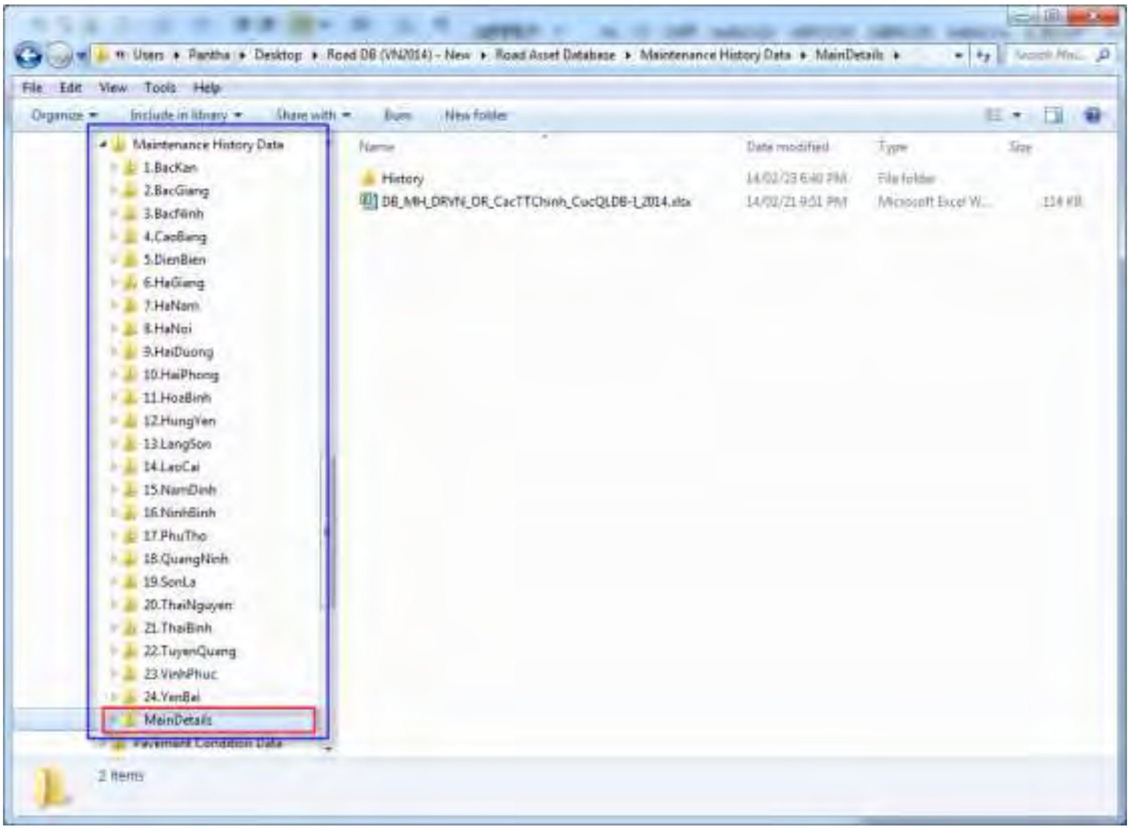
A1.2 MAIN DETAILS OF ROAD ASSET DATA

The "**Road Main Details**" pivot table itself is the main details of road asset data to be utilized in preparing PMS and PMoS dataset. Therefore, any additional operation and processing is not required for preparing main details of road asset data.



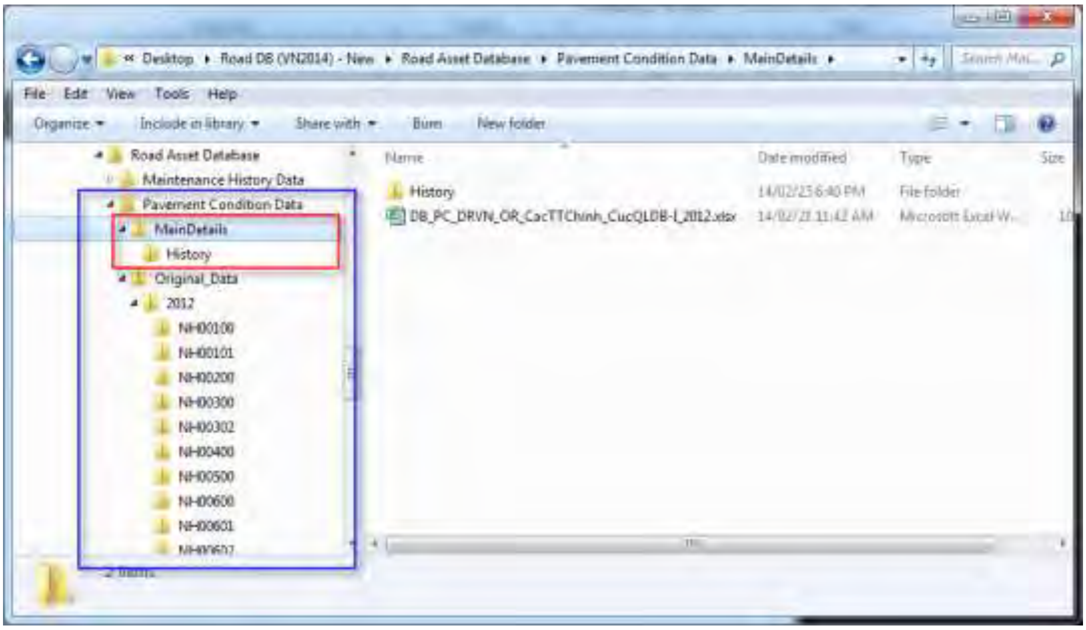
A1.3 MAIN DETAILS OF MAINTENANCE HISTORY DATA

Since data input sheet and data input support system has been developed in road database system, main details of maintenance history data is generated in parallel when pivoting the inputted / edited maintenance history data. Maintenance history pivot table is saved inside respective provinces however main details of maintenance history are saved in a common file irrespective of province name. An additional sub-routine is included in the system. Therefore, it is not necessary to do anything by database operator to prepare main details of maintenance history. A separate folder "**Main Details**" is designed inside the "**Maintenance History Data**" Folder. The Main Details folder contains the latest main details of maintenance history data (as file) as well as past data as time series data in history data.



A1.4 MAIN DETAILS OF PAVEMENT CONDITION DATA

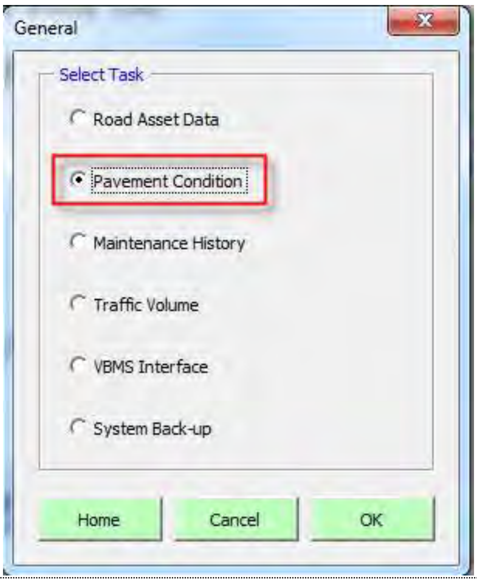
A tool to prepare main details data sheet of pavement condition data by combining all pavement condition data into one file is designed in road database system. It is presumed that pavement condition data submitted (to be submitted) by pavement condition survey team are in several folders by national highway name and stored in "**Original_Data**" folder located inside the database system.



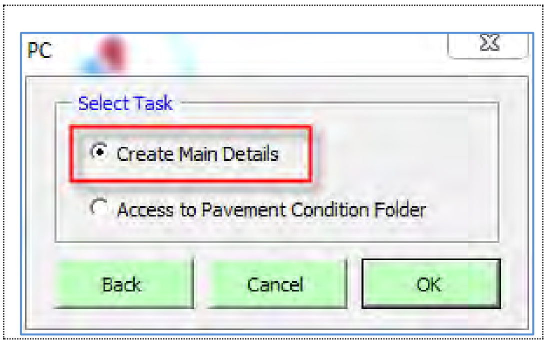
Upon receiving the final output of pavement condition data in the predefined format, the tool will combine all data into a single file. The combined data file contains two different sheets for UP and DOWN direction. In preparing PMS and PMoS dataset, this combined data file will be as an input file for conversion software. The details procedure for preparing main details of pavement condition data are described below.

(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.

(1) Click "**Select the Task**". General Window is appeared as shown below. Click "Pavement Condition" from the general window. Upon selection of task and clicking "**OK**" button, the system prompts the user to select next task as shown below.



(2) Select "**Create Main Details**" and Click "OK". To exit from Main Window, click "**Cancel**". Upon selecting "**Create Main Details**" and clicking "**OK**", the system automatically combine all individual files of pavement condition data into one.



A1.5 MAIN DETAILS OF TRAFFIC VOLUME DATA

Traffic volume data are preserved in DRVN format. However, the structure of data format is not in the form that software can extract the information from there without any system error. It presumed that possibility of occurring error is very high if the existing DRVN's format is used as the input file for conversion software. Therefore, main details sheet of traffic volume is prepare for avoiding possible error. DRVN is requested to summarize the annual traffic volume data in the format recommended by JICA Project team.

Socialist Republic of Vietnam
Directorator for Roads of Vietnam (DRVN)
Regional Road Management Bureau (RRMB)
Regional Road Management Sub-Bureau (RRMS-
SUMMARY OF TRAFFIC COUNT

Road Name	Route Branch No	RRMB Name	RRMS-B Name	Counting Station					Traffic Counting Year (yyyy)	Total Traffic Volume			Total Heavy Traffic Volume			Car, Jeep			Light Truck		
				Name	Chainage		Latitude	Longitude		Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total
					Km	m															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

B)

Medium Truck (2 Axles)			Heavy Truck (3 Axle)			Heavy Truck (>3 Axle)			Small Bus			Large Bus			Tractor			Motorbike including 3			Bicycle / Pedicab			Grand Total
Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47

APPENDIX - 2 PMOS AND PMOS DATASET

A2.1 PMS DATASET

PMS dataset contains 61 data items in total as shown **Table A2.1**.

Table A2.1 PMS Dataset

Road Asset Data							Pavement Condition Data												
							Latest Condition Survey										2nd Latest Condition Survey		
Pavement Width (m)	Pavement Thickness (m)	Climate		Terrain Type Flat/Rolling/Moun-tainous	Road Class	<Dummy>	Year/month of survey	Lane position surveyed	Pavement type	Crack Rate				Rut Depth		IRI (mm/m)	Year/month of survey	Lane position surveyed	Pavement type
		Annual Precipi-tation	Temper-ature							Cracking %	Patching %	Pothole unrepaired %	Total %	Maximum (mm)	Average (mm)				
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Road Asset Data							Pavement Condition Data												
							Latest Condition Survey										2nd Latest Condition Survey		
Pavement Width (m)	Pavement Thickness (m)	Climate		Terrain Type Flat/Rolling/Moun-tainous	Road Class	<Dummy>	Year/month of survey	Lane position surveyed	Pavement type	Crack Rate				Rut Depth		IRI (mm/m)	Year/month of survey	Lane position surveyed	Pavement type
		Annual Precipi-tation	Temper-ature							Cracking %	Patching %	Pothole unrepaired %	Total %	Maximum (mm)	Average (mm)				
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Pavement Condition Data									Maintenance History						Traffic Volume Data					
2nd Latest Condition Survey							MCI	<Dummy>	Latest Repair				<Dummy>	<Dummy>	Latest Survey		2nd Latest Survey		<Dummy>	<Dummy>
Crack Rate				Rut Depth		IRI (mm/m)			Year / Month of the latest repair	Repaired Lane	Repair Method	Repair Classification			Total traffic volume	Heavy traffic volume	Total traffic volume	Heavy traffic volume		
Cracking %	Patching %	Pothole unrepaired %	Total %	Maximum (mm)	Average (mm)										AADT (24 hour data)	AADT (24 hour data)	AADT (24 hour data)	AADT (24 hour data)		
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61

A2.2 PMOS DATASET

PMoS dataset contains 35 data items in total as shown **Table A2.2**.

Table A2.2 PMoS Dataset

Road Asset Data														Pavement Condition Data				
Road ID	Road Name	Route No	Route Branch No.	Direction	Lane Position	Date of update	Location				Pavement type	Structure type	Crossing type	Road condition				
							from		to					Year/month of survey	Crack Rate (%)			
							Km	m	Km	m					Cracking	Patching	Pothole unrepaired	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Pavement Condition Data						Maintenance History Data									
Road condition						2013		2012		2011		2010		2009	
Rut Depth (mm)		IRI (mm)	FWD (mm)												
Average	Maximum		Year/month of survey	D_{0max}	D_{150max}	Repair Method	Repair Classification	Repair Method	Repair Classification	Repair Method	Repair Classification	Repair Method	Repair Classification	Repair Method	Repair Classification
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35

VOL. III

PAVEMENT MANAGEMENT SYSTEM
USER'S MANUAL

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 IN THE SOCIALIST REPUBLIC OF VIETNAM

PAVEMENT MANAGEMENT SYSTEM (PMS) USER'S MANUAL

APRIL 2014

JICA PROJECT TEAM

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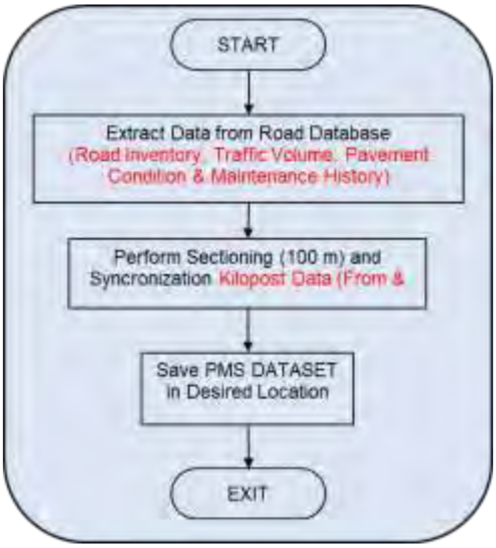
CHAPTER 1 INTRODUCTION

1.1 GENERAL

Pavement Management System (hereinafter referred to as “PMS”) has been developed under Activity-2: Enhancement of Planning Capacity for Road Information Management of the JICA Project on **Capacity Enhancement in Road Maintenance in Vietnam**. This quick operation manual is prepared to explain the step-by-step procedure to run the Pavement Management System (PMS). Since PMS is still under development, the operation manual will be updated in parallel with system development and the full-version of operation manual will be finalized together with PMS software.

1.2 PMS DATASET AND ITS FORMULATION

PMS Dataset, which contains road inventory data, pavement condition data, maintenance history data, traffic volume data and some repair work unit cost, has been formulated to fulfill the requirement of PMS. Since only some specific data are required for PMS, conversion software is developed to extract data from road database and formulate the PMS dataset in the desired format. The conversion software can run independently from the PMS software. A separate user manual is prepared for conversion software. General flow of PMS dataset formulation is illustrated in Figure below.



1.3 PMS SYSTEM INSTALLATION

PMS system can be installed in any drive (C:/, D:/, …) on computer. Upon successful installation of PMS, PMS will be listed up in the start menu.

1.4 USER ID AND ACCESS AUTHORITY

It is prerequisite to have user ID to access to PMS system. Two types of user ID can be created by administrator **with or without administrative rights** in the system. User ID without administrative rights (Guest User) cannot change PMS Master Dataset which contains very important information.

1.5 GENERAL PROCEDURE OF PMS OPERATION

General procedure of PMS Operation is shown in **Figure** 1.5.1.

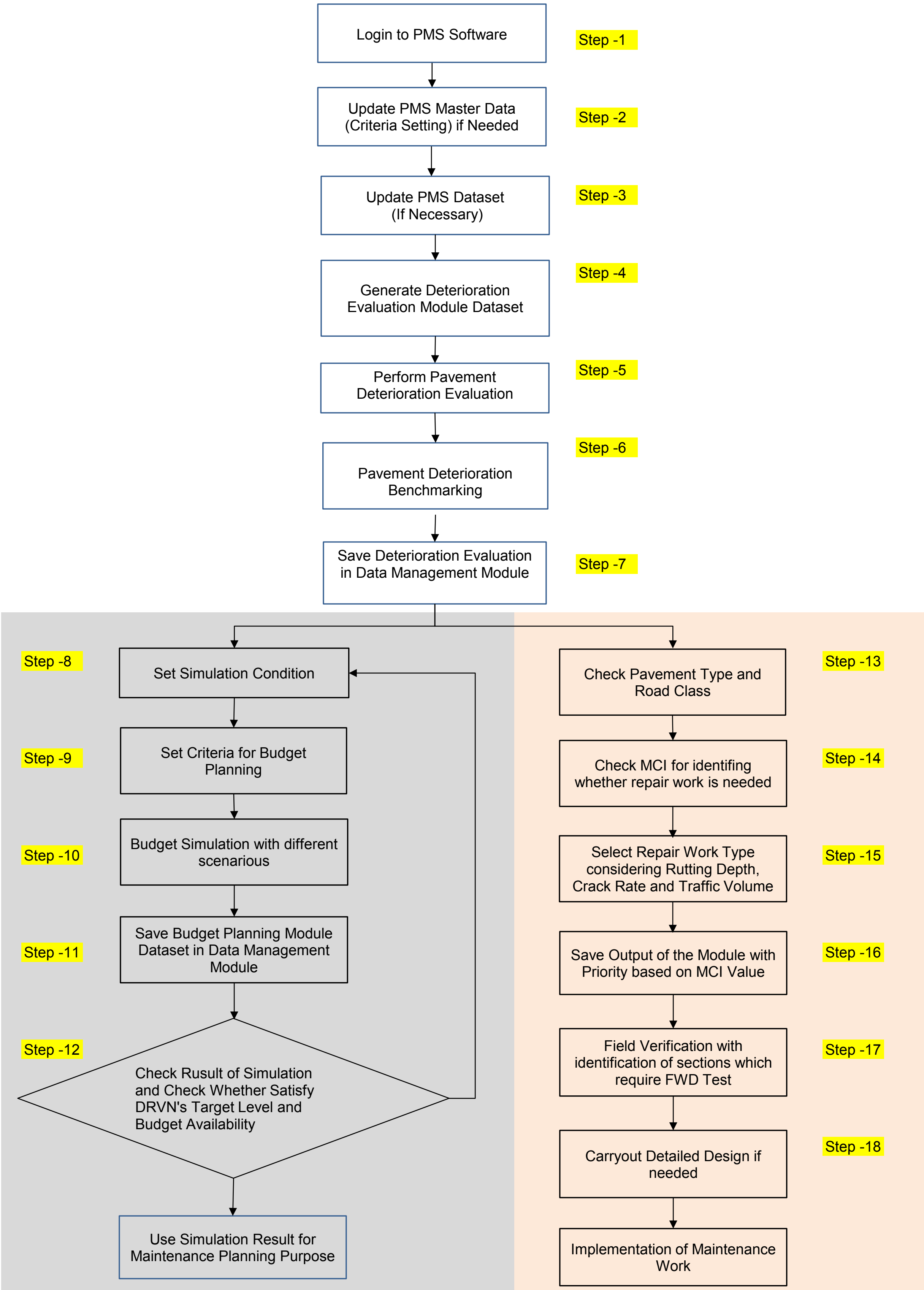


Figure 1.5.1 General Procedure of PMS Operation

Step-1: Login to PMS Software

User shall log in to PMS software by entering User ID and Password provided by the administrator. Creating new User ID and Password is possible. System administrator shall access to login_data.xlsx file to add or delete or reset the User ID and Password. Login_data.xlsx file is stored inside the "**System**" folder of the main "**Asset**" folder.

Step-2: Update PMS Dataset

PMS Dataset prepared by using Conversion Software shall be imported into the system to update the PMS Dataset. However, if user has already updated the PMS Dataset and intending to work in some module only, it is not necessary to update PMS dataset. If PMS dataset is updated, user shall update all module dataset as well.

Step-3: Update PMS Master Dataset

PMS master dataset contains very important information. Therefore, only user having administrative rights can update this dataset. To modify PMS master dataset, user shall have sufficient know-how of the PMS system because it has contains various condition setting data such as Damage Ranking, Repair Work, Repair Policy, Markov Transition Procedures and Benchmarking Evaluation. The consequences of modification may affect inout of the other module.

<u>Pavement Deterioration Evaluation</u>

Step-4: Generate Deterioration Evaluation Module Dataset

Upon updating PMS dataset by the latest data, module dataset for deterioration eveluation, budget planning and annual repair work planning can be generated. However, other module dataset can not be prepared without generating and saved the deterioration evaluation module dataset first.

Step-5: Perofrm Deterioration Evaluation

Upon generating and saving deterioration evaluation module dataset, user can perofm pavement deterioration evaluation by using different pavement damage indices such as cracking, rutting and IRI. Markov hazard parameter can be computed using various factorial analysis variables. Repeated execution might needed to adjust the hazard parameters within the acceptable range. Markov Transition matrix, deterioration curve and pavement defects transition chart can be prepared and evaluated.

Step-6: Pavement Deterioration Benchmarking

Upon generation of markov transition matrix, benchmarking can be done to identify the high speed deterioration and low speed deterioration roads based on computed epsilon value. Benchmarking can be done by Road Name, RRMU Field Office, Pavement Type and so on. The output of bench marking can be extracted in MS-Excel format.

Step-7: Saving Deterioration Evaluation Data

Upon completion of pavement deterioration evaluation and benchmarking, all computed data can be save within and outside of the system. The output file will be in MS-Excel file containing tabular data, chart and graphs which can be best utilized for preparing documents for various purposes.

Mid-term Budget Planning

Step-8: Set Budget Simulation Condition for Mid-term Budget Planning

Upon completion of pavement deterioration evaluation, generating budget planning module dataset is possible. The simulation condition can be shall be set by the user particularly setting the group for simulation. Setting target group of simulation is very important because the software will simulate only for specified groups. Users may simulate for the entire national road network of Vietnam, only by RRMU target area, only some specific route or road class.

Step-9: Set Criteria for Budget Planning

Under the Budget Planning Module, various criateria shall be set by the user to customize with the real situation of road maintenance practice in Vietnam such as setting repair work unit cost, repair work type, repair work policy, simulation year and budget scenario (with or without budget constrain).

Step-10: Budget Simulation with Different Scenarios

Based on the availablity of maintence fund in DRVN, user can simulate the road maintenance budget with or without budget constrain. User can check how much amount of budget is required for sepecified year of budget planning and set management level (i.e. without budget constrain scenario). The system will summarize the scenario by cost of repair, road lenth and pavement condition as well. Similarly, user can simulate for budget constrain scenario and check the pavement condition, road length and cost by repair work type that can by accomplished by the constrained budget amount.

Step-11: Saving Budget Planning Module Data

Upon completion of budget simulation, the budget planning module data shall be saved.

Step-12: Check Result of Simulation & Confirm with DRVN's Management Target Level

Upon completion of budget simulation, the results shall check carefully and shall tally with DRVN's target management level. If simulation results are quite unrealistic or unaffordable to DRVN, simulation criteria shall be changed and resimulate again.

Annual Repair Work Selection and Budget Planning

Step-13: Check Pavement Type and Road Class

Since repair work types for annual road repair are differed by pavement type and road class, the planning system will check the pavement type and road class in the beginning and direct the repair work planning procedure accordingly. It is not necessary to input pavement type and road class by the user. The system will automatically extract the information from PMS Dataset which has been saved within the system already.

Step-14: Check MCI Value for Identifying Repair Needed Sections (AC Pavement only)

The system will check the MCI value which has been internally calculated by the system considering the rutting depth, crack rate and IRI. If the road section has MCI value equal or greater than 5, the planning system will display the message that "No Repair Work is Needed". Roads sections having MCI value less than 5 will be considered for repair work.

Step-15: Selection of Repair Work

The system will advice the user for repair work type and corresponding cost by analysisng rutting depeth, crack rate and heavy traffic volume. Repair work unit cost shall be updated reguraly because principally unit sot will change every year. At the moment, only some standard pavement types and cross setions are included taking representative of each road class. However, in practice engineer can make actual judgement after checking on the field.

Step-16: Saving Output of the Module with Priority

Output of the repair work planning module consists some general information of each route and some repair works specific items such as repair work category, repair work type, cost and priority based on MCI value. This output file shall be saved in within the system and if necessary it can be saved outside of the system as well.

Step-17: Field Verification and Carrying-out FWD Test

Upon selection of the repair work type with priority based on MCI value, it is recommended to conduct FWD test for the sections where big repair work (i.e. cut and replacement including subgrade replacement) are selected. It is advice to check benckmarking result also while selecting and prioritizing for FWD test.

During field verification, engineer shall decide the extent of the repair work (i.e. actual length) because in analysing by the system system has considered all road section of length 100m except some exceptional cases.

Step-18: Detailed Design of Pavement Structure

Upon selection of repair work type and FWD Test (for selected sections), engineeri shall carry out detailed design to decide pavement thickness of each layer. The actual total cost of repair work will be known only after the detailed design of pavement structure.

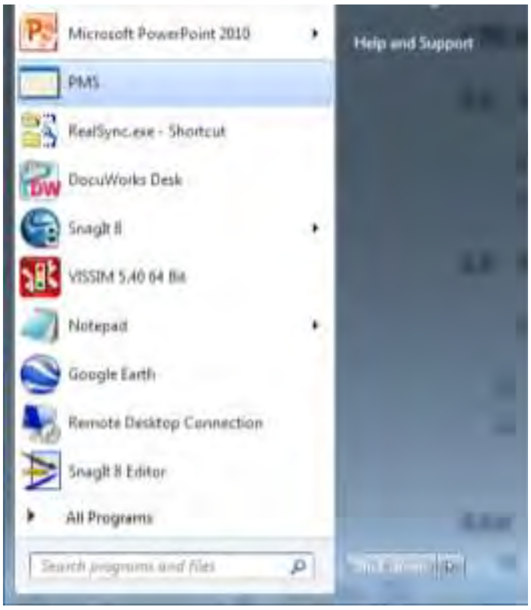
CHAPTER 2 PMS OPERATION

2.1 LOGIN TO THE SYSTEM

Users can log-in to the system by two ways;

(1) Login from Start Menu or Shortcut Menu

1) User can log-in to the system from "**Start Menu**" or Shortcut menu saved in any location.

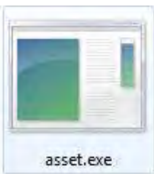


2) Enter User ID and Password

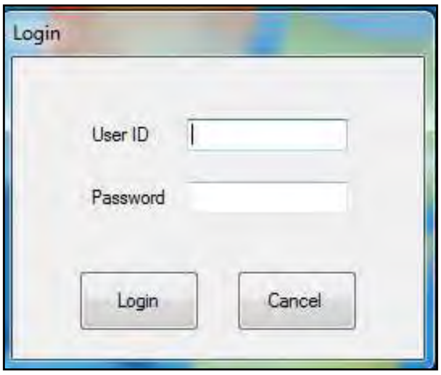
(2) Login from System Execution File

1) Browse Asset folder

2) Click Asset.exe file



3) Enter User ID and Password

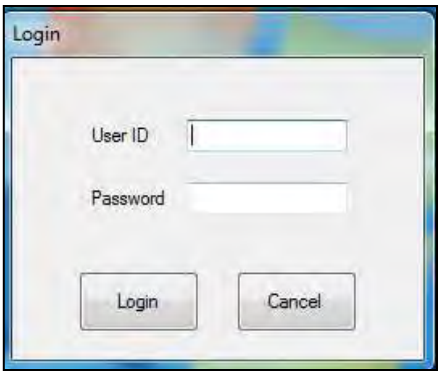


2.2 UPDATE PMS DATASET

PMS Dataset shall be prepared by Conversion Software before login into PMS software.

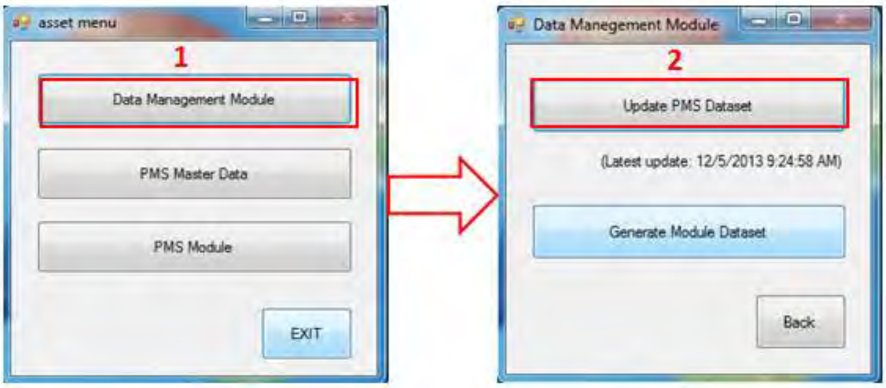
1) Click Execution File

2) Login to the PMS Software



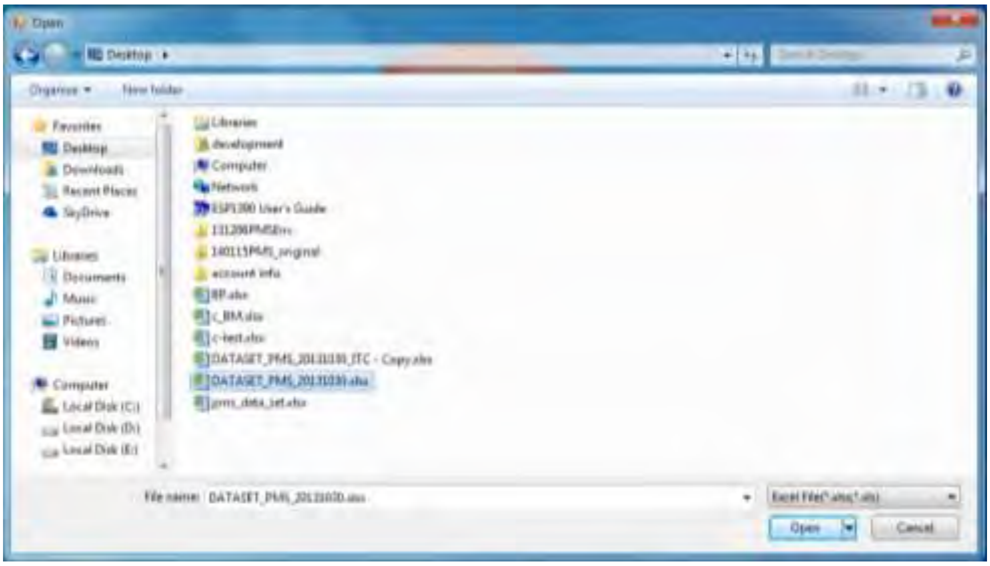
3) Click Data Management Module

4) Click Update PMS dataset

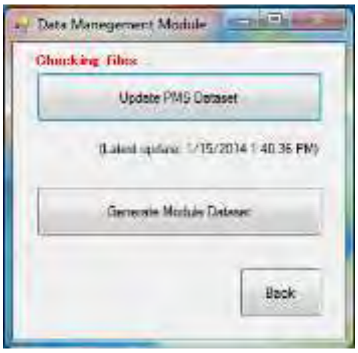


5) Browse Folder where PMS Dataset file (prepared by Conversion Software) is saved.

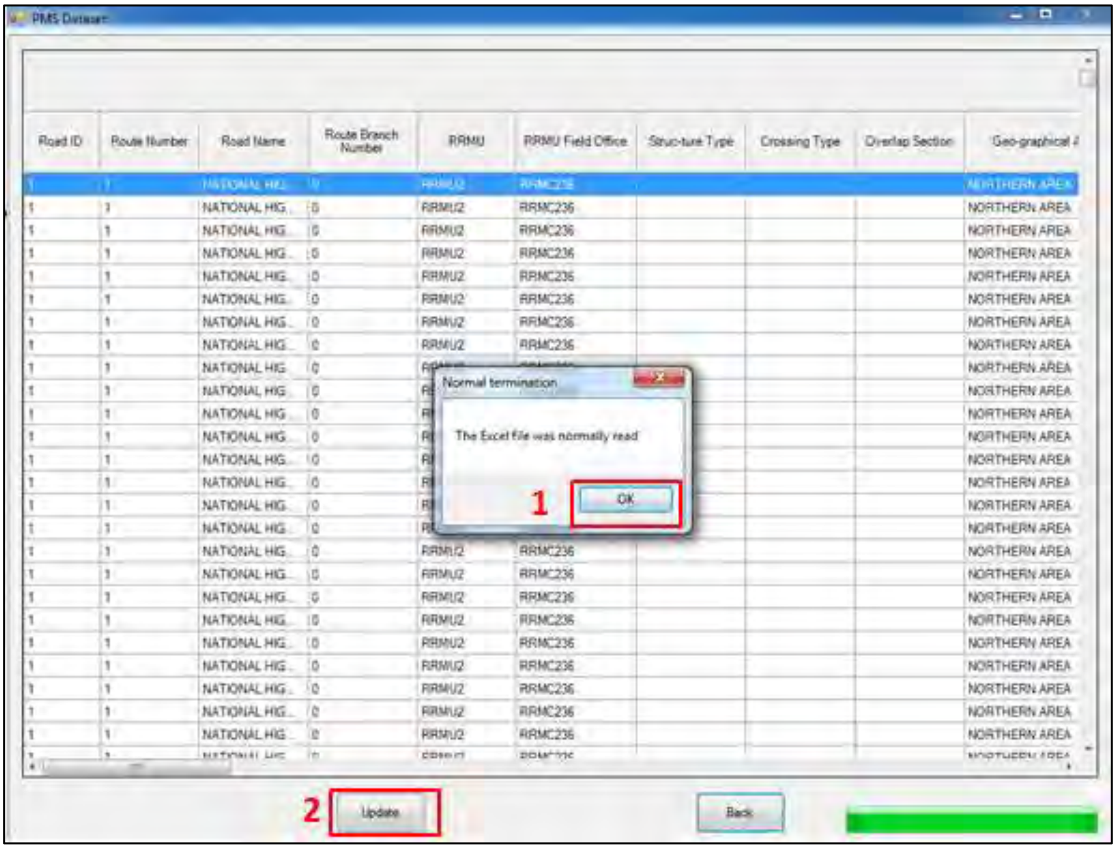
6) Double Click “**DATASET_PMS_20131030.xlsx**” file



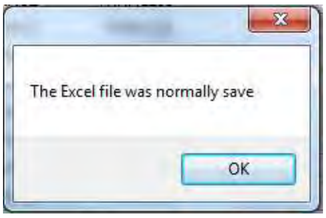
7) Software check the data validation of the PMS Dataset file uploaded into the system. “**Checking files …**” message will be appeared on interface.



8) When the file is valid or normally read click “**OK”** then “**Update**” button to update new dataset for PMS.



9) When popup with "**The Excel file was normally saved**" is appeared, the PMS Dataset will be saved after pushing the bottom "**OK**".



10) If PMS Dataset format or data itself are different from the original PMS Dataset, an error message will display. User shall check and rectify the PMS Dataset so that software can read the dataset file without any error.

2.3 PAVEMENT DETERIORATION EVALUATION

2.3.1 Flowchart

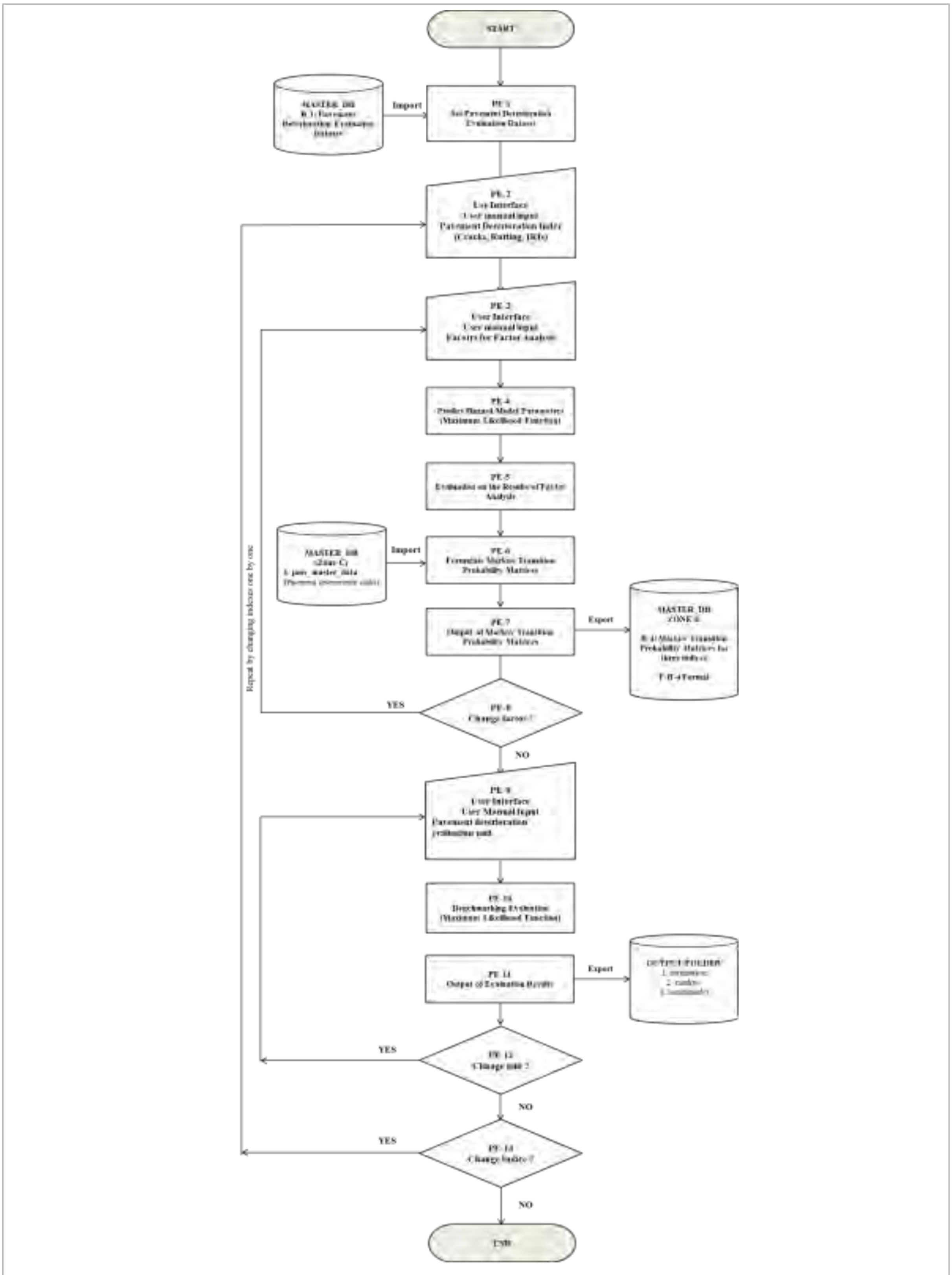


Figure 2.3.1 Flowchart of Pavement Deterioration Module

2.3.2 General Steps of Pavement Deterioration Evaluation

1. Setting the ranking for Crack, Rutting and IRI

2. Create Pavement Deterioration Evaluation Dataset
3. Estimate the Hazard Parameters
4. Calculate the Pavement Deterioration according to Markov Module
5. Calculate the Pavement Deterioration according to Benchmarking Module

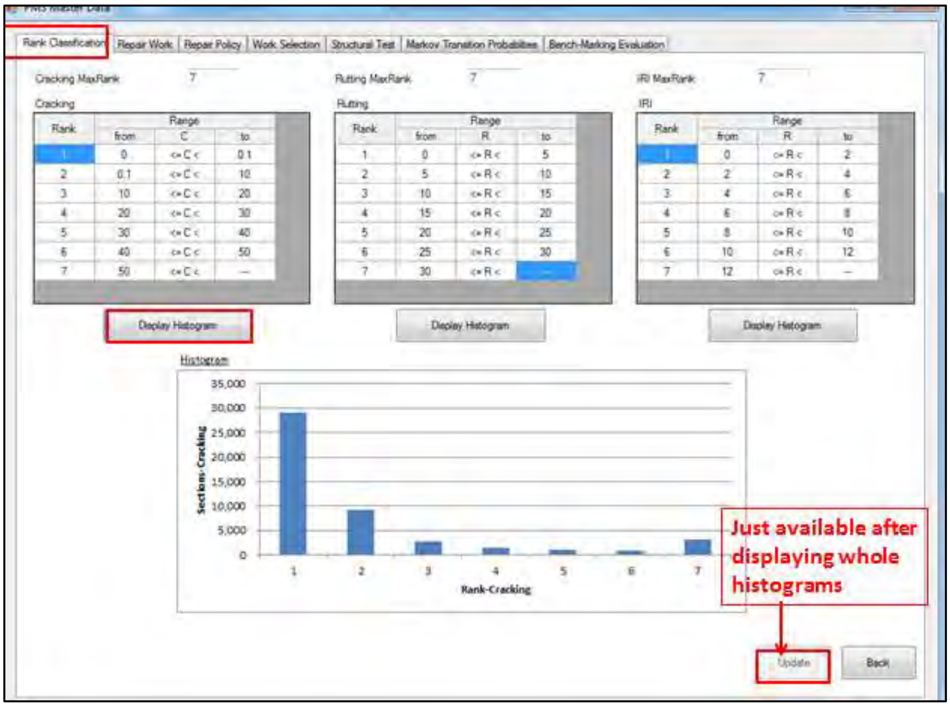
2.3.3 Setting the Ranking for Crack, Rutting and IRI

This function is enabled only for user having administrative right.

1) After updating PMS Dataset, the system will automatically back to Asset Menu and click "**PMS Master Data"**

2) Select "**Ranking Classification"** Tab, then set / modify the ranking for Crack, Rutting and IRI

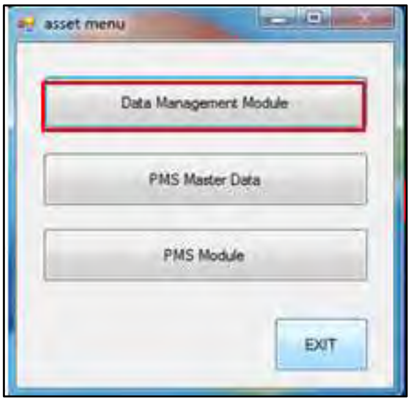
3) **Click "Display Histogram"** for Crack, Rutting and IRI after setting / modifying ranking and then click on "**Update"** button. All three indices (i.e. Crack, Rutting and IRI) shall set and display histogram one by one. After setting ranking and displaying histogram of all three indices, "**Updat**e" button will be enabled.



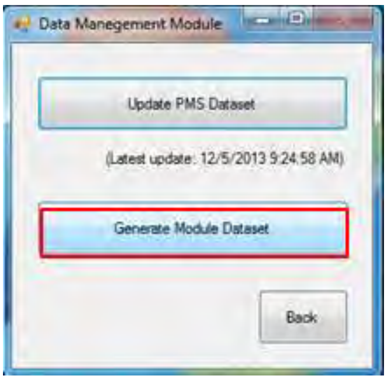
***Note**: If you don't display histogram for whole damage types (crack, rut, IRI) the Update button will not available.*

2.3.4 Create Pavement Deterioration Evaluation Dataset

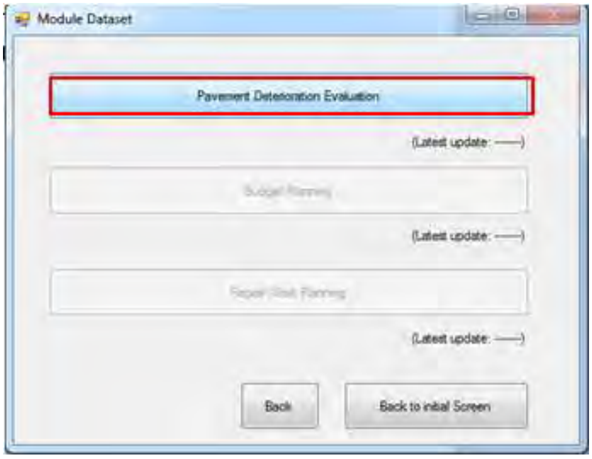
1) Back to Asset Menu and Click "**Data Management Module**"



2) Click "Generate Module Dataset"

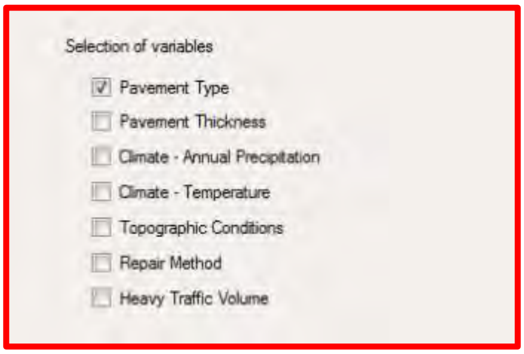


3) Click "Pavement Deterioration Evaluation"



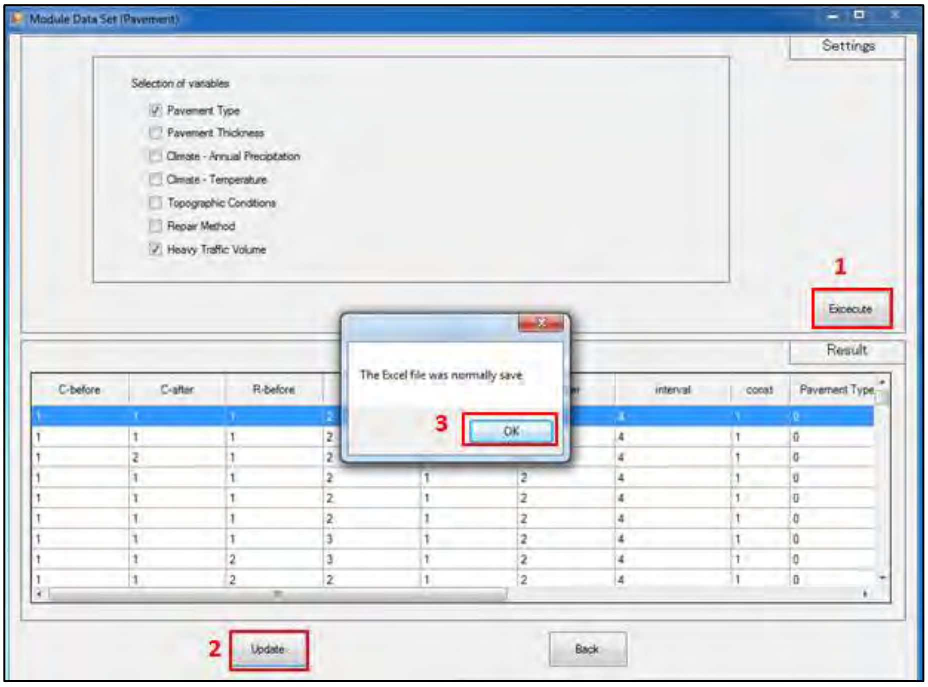
Note: *Dataset generation of Budget planning and Repair work planning is impossible at this stage because those dataset should be had the data created from the result of Pavement Deterioration Evaluation Module. These two modules dataset can be generated only after completing pavement deterioration evaluation.*

4) Select variables (for factorial analysis) by clicking on the check box



Note*: the maximum number of variables that can consider at a time is 4. However, at the moment only* ***Pavement Type*** *and* ***Heavy Traffic Volume*** *can be selected because other data are not available in DRVN. If data are available, they can be used even now.*

5) Create the dataset for Pavement Deterioration Evaluation by clicking on the "**Execute"** button and then "**Save"** the data by clicking on "**Update"** button. Pavement Deterioration Evaluation Dataset is saved inside the system.



2.3.5 Estimate the Hazard Parameters

1) Back to Asset Menu, then click “**PMS Module**”

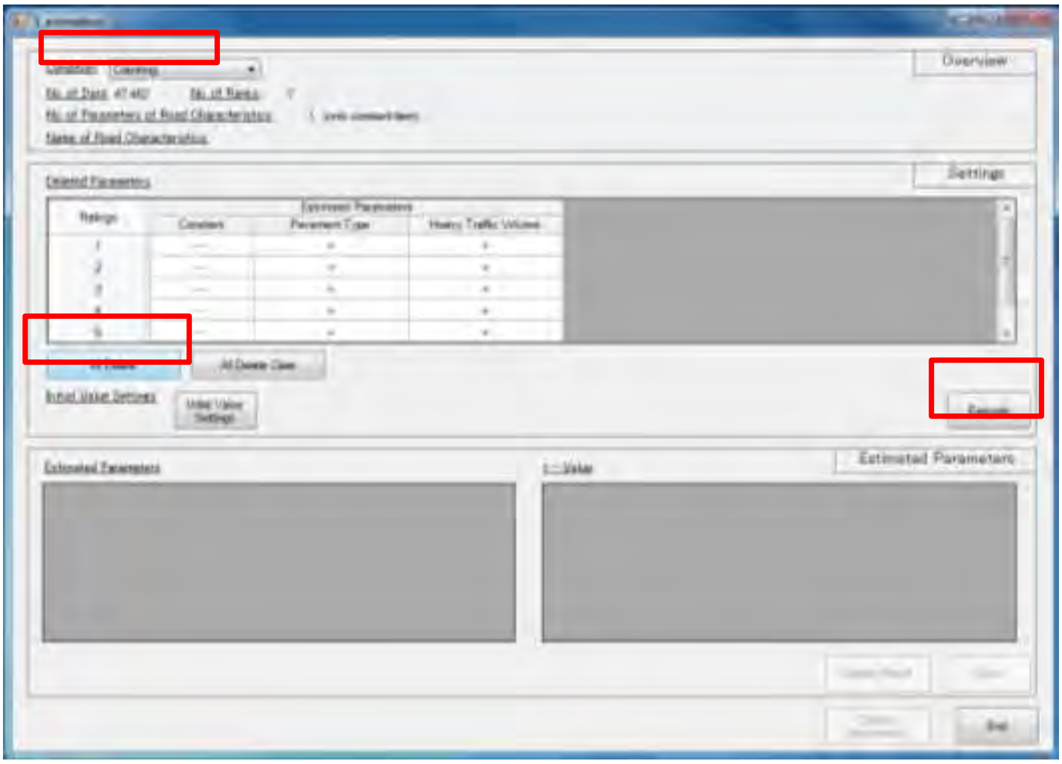
2) Click “**Pavement Deterioration Evaluation Module**”. Other modules (Budget Planning and Repair Work Planning) are disabled at this stage because corresponding datasets have not been prepared yet.

3) Estimate hazard parameters for case of cracking

i. Select "**Cracking**" from Condition menu

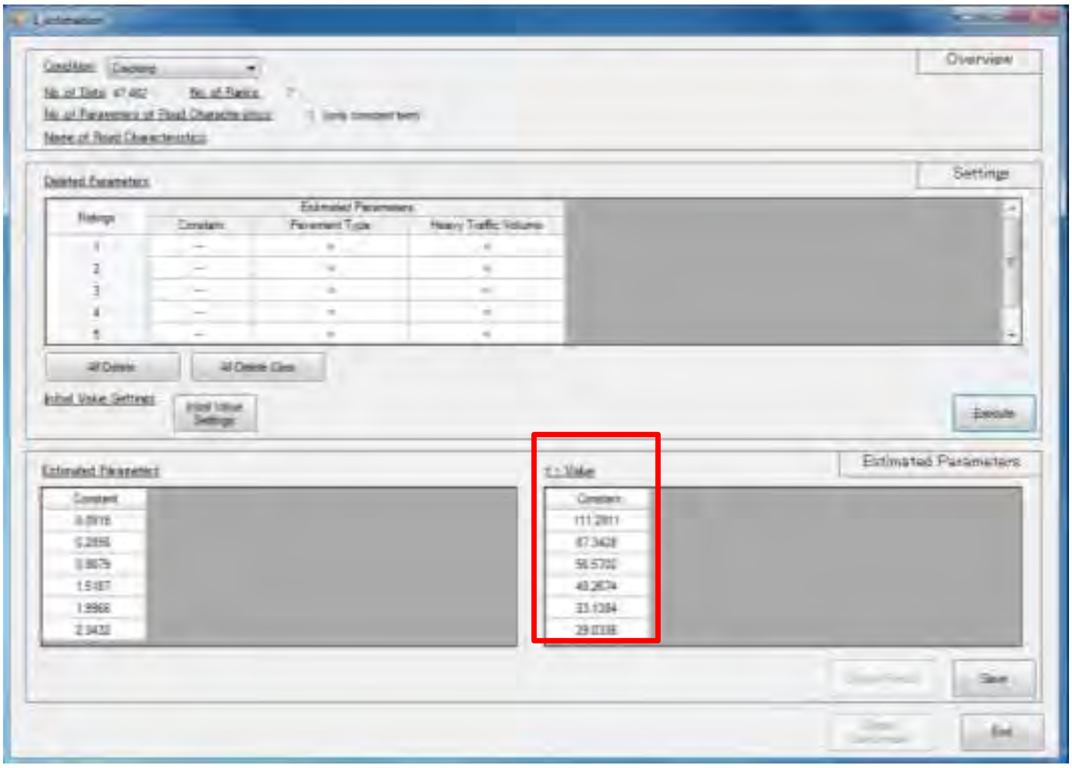
ii. It is recommended to click "**All Delete**" bottom to start from the condition where all parameters are deleted. (Please see the Tips 1 for the reason and solutions)

iii. Click "**Execute**" button to start calculation



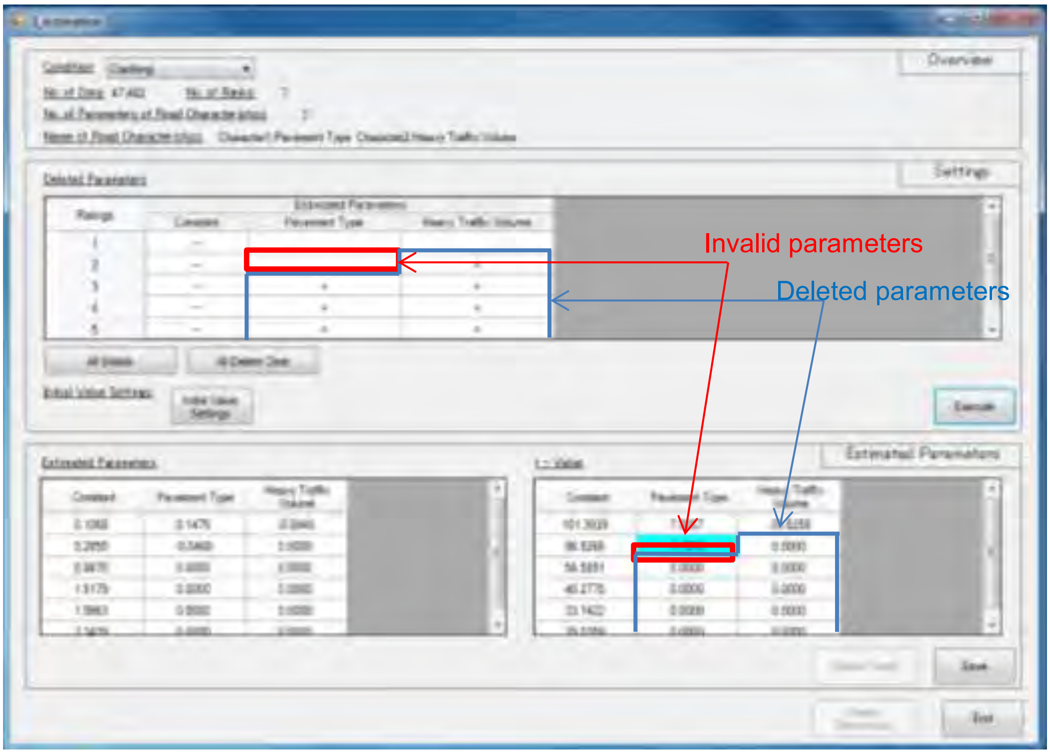
iv. Check the result

- Return to "Ranking" classification when it is not calculated or absolute t value (|t-value|) < 1.96.



v. Check the "**t value**"

- A t-value is considered as invalid value when |t-value|< 1.96
- The invalid t-values are highlighted by blue color.
- Omit invalid values by selecting the corresponding cells at Deleted Parameters Table
- Click on **Execute** button to estimate again then check the result to delete the invalid values (if any)
- Until there is no invalid value, repeat excluding parameter from setting window. Click on **Save** button to save the results

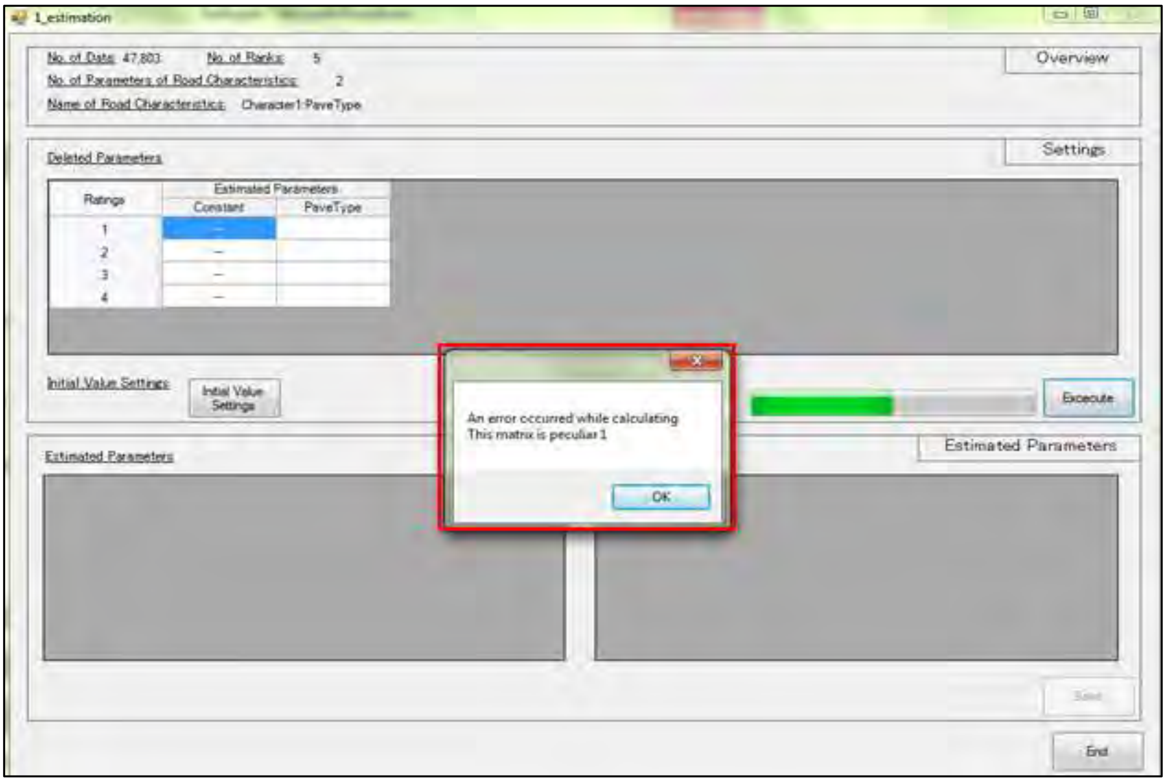


4) Estimate hazard parameters for the remaining cases (Rutting, IRI)

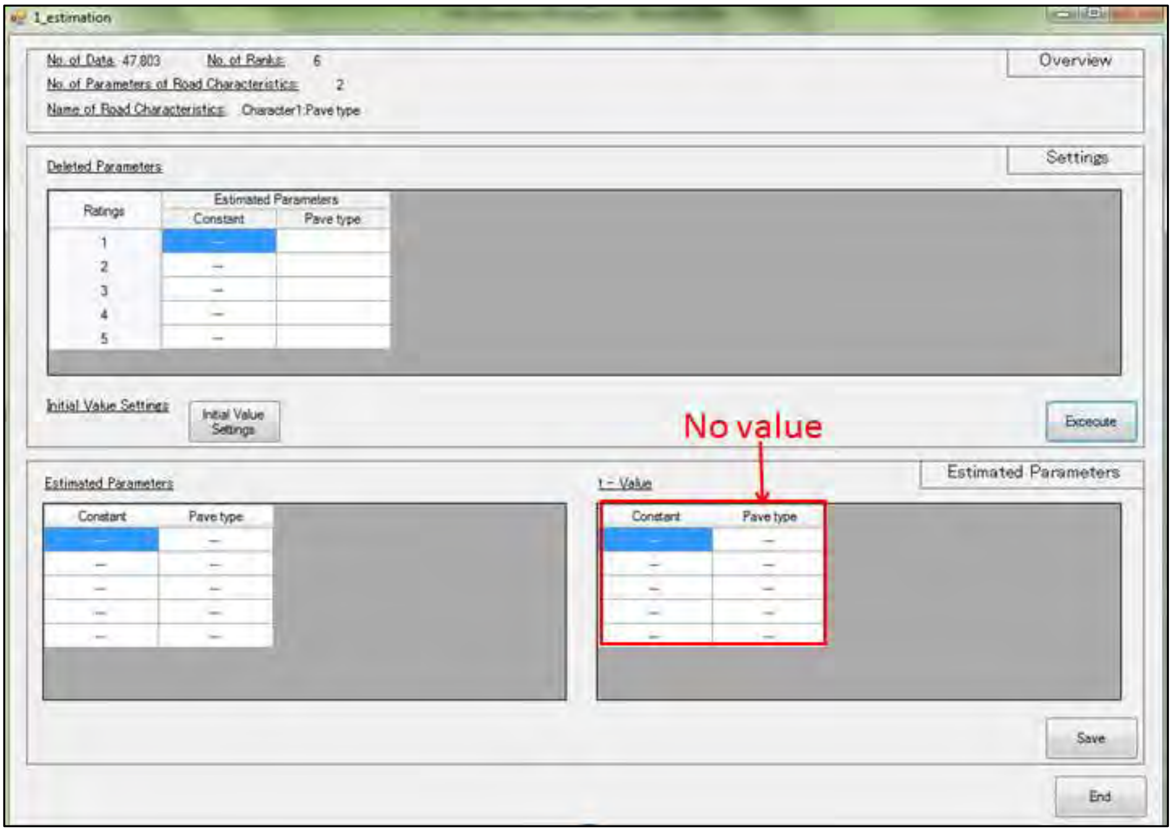
❖ ***Tips:*** *Following tips will be effective during calculation and evaluation process*

Tips No.1:

- *A dialogue box indicating that "**An error occurred while calculating**"*



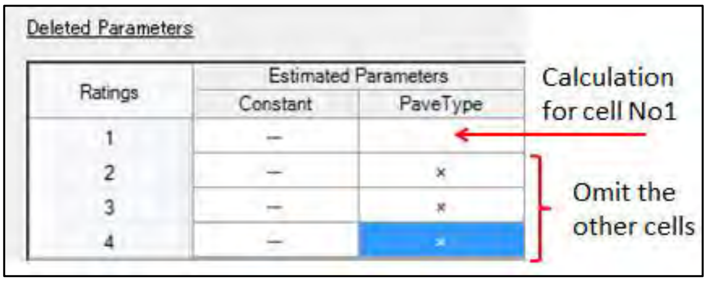
*There's no value in **T-value** table.*



***Solutions**: Follow these steps to solve the problem/error:*

Both of cases are occurred by diverging in calculation.

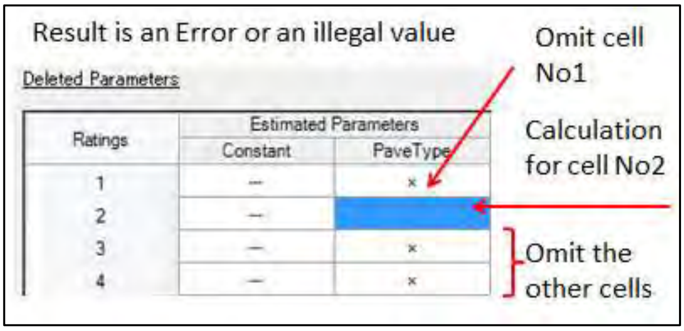
***Step1**: Conduct calculation for cell No1 (calculate one by one)*



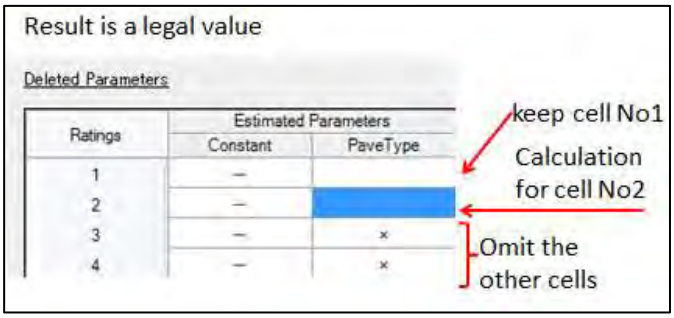
***Step 2**: Judge the result*

Click **"Execute"** button and wait for result

- *If the result is an "Error " omit cell No1 and keep calculating for the other cells (one by one)*



- *If the result is not an "Error" keep cell No1 and conduct calculation for the other cells (one by one)*



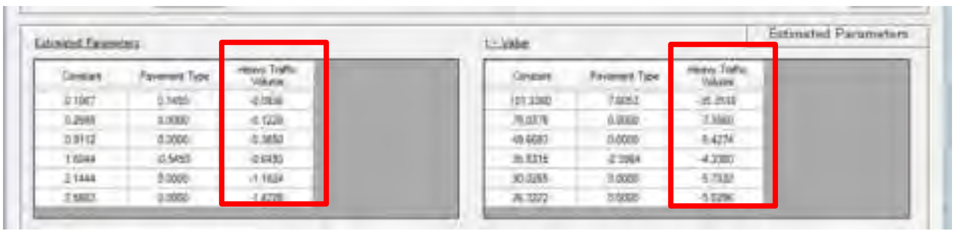
Step 3: *Continue until calculate all of cells*

Step 4: *After omitting all "Error". Delete all of illegal value |X|<1.96 and click "**Execute"** button*

Step 5: *Save calculated data file*

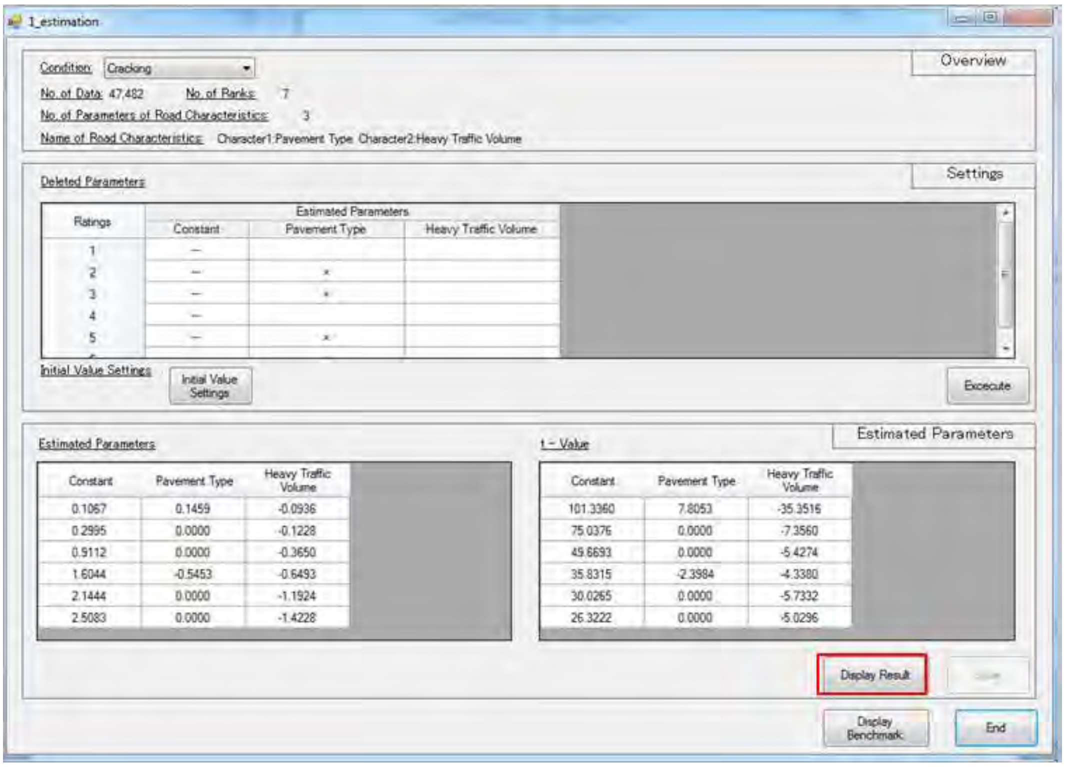
Tips No.2: *Negative parameter of Traffic Volume on factorial analysis*

- In general, hazard rate and traffic volume is positive correlations (This means the higher traffic volume is increased to higher hazard rate). Therefore, the parameter with correlation negative shall be deleted during the factorial analysis.



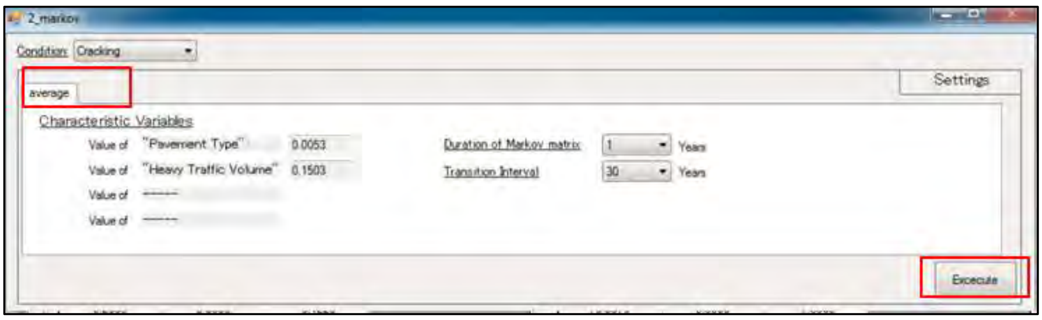
2.3.6 Calculate the Pavement Deterioration according to Markov Module

1) After estimating Hazard Parameters for all cases (crack, rutting, IRI), click on "**Display Results"** button



2) Evaluate Pavement Deterioration in case of cracking

3) Click on "**Execute"** button to conduct Pavement Deterioration Evaluation with average value of variables



4) Click on "**Save**" button to save the result

5) Click on "**+Add Sheet"** button to conduct Pavement Deterioration Evaluation with the other value of variables. A new sheet would be created, Select values of variables from drop-down list then click on "**Execute"** button to calculate.

6) Click on "**Save"** button to save the result

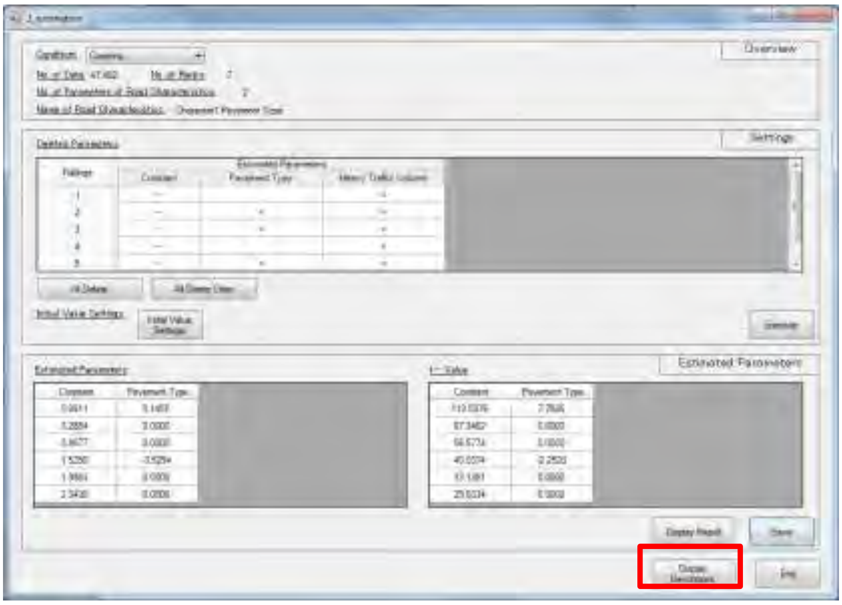
Note:

- *Value of Pavement type = on=1 means 100% of sections are cement concrete*
- *Value of Pavement type = off =0 means 100% of sections are Asphalt concrete*
- *Value of Pavement type = 0.0053 (case of average) means cement concrete made up 0,53% of whole sections*
- *Value of heave traffic volume= 90 percentile= 0.34 is the value below which 90% of observations may be found.*
- *Duration of Matrix Markov: normally chose 1*
- *Transition interval: The number of years which you want to check the pavement deterioration transition. For ex: 30 years*

7) Evaluate Pavement Deterioration for remaining cases (Rutting and IRI)

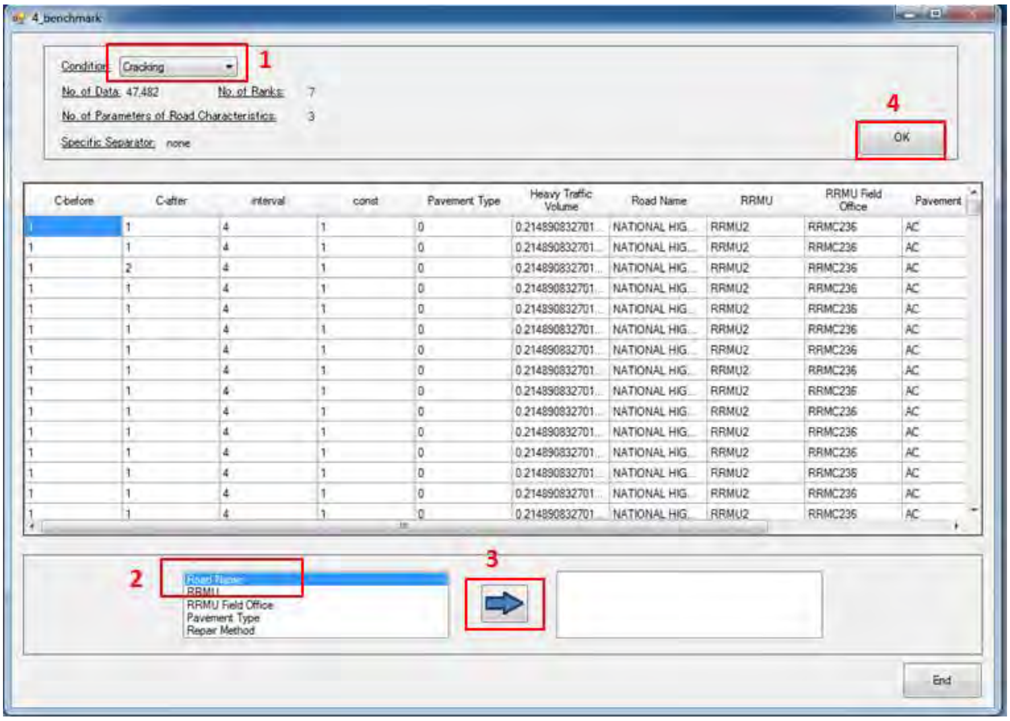
2.3.7 Calculate the Pavement Deterioration according to Benchmarking Module

1) Click on "**Display Benchmark**" button to proceed to Benchmarking Module interface

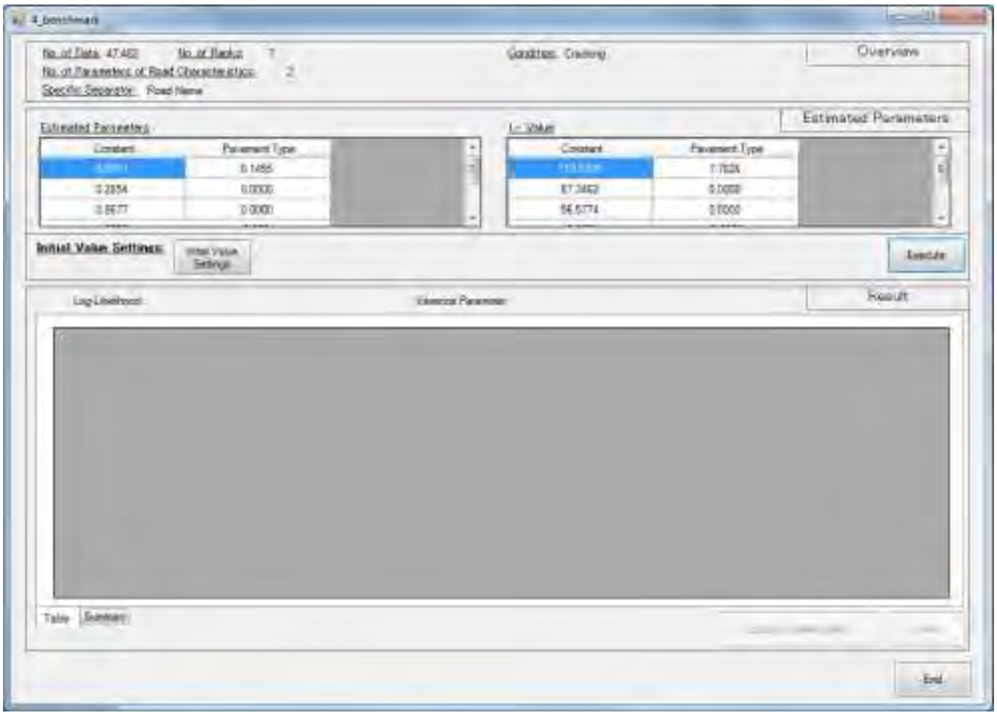


2) Calculate Pavement Deterioration Evaluation in case of cracking

3) Select specific separator : “Road Name” or “RRMU” or the other

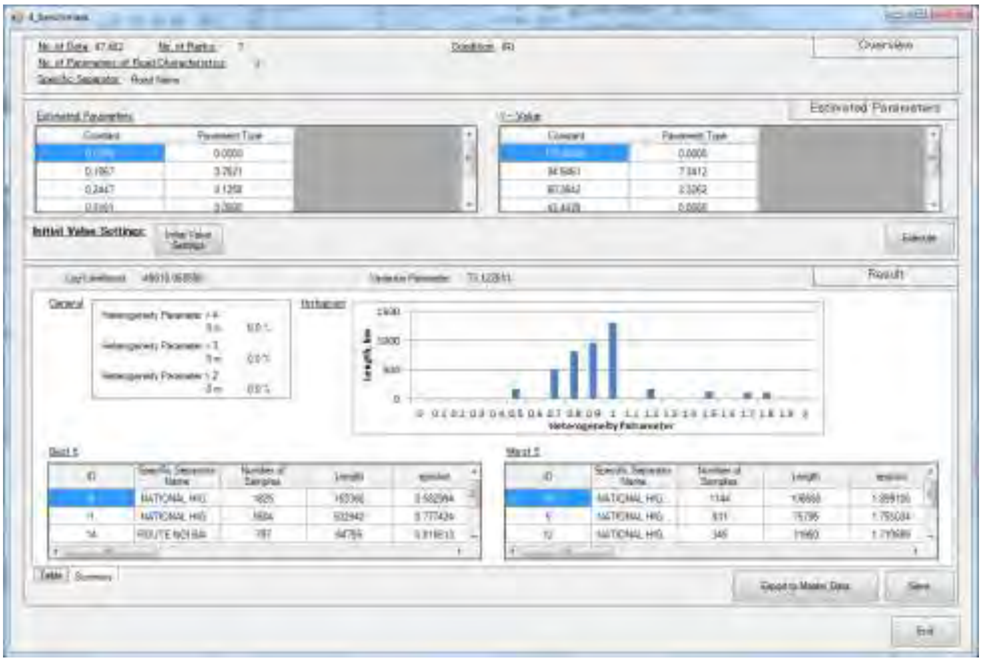


4) Click “**Execute**” button to calculate



5) Check “**Table**” tab to sort deterioration evaluation result according to epsilon (Evaluation value (coefficient) of deterioration speed in each group based on selected specific indicator), hazard rate and so on.

6) Data summary is also available in “**Summary**” Tab.



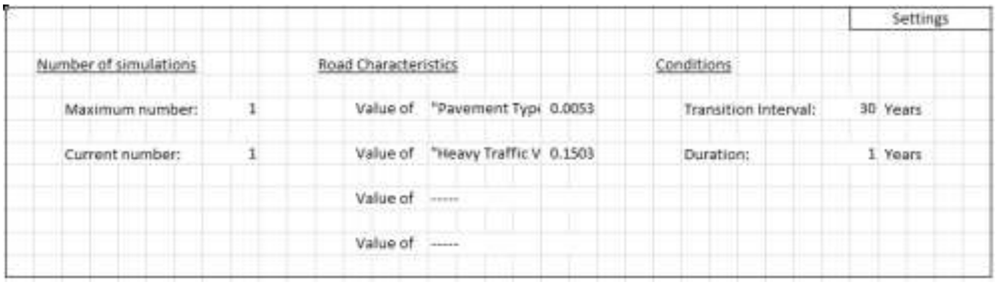
7) After checking both of sheets, click on "**Export to Master Data**" button to store the result data to master database and "**Save**" button to save the result

8) Calculate Pavement Deterioration Evaluation for remaining cases (Rutting and IRI)

2.3.8 Markov Results

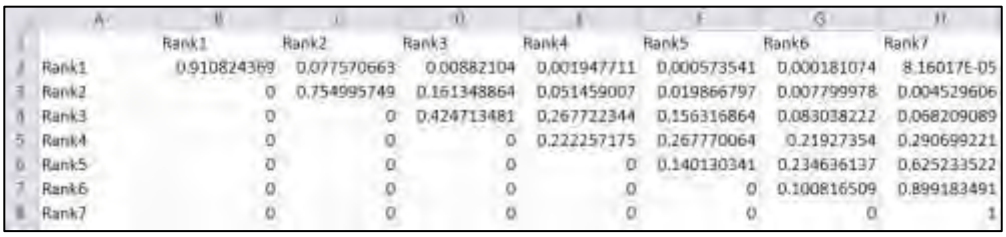
Markov results comprise following items.

(1) Parameters



The values that were set is displayed in **Parameters** sheet

(2) Matrix



	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7
Rank1	0.910824369	0.077570663	0.00882104	0.001947711	0.000573541	0.000181074	8.16017E-05
Rank2	0	0.754995749	0.161348864	0.051459007	0.019866797	0.007799978	0.004529606
Rank3	0	0	0.424713481	0.267722344	0.156316864	0.083038222	0.068209089
Rank4	0	0	0	0.222257175	0.267770064	0.21927354	0.290699221
Rank5	0	0	0	0	0.140130341	0.234636137	0.625233522
Rank6	0	0	0	0	0	0.100816509	0.899183491
Rank7	0	0	0	0	0	0	1

- Transition matrix is displayed in **Matrix** sheet as shown above.

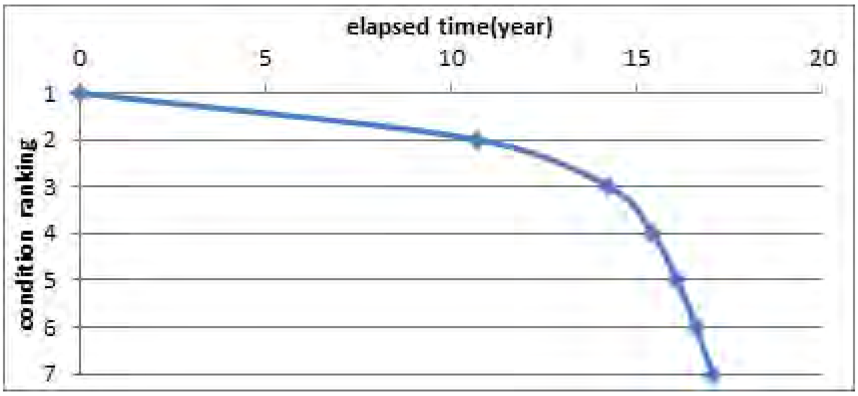
$$\begin{pmatrix} p_{11} & p_{12} & \cdots & p_{1K} \\ 0 & p_{22} & & \vdots \\ \vdots & & \ddots & \\ 0 & \cdots & 0 & p_{KK} \end{pmatrix}$$

- Pij expresses the probabilities of changing of road network from rank i to rank j after 1 year.
- An example:
  - B2= 0.91 it means after 1 year 91% road network will change from rank 1 to rank 1 (i.e. remain in same ranking level)
  - C2= 0.077 it means after 1 year 7.7% road network will change from rank 1 to rank 2
  - D3=0.16 it means after 1 year 16 % road network will change from rank 2 to rank 3

(3) Deterioration Curve

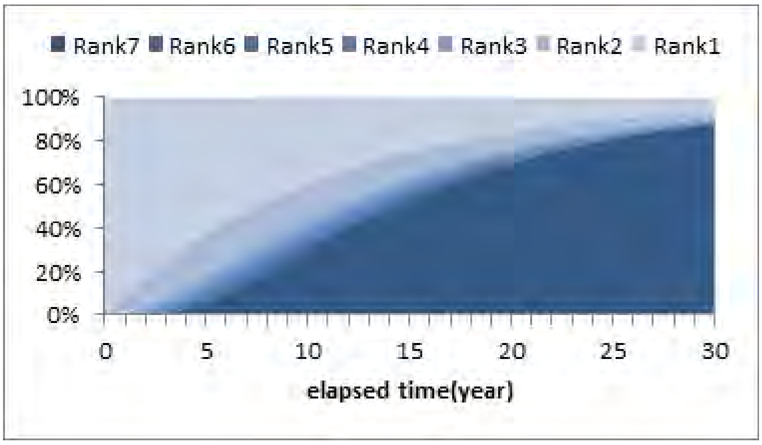
The deterioration curve is displayed in **Curve** sheet.

Deterioration curve



(4) Transition Chart

Transition chart is displayed in **Transition** sheet.



Based on transition chart we can know the percentages of each rank at a particular time.

2.3.9 Benchmarking Results

Benchmarking results are shown with epsilon sheet as shown below.

ID	Specific Separator Name	Number of Samples	Length	epsilon	Specific Parameter1 (Constant)	Specific Parameter 2	Specific Parameter 3	Hazard Rate						Accumulated Life Span						
								1	2	3	4	5	6	1	2	3	4	5	6	7
1	IONAL HIGHW	5604	502940	0.485141	1	0.002498	0.404248	0.0336	0.1212	0.3705	0.6504	0.8065	0.9378	0.00	29.78	38.03	40.72	42.26	43.50	44.57
2	IONAL HIGHW	6043	547380	1.265563	1	0.006123	0.11224	0.1229	0.3616	1.1013	1.9340	2.5445	2.9723	0.00	8.14	10.90	11.81	12.33	12.72	13.06
3	IONAL HIGHW	6229	569820	0.529688	1	0.004816	0.050304	0.0544	0.1554	0.4729	0.8311	1.1041	1.2907	0.00	18.38	24.82	26.93	28.14	29.04	29.82
4	'AY 3(THE OLD	15	1295	0.387626	1	0	0.049384	0.0396	0.1137	0.3462	0.6095	0.8084	0.9450	0.00	25.27	34.06	36.95	38.59	39.83	40.89
5	ONAL HIGHWA	931	75795	2.324897	1	0	0.031367	0.2412	0.6874	2.0918	3.6827	4.8986	5.7278	0.00	4.15	5.60	6.08	6.35	6.55	6.73
6	IONAL HIGHW	1825	163360	1.596279	1	0.008767	0.680883	0.0706	0.3446	1.0578	1.8477	2.1271	2.4575	0.00	14.16	17.06	18.00	18.55	19.02	19.42
7	IONAL HIGHW	7429	689875	1.048435	1	0	0.07197	0.1048	0.3047	0.9278	1.6331	2.1583	2.5224	0.00	9.54	12.82	13.90	14.51	14.98	15.37
8	AY 6-1(THE OI	87	7940	0.494186	1	0	0.017243	0.0519	0.1470	0.4472	0.7873	1.0496	1.2274	0.00	19.26	26.06	28.30	29.57	30.52	31.33
9	AY 6-2(THE OI	26	2545	0.982692	1	0	0.016488	0.1033	0.2923	0.8895	1.5661	2.0880	2.4418	0.00	9.68	13.10	14.22	14.86	15.34	15.75
10	ONAL HIGHWA	2913	260315	0.205353	1	0.004119	0.207779	0.0180	0.0563	0.1715	0.3013	0.3895	0.4544	0.00	55.43	73.20	79.03	82.35	84.92	87.12
11	L HIGHWAY 1	65	6420	0.332430	1	0	0.115297	0.0319	0.0949	0.2889	0.5085	0.6672	0.7793	0.00	31.36	41.91	45.37	47.34	48.83	50.12
12	ONAL HIGHWA	345	31960	1.088163	1	0.005797	0.06411	0.1105	0.3173	0.9661	1.6971	2.2503	2.6302	0.00	9.05	12.20	13.24	13.83	14.27	14.65
13	ONAL HIGHWA	1048	91960	0.889668	1	0.04771	0.245923	0.0806	0.2396	0.7308	1.2622	1.6469	1.9203	0.00	12.40	16.57	17.94	18.73	19.34	19.86
14	NOI BAI - BA	797	64755	0.159642	1	0	0.202805	0.0140	0.0438	0.1336	0.2351	0.3037	0.3544	0.00	71.41	94.22	101.71	105.96	109.25	112.07
15	CHI MINH ROI	2150	186300	0.805380	1	0	0.107869	0.0778	0.2305	0.7022	1.2357	1.6235	1.8965	0.00	12.85	17.19	18.61	19.42	20.04	20.57
16	ONAL HIGHWA	769	68730	1.184061	1	0.002601	0.164384	0.1086	0.3307	1.0079	1.7716	2.3070	2.6930	0.00	9.21	12.23	13.23	13.79	14.22	14.60
17	ONAL HIGHWA	1430	124730	1.833774	1	0.002797	0.174162	0.1665	0.5100	1.5544	2.7319	3.5515	4.1452	0.00	6.01	7.97	8.61	8.98	9.26	9.50
18	NAL HIGHWA	1904	170000	1.180635	1	0.058824	0.079275	0.1273	0.3421	1.0416	1.7956	2.4202	2.8282	0.00	7.85	10.78	11.74	12.29	12.71	13.06
19	ONAL HIGHWA	1144	106685	1.385021	1	0.017483	0.010973	0.1499	0.4129	1.2565	2.1991	2.9519	3.4524	0.00	6.67	9.09	9.89	10.34	10.68	10.97
20	ONAL HIGHWA	4330	395905	0.691666	1	0.002309	0.048564	0.0709	0.2030	0.6180	1.0870	1.4432	1.6871	0.00	14.11	19.03	20.65	21.57	22.26	22.86
21	NAL HIGHWA	2398	209035	1.318759	1	0.001668	0.03446	0.1368	0.3894	1.1851	2.0851	2.7738	3.2432	0.00	7.31	9.88	10.72	11.20	11.56	11.87

- Epsilon <1 : long life group
- Epsilon >1 : high-speed deterioration group
- **Accumulated life span** expresses the time interval it takes to a route reach to a particular rank.
- Based on these results (Accumulated life span) we can draw deterioration diagram for all routes

2.4 BUDGET PLANNING (MID-TERM BUDGET PLAN)

2.4.1 Flowchart

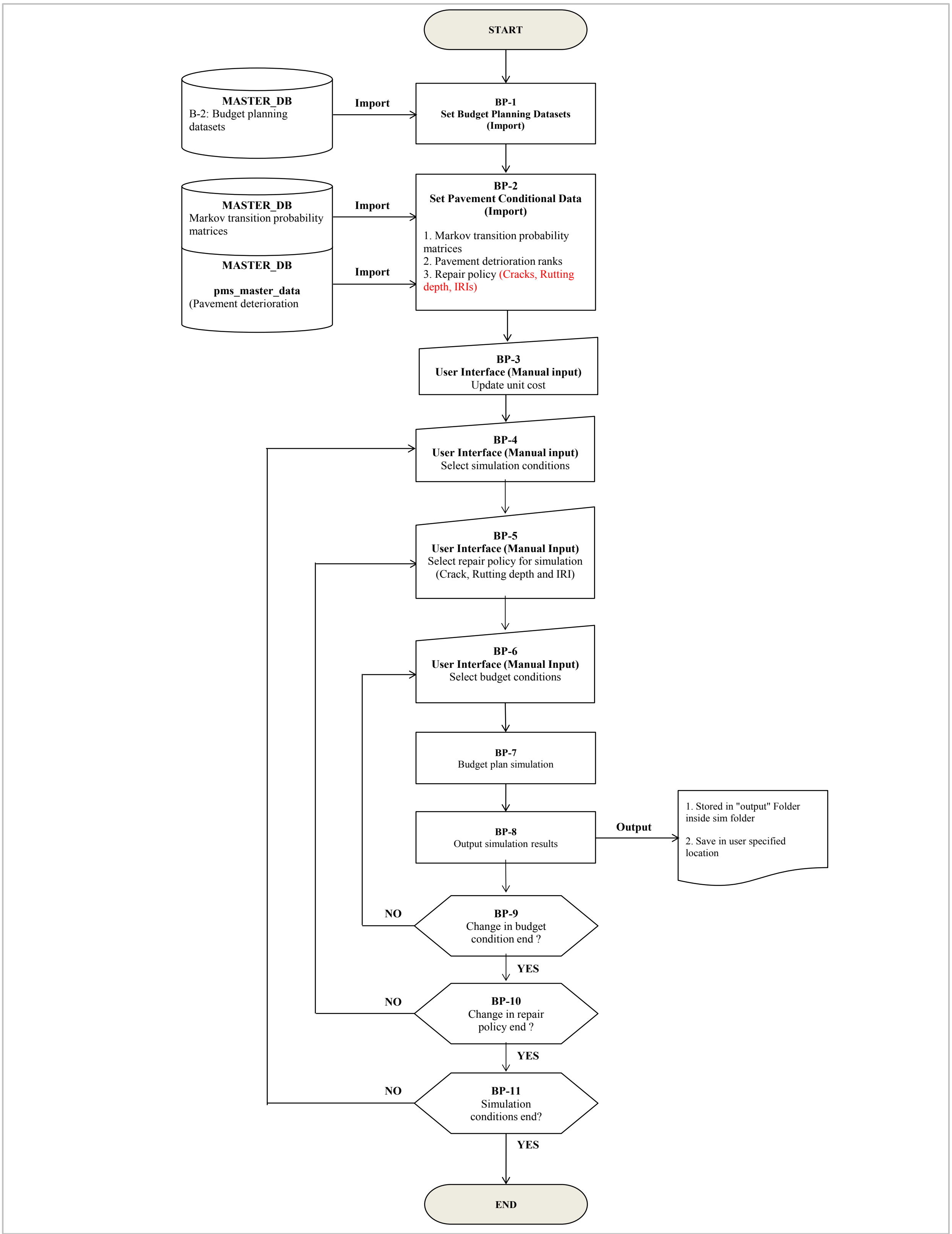


Figure 2.4.1 Budget Planning Flowchart

2.4.2 General Steps of Budget Planning (Mid-term)

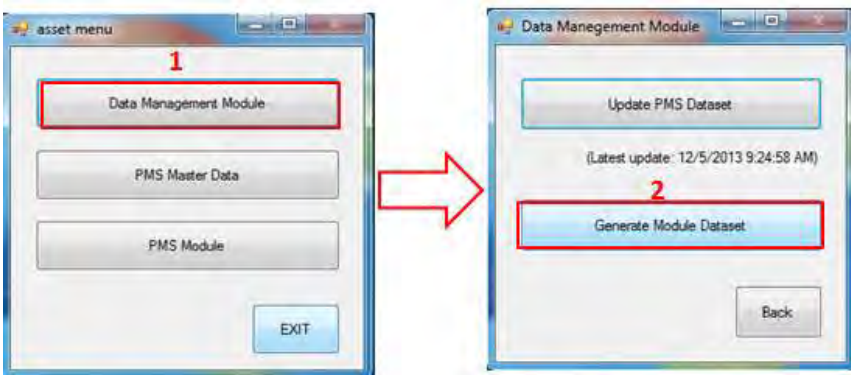
Budget planning includes following steps:

1. Creating Budget Planning Dataset
2. Setting Repair Unit Cost
3. Setting Repair Policy
4. Setting Simulation Condition
5. Setting Budget

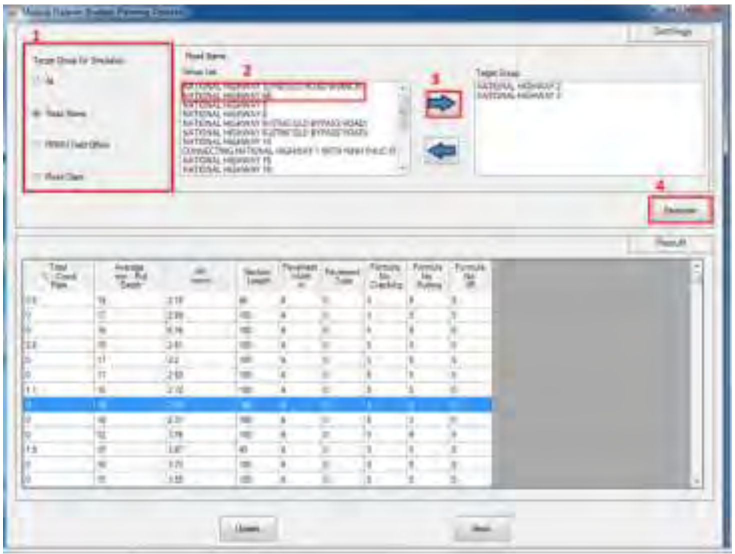
2.4.3 Creating Budget Planning Dataset

1) Back to Asset menu, and then Click "**Data Management Module**"

2) Click "**Generate Module Dataset**"



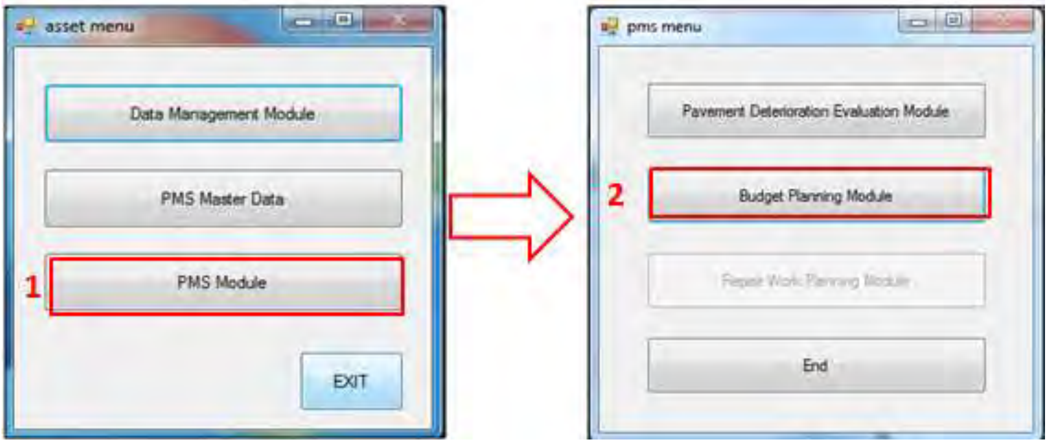
3) Select target group for simulation.



2.4.4 Setting Repair Unit Cost

1) Back to Asset menu and then Click "PMS Module"

2) Click "**Budget Planning Module**"



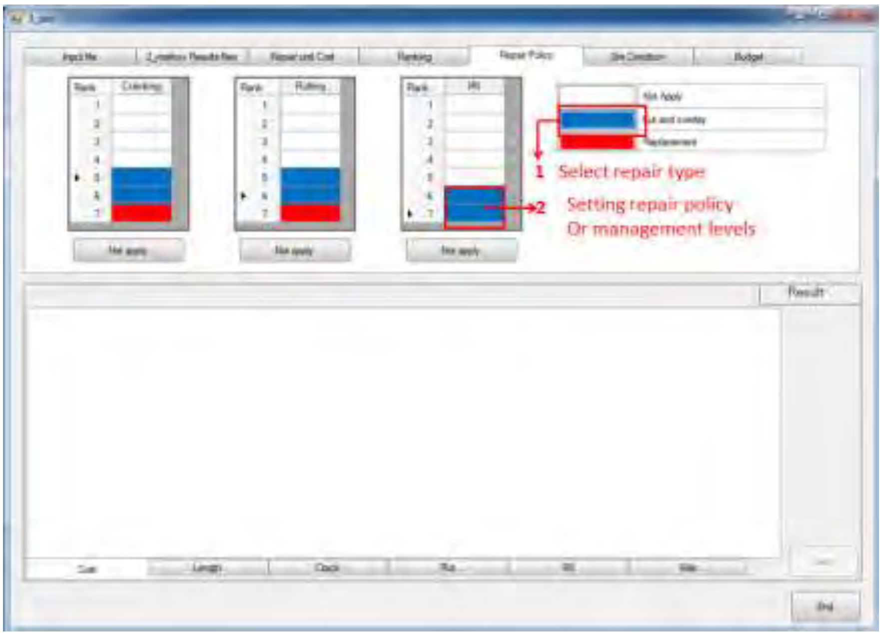
3) Select the repair work type by clicking on the "**Check Box**" then setting the unit cost for such repair work type.

4) To add more repair method click on "**Add Repair Method**" button

5) To delete a repair method, select the object and then click on "**Delete Repair Method"** button

2.4.5 Setting Repair Policy

1) Select "**Repair Type**" for each damage "**Ranking**"

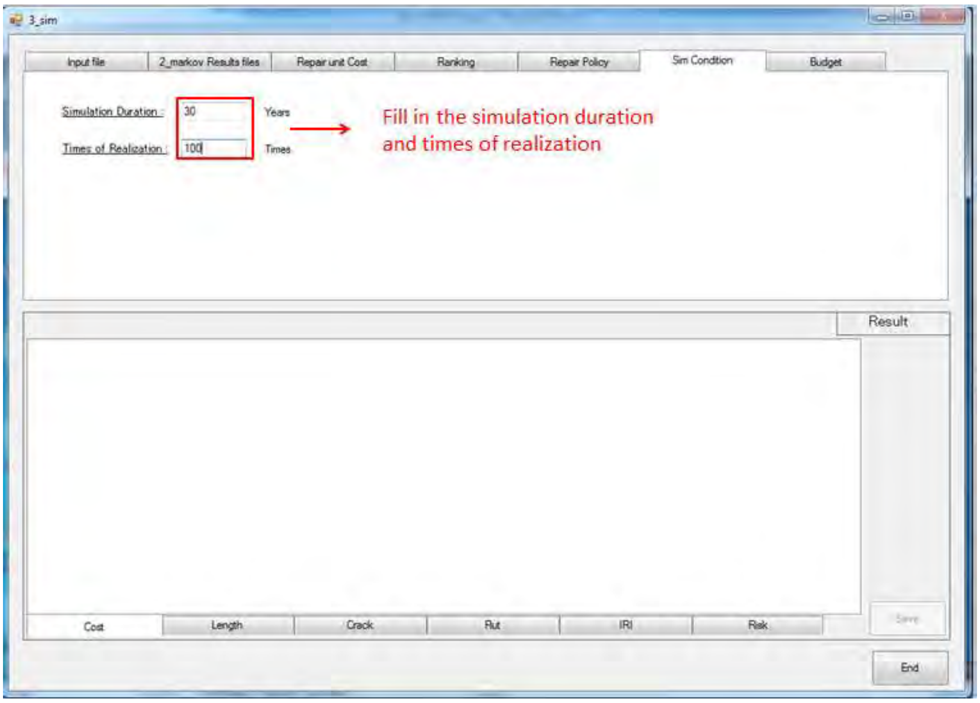


- Above setting could be understood as follows:
  - If crack condition of a section is from rank 1 to rank 4, it doesn't need to be repaired
  - If crack condition of a section is rank 5 or 6 it needs to be repaired with "Cut & Overlay"
  - If crack condition of a section is rank 7 it needs to be repaired with "Replacement"
  - If Rutting condition of a section is from rank 1 to rank 4, it doesn't need to be repaired
  - If rutting condition of a section is rank 5 or 6 it needs to be repaired with "Cut & Overlay".
  - If Rutting condition of a section is rank 7 it needs to be repaired with "Replacement"
  - If IRI condition of a section is from rank 1 to rank 5, it doesn't need to be repaired
  - If IRI condition of a section is rank 6 or rank 7, it needs to be repaired with "Cut & Overlay".
- In each specific case the management levels would be change to be more suitable with the current situation.

2.4.6 Setting Simulation Condition

1) Fill in the simulation duration and times of realization

- Simulation Duration: Period of time to be simulated.
- Time of realization: number of calculation repetition. After calculating get the average value
- In each particular case, the value can be changed.



2.4.7 Setting Budget Scenario

1) Setting annual budget for road maintenance. There are 2 scenarios

- No budget constrain
- Budget constrain

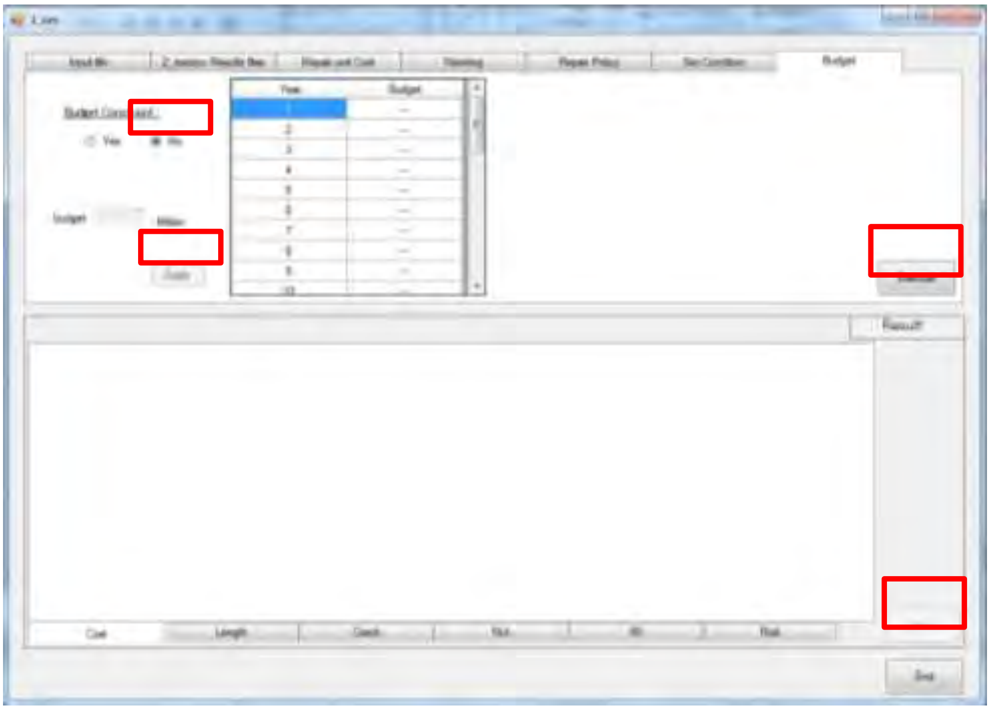
It's required to set annual budget for road maintenance. Note that unit of budget is million VND.

2) **Case 1**: No Budget Constrain

- In term of budget constraint select "**N**o" button
- Click "**Execute**" button
- Click "**Save**" button to save the result

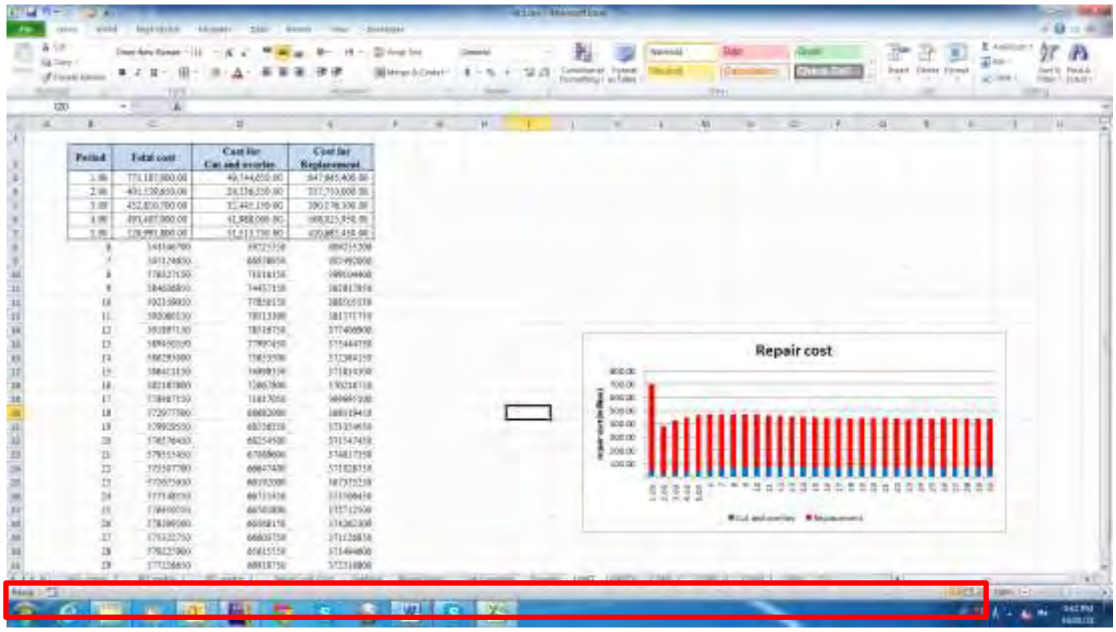
3) **Case 2**: Budget Constraint

- Budget constraint: select "**Yes**" button
- Input the annual budget for road maintenance
- Click on "**Apply**" button
- Click on "**Execute**" button
- Click on "**Save**" button to save the result



2.4.8 Budget Planning Results

1) Result of Budget Planning will be summarized in various sheets as captured in the below picture.



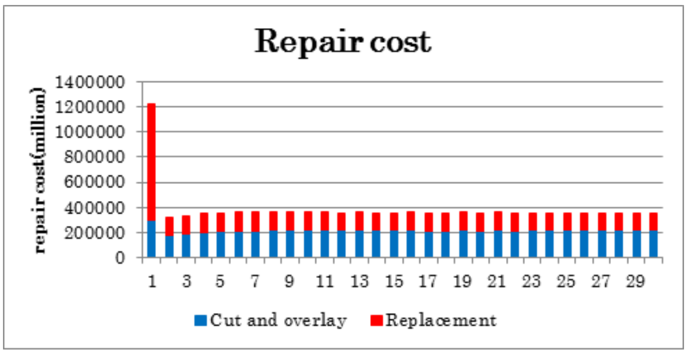
2) Cost

Repair cost for pavement will be displayed by both chart and particular values. In the following table and is figure, the repair costs for each year are indicated. This table can be used for Mid-term maintenance budget planning.

Table: Repair Work Cost for Five (5) Consecutive Years

Period (Year)	Total cost	Cost for Cut and overlay	Cost for Replacement
1	773,187,000.00	49,744,650.00	647,645,400.00
2	401,539,650.00	24,136,350.00	357,750,000.00
3	452,810,700.00	32,445,150.00	390,176,100.00
4	493,407,000.00	41,988,000.00	408,025,950.00
5	520,993,800.00	51,513,750.00	410,685,450.00

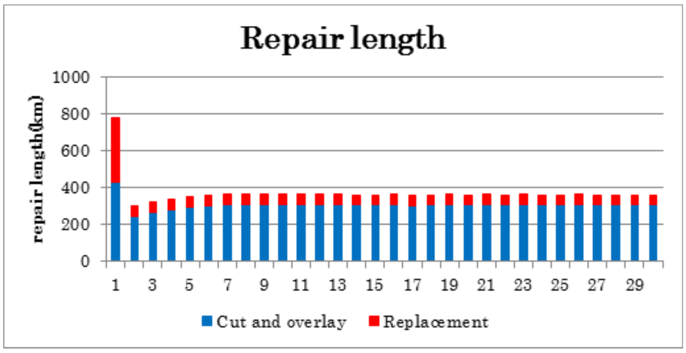
Repair cost for whole target sections



3) Repair Length

Repaired length of whole target routes will be display by both charts and particular values.

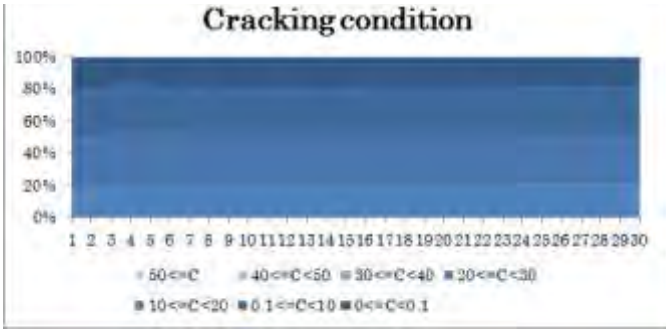
Repaired length of whole target sections



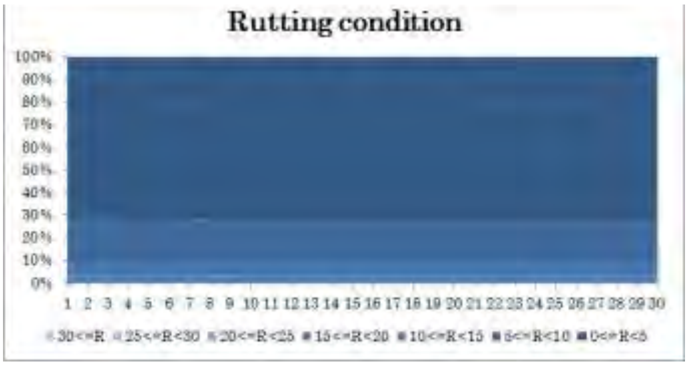
4) Crack, Rut and IRI Condition Transitions

Cracking, Rutting and IRI condition are displayed for whole target sections.

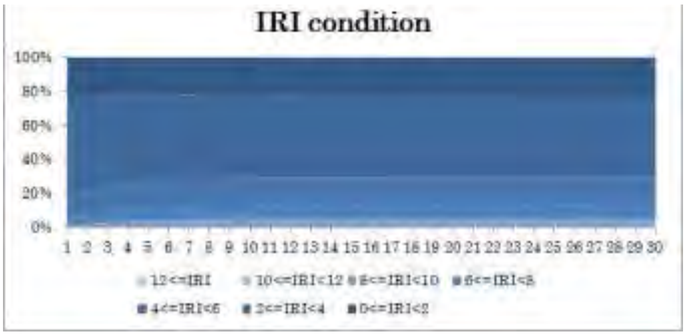
Cracking condition of whole network



Rutting condition of whole network



IRI condition of whole network



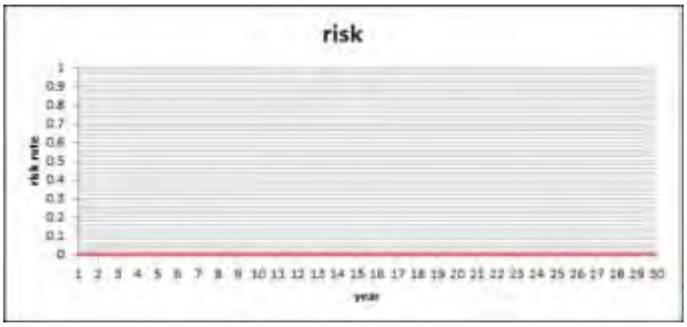
2.4.9 Risk

Risk is defined as;

Risk = Non-repaired length / full network length

Risks are displayed for whole target sections. If no budget constrain, risk line will be zero because all damage sections are always repaired timely.

Risk chart for whole network (in case of no budget constrain)



2.5 REPAIR WORK PLANNING (ANNUAL BUDGET PLANNING)

Repair work planning module is separately developed from the main PMS software (i.e. software containing data management module, pavement deterioration evaluation module and mid-term budget planning module). However, it will be integrated into PMS software upon incorporating the requests of DRVN which is under development at the moment. Therefore, the operation procedure of repair work planning module is described presuming that this module is running separately from the main PMS software. The repair work planning dataset which would be the output of the main PMS software can be imported from any location upon defining the path of the files by the user.

2.5.1 Repair Work Selection Flowchart

Flowchart of annual repair work planning module is shown in **Figure** 2.5.1.

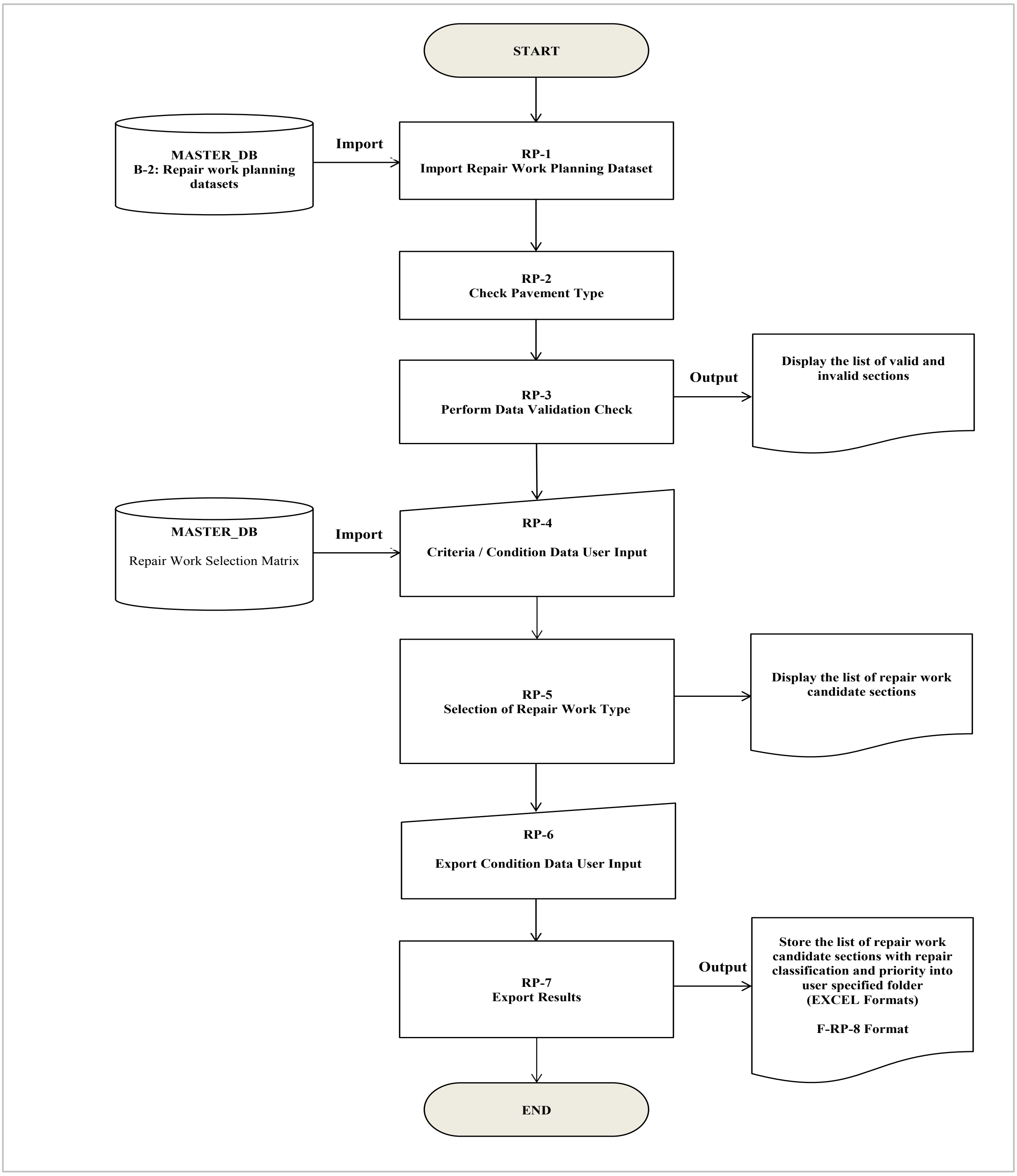


Figure 2.5.1 Annual Repair Working Planning Flowchart

All files and folders related to this module shall be saved in a common folder. The list of files and folders requires for running repair work planning module is shown in

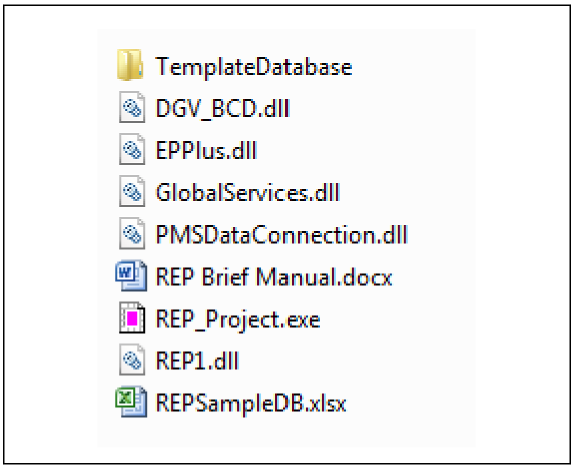


Figure 2.5.2 Files and Folders for Repair Work Planning Module

General steps of repair work planning are shown in **Figure** 2.5.3. These steps presume that the repair work planning module is running independently from the main PMS software. Upon integration of the repair work planning module into the main PMS software, the procedure of running this module shall be updated.

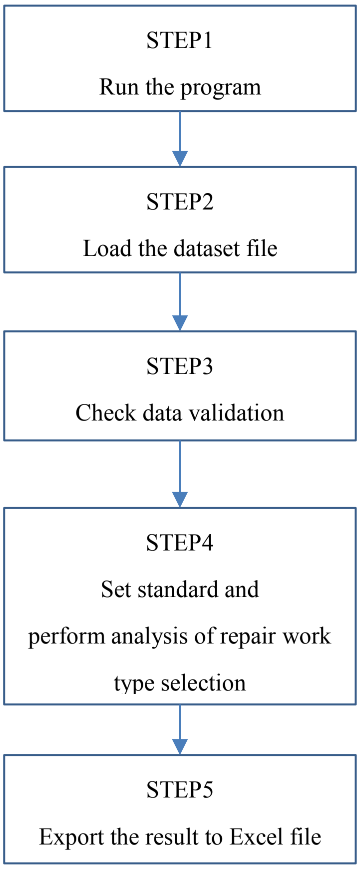
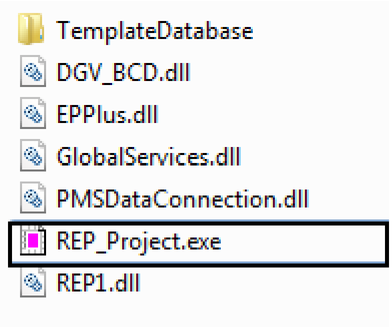


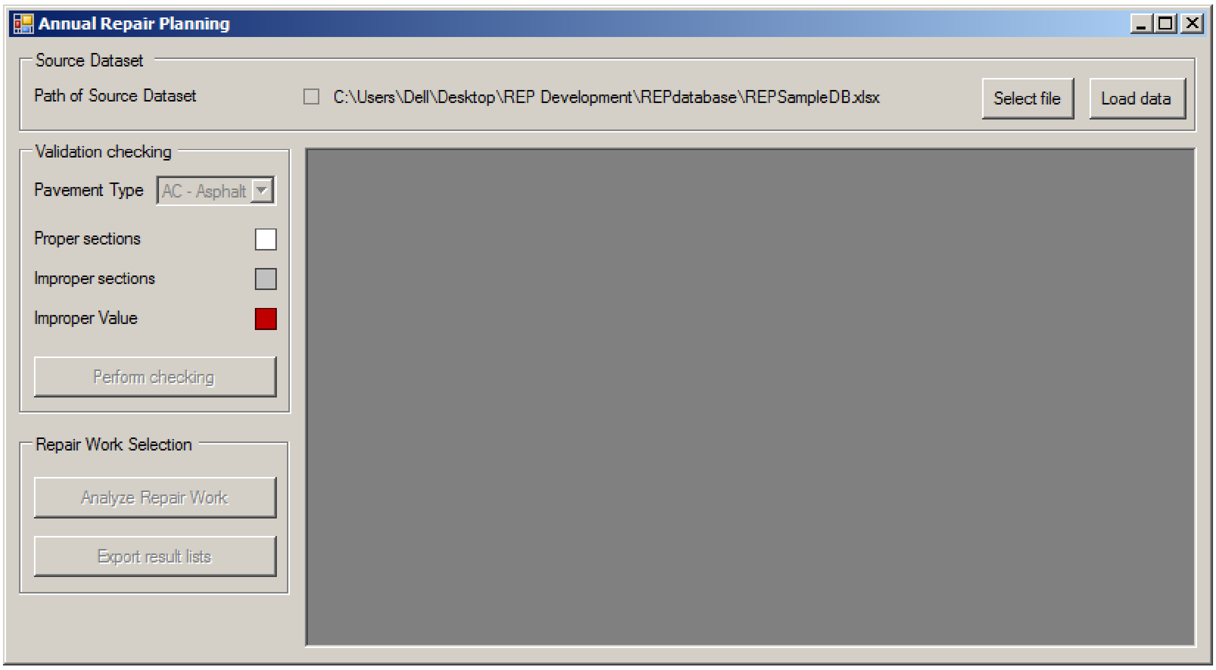
Figure 2.5.3 General Steps of Annual Repair Work Planning

(1) Run the Program

1) Launch the file "**REP_Project.exe**" from the folder where the packages of all related files and folders of repair work planning module are saved.

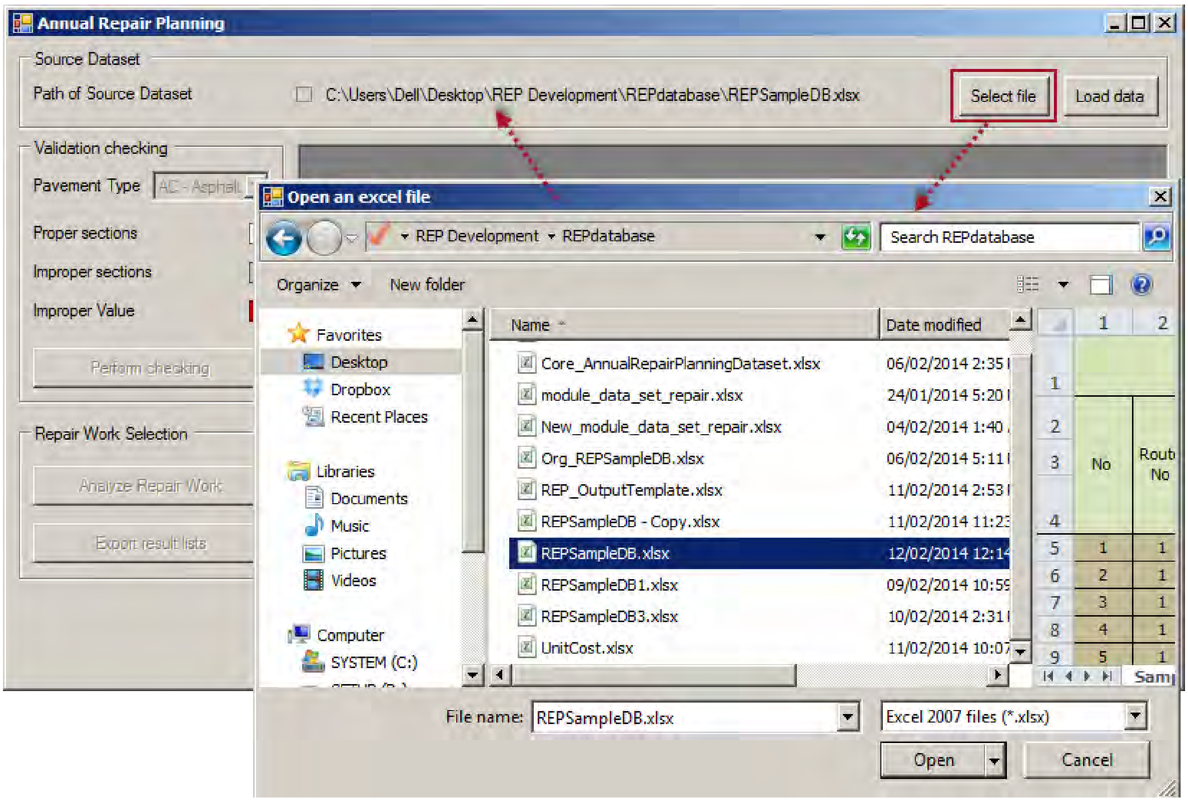


2) The main interface of program will appear as shown below.

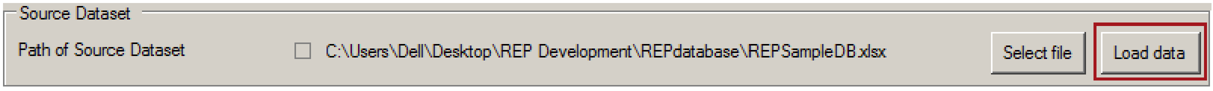


(2) Load the dataset file

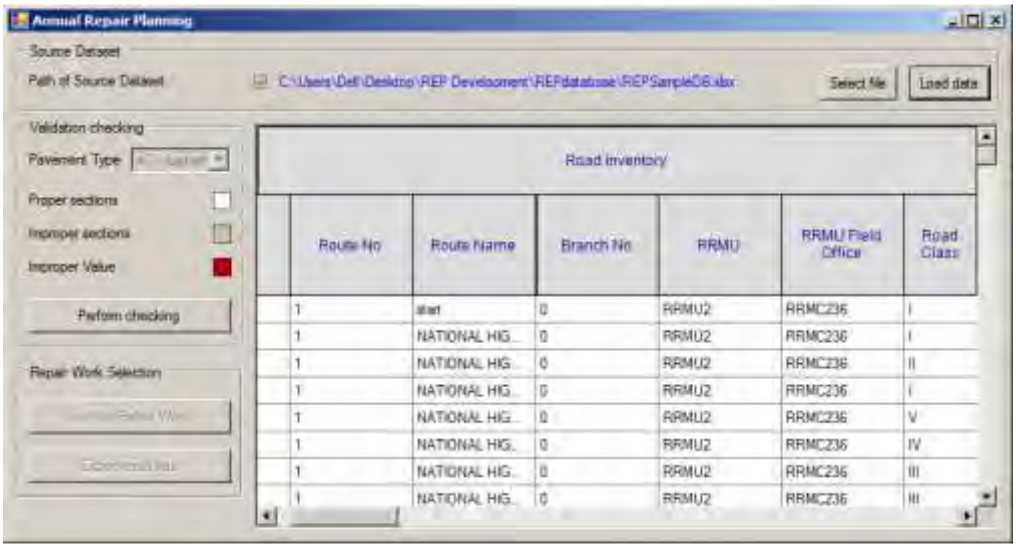
1) Click on the "**Select file**" button on the main system window to choose the repair work planning dataset file. The dataset file can be selected from any location inside the computer including USB. The path and file name of the selected file will be displayed on the main window.



2) If the selected dataset file is correct, click "**Load data**" button to load and show data in the selected file.



3) Data will be loaded and displayed into the main window. In case, there are more than one sheet in the file, the program will show a small window listing all the sheets in the file for asking the user to choose the relevant sheet. If data structure (table) of selected file is correct, it will be displayed as shown below. If data structure (table) is different from the specified structure, data display area will be turned to grey.

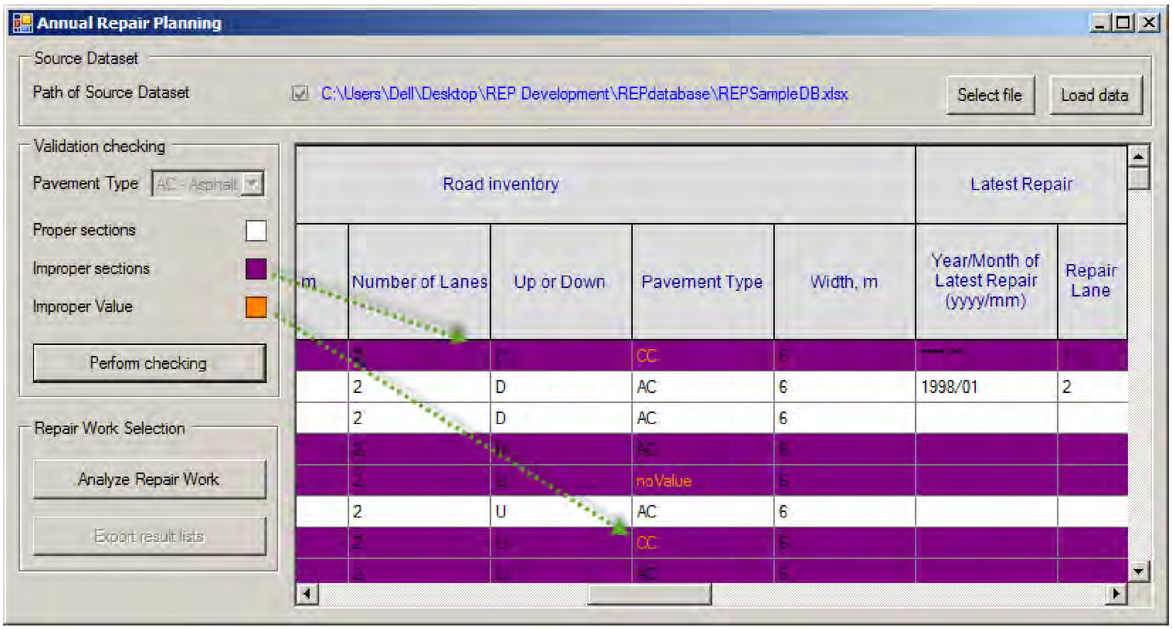


(3) Validation Check

1) For the purpose of checking whether or not data is valid, three (3) types of validation check are performed; proper section, improper sections and improper value. The desired color settings of each validation check items can be done by clicking each color box.

2) Click "**Perform checking**" button under validation checking box in the main window to perform the validation check of three check items. Upon completion of validation check, results are displayed in accordance with the selected color.

3) If user wants to rectify the error in the dataset file, user shall modify the dataset file first and then click "**Select file**" button again. Some markings of inappropriate sections will be made to let the user know which sections are out of the question.



4) If user wants to rectify the error in the dataset file, user shall modify the dataset file first and then click "**Select file**" button again.

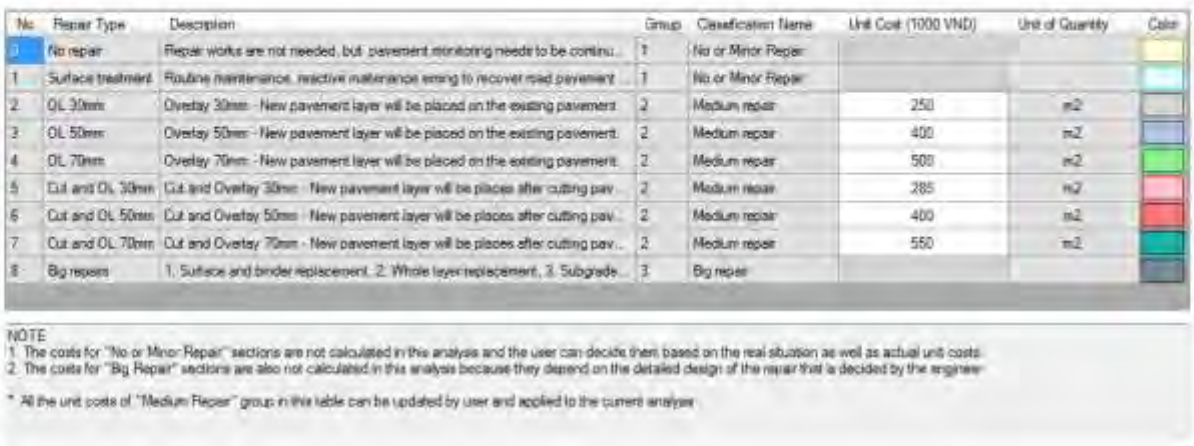
5) If dubious data are not rectified, sections identified as improper sections and improper values will be excluded from the analysis.

(4) Set Standard and Judge Repair Work Types

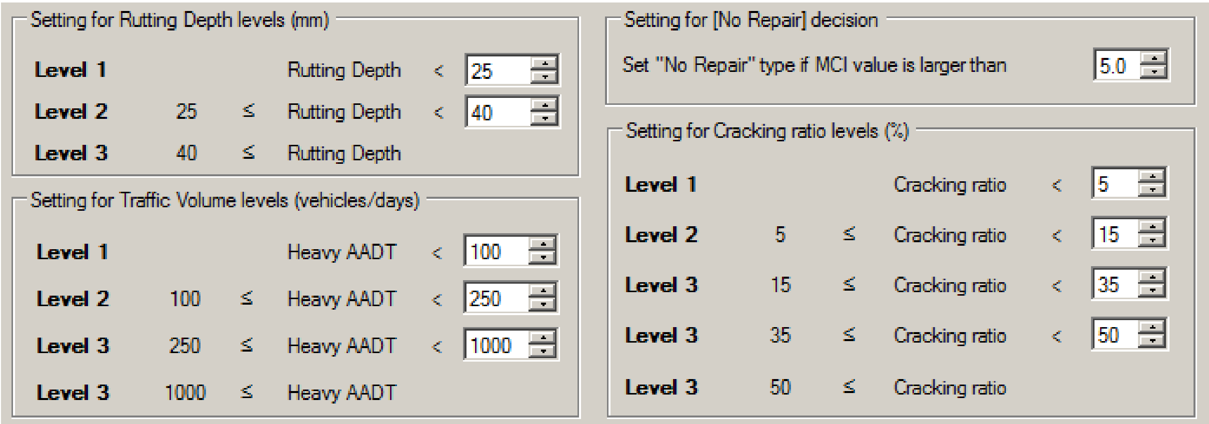
1) Upon completion of validation check and taking decision on dubious data, click "**Analyze Repair Work**" button from the main window. The "Standard Setting and Repair Work Selection" window will be displayed as shown below.

2) There are 3 tabs in this window: the first tab shows a table of repair types and the two other tabs shows setting the standards of repair types relating to two groups of road classes: (I, II, III) and the others (IV,V,VI). The default criteria are set based on the agreement between JICA Project Team and DRVN, however, these criteria can be customized if necessary. The customization is possible for the classified levels (Rutting depth, Traffic volume, Cracking, and MCI) and specific repair types.

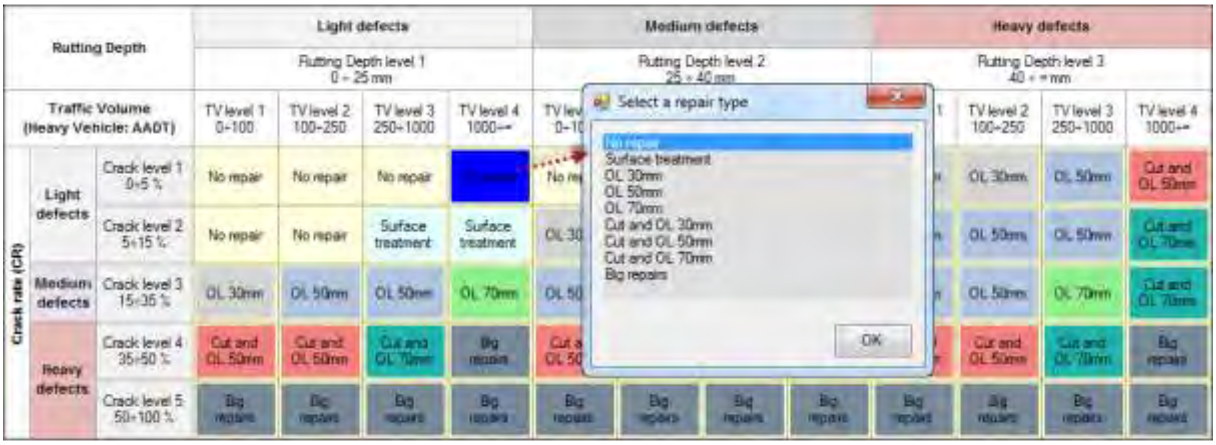
3) To change the color legend of each repair type, and the unit cost for repair type in "Medium Repair", click the first tab. The windows as shown below will appear. **<u>User shall input the unit cost of the corresponding year because unit cost of repair work items will change every year considering the market prices of materials and labors</u>**.



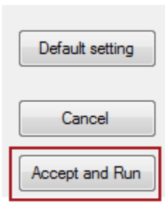
4) To change the level of pavement deterioration indices and traffic volume, use the setting of corresponding level as shown below.

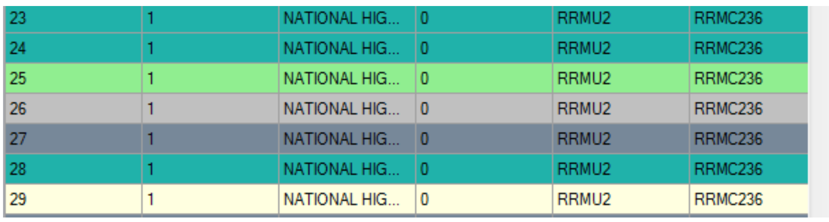


5) To change the specific repair type for each case, move the mouse through the relating button and click on it. In the window of repair type selection, choose the relevant repair type and click "**OK**" button. Please note that changing the repair work type in the matrix shown below will have significant changes in repair cost. Therefore, before changing the repair work type of particular cell, proper justification is needed otherwise the logic of this matrix will be lost.



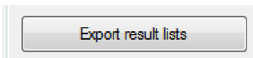
6) After confirming the repair type standard, click on "**Accept and Run**" button to apply the standard. Next, in the main window, markings for repair types will be shown to let the user know about the repair type for each section.



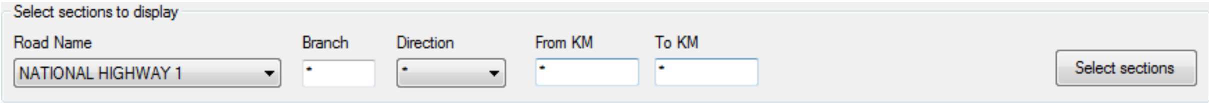


(5) Export the Result to Excel file

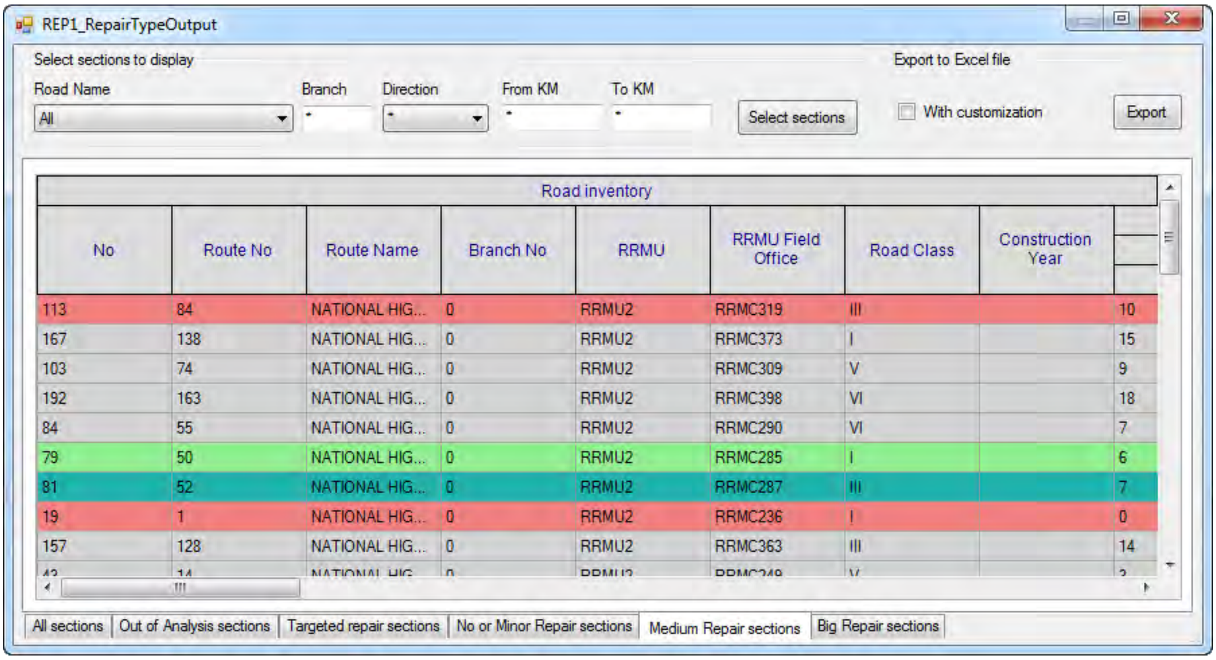
1) In the main window, click on the button "**Export result lists**".



2) Upon clicking "**Export result lists**", the window for exporting will be displayed. The user can partly choose the results to export by using some criteria such as road name, branch, direction, or location before selecting button "**Select sections**" to show the needed results.



3) After that, the results will be shown in some tabs in accordance with types of data



4) Select button "**Export**" to save the results in an Excel file. In this step, the user needs to define the destination folder and file name in order to save the output of the analysis.

5) The results of analysis are summarized into seven (7) sheets in MS-Excel file as follows;

i. Report Summary

ii. All Sections

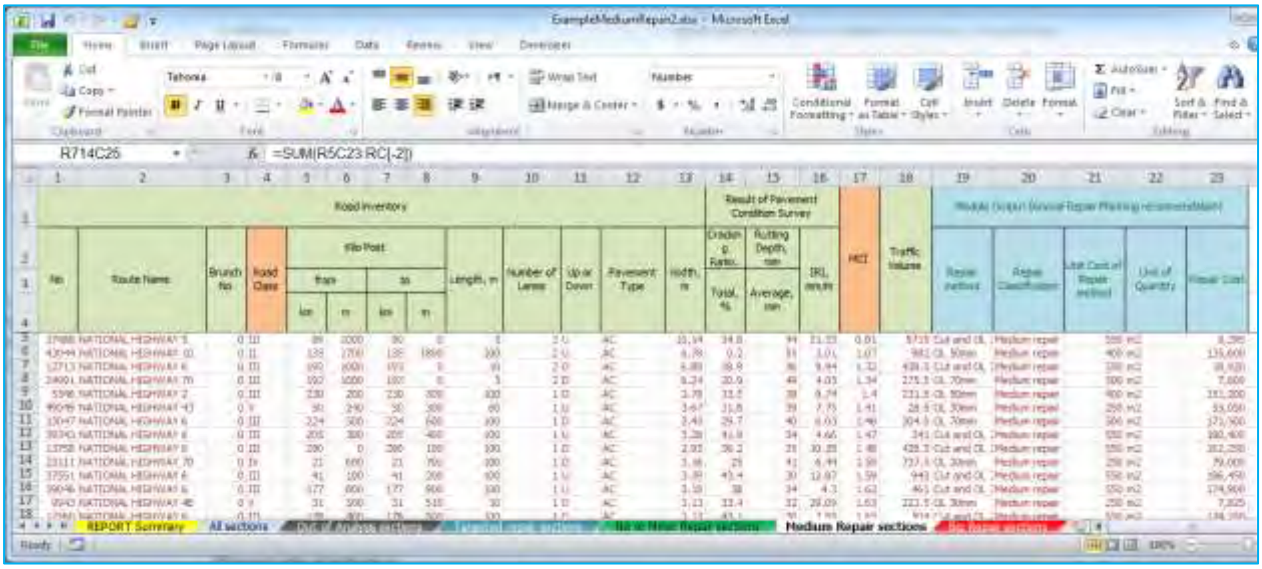
iii. Out of Analysis Sections

iv. Target Repair Sections

v. No or Minor Repair Sections

vi. Medium Repair Sections

vii. Big Repair Sections



6) Repair work costs for medium repair work are summarized in "**Medium Repair Sections**" sheet sorting by MCI value. Road sections having the lowest MCI value shall get the higher priority.

7) Sections identified for big repair works are summarized in "**Big Repair Sections**" sheet. Repair work costs of sections categorized into big repair are not computed by the module automatically because the unit cost of big repair work can decide only if the thickness of pavement is determined. Pavement condition data collected by pavement condition survey vehicle can only collect the surface condition of pavement and cannot predict the structural adequacy of the existing pavement. Therefore, further field survey is recommended in the sections which are categorized as big repair for identifying the required pavement thickness. After identifying the required pavement thickness, engineer shall compute the cost for big repair manually outside of the module.

8) Since outputs are summarized into numbers of sheets, user can select the road sections for preparing annual maintenance plan by taking account of budget condition for a particular year. Allocation of budget for User shall decide the proportion of budget for big repair work, medium repair work and minor repair works.

VOL. IV

PAVEMENT MONITORING SYSTEM USER'S MANUAL

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 IN THE SOCIALIST REPUBLIC OF VIETNAM

PAVEMENT MONITORING SYSTEM USER'S MANUAL

APRIL 2014

JICA PROJECT TEAM

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CHAPTER 1 INTRODUCTION

1.1 PURPOSE OF PAVEMENT MONITORING SYSTEM (PMoS)

Pavement Monitoring System (hereinafter referred to as “PMoS”) is a visualization system of road conditions utilizing Road Database. It shows road pavement conditions, management criteria and a maintenance history in the same sheets in order of chainage of kilopost. The PMoS is supposed to help the routine road pavement maintenance and the prioritization of repair works, referring to the policy of maintenance and repair works selection.

PMoS has been developed under Activity 3: Improvement of Road Maintenance Technology of the JICA Project for Capacity Enhancement in Road Maintenance, working together with JICA experts and Vietnamese experts.

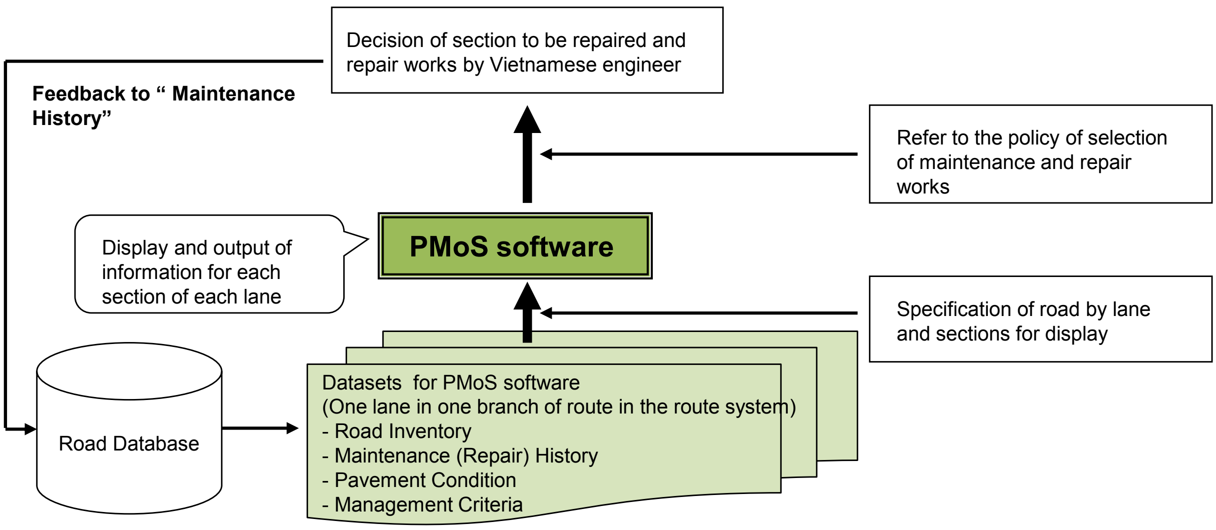

Figure 1.1.1 Image of Workflow of Road Pavement Maintenance Using PMoS

1.2 ORGANIZATION OF USER’S MANUAL

This PMoS User’s Manual consists of five (5) chapters. Details of each chapter are as shown below;

Chapter 1: Introduction of PMoS
Chapter 2: Installation of PMoS
Chapter 3: Function of Applications in PMoS
Chapter 4: Operation of PMoS Software
Chapter 5: Configuration of PMoS Software

1.3 REQUIREMENTS

PMoS is a visualization system to be maintained and enhanced by DRVN. PMoS is supposed to be improved by DRVN in the future. Hence following requirements of the system are considered and fulfilled as follows.

(1) To Visualize Road Conditions

The PMoS software visualizes integrated information derived from Road Database.

(2) To Provide Easy Extendibility of the Monitoring Function

PMoS software is developed in MS excel VBA. Copyright belongs to DRVN and JICA. DRVN can modify or add any new functions on PMoS software on their own responsibility.

(3) To Assist Creation of Dataset for Pavement Monitoring

The Conversion Software for PMoS (hereinafter referred to as “the CS”) creates dataset for PMoS software from Road Database.

1.4 USERS

The users of the PMoS are assumed as DRVN Road Maintenance and Management Department and Planning & Investment Department, RRMB and its Sub-Bureaus.

1.5 STRUCTURE OF PMoS

In the view of software applications, PMoS consists of CS and PMoS software. PMoS datasets are interpolation datasets between Road Database and PMoS outputs, which have integrated data records of road database data items with 100m length basically. Since each data records in road database, such as road asset, maintenance history and pavement condition has different unit length of data, integrated dataset of PMoS dataset is required.

PMoS software creates visualized outputs from PMoS datasets and CS creates PMoS datasets. Data items and unit length of each record of PMoS dataset were defined from output items through Activity-3. In this regards, dataset unit was defined as lane of road branch. Hence, PMoS output file is created from corresponding PMoS dataset of lane of road branch.

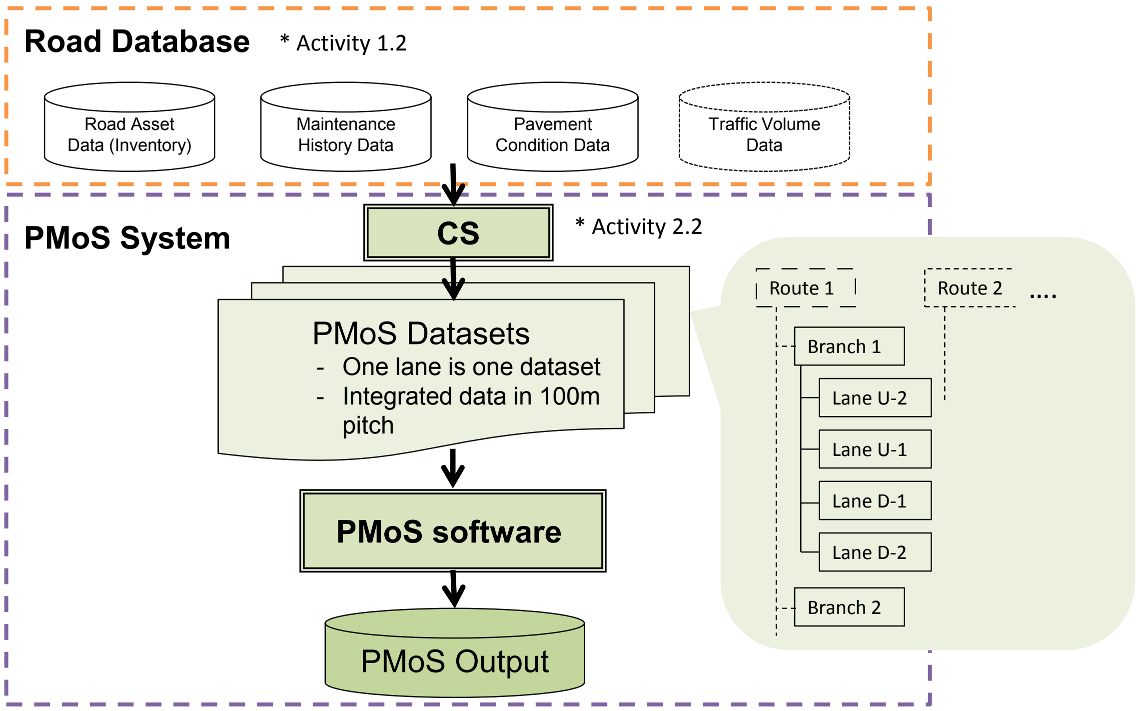

Figure 1.5.1 Structure of the PMoS and Relation of Road Database

1.6 FOLDER STRUCTURE OF PMoS

PMoS folder structure is as shown below. PMoS software, PMoS.xla, locates under the PMoS folder. In the folder, three (3) folders," Dataset"," Output" and "Support" are contained. "Dataset" shall contain datasets created by CS. "Output" stores output files created by PMoS software." Support" contains this PMoS user's manual.

You have to move dataset files to "Dataset" folder, after you create PMoS datasets by CS.

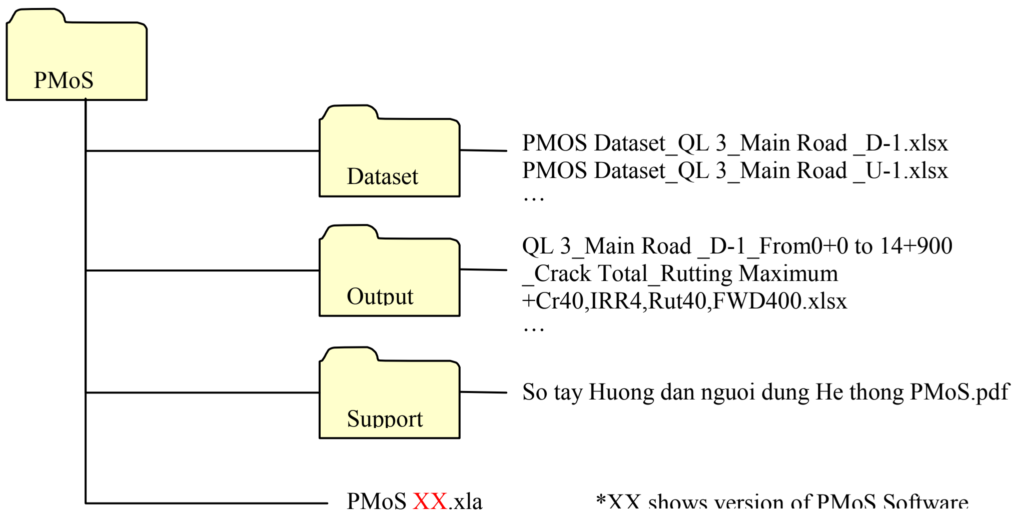

Figure 1.6.1 Folder Structure of PMoS

CHAPTER 2 INSTALLATION OF PMoS

2.1 INSTALLATION OF CS

Instruction of installation process of CS is described in CS user's manual

2.2 INSTALLATION OF PMoS SOFTWARE

PMoS software is developed as a MS Excel add-in. You can use it as add-in of your MS Excel or as single use by clicking PMoS software, PMoS.xla. In the case you installed PMoS software as add-in, when you start MS Excel, the PMoS software starts automatically and shows interface.

2.2.1 Security Level Settings of MS Excel

MS Excel later than 2003 version is required to be installed in your computer to activate PMoS software.

Macro Security Level of MS Excel shall be configured as shown in following figures.

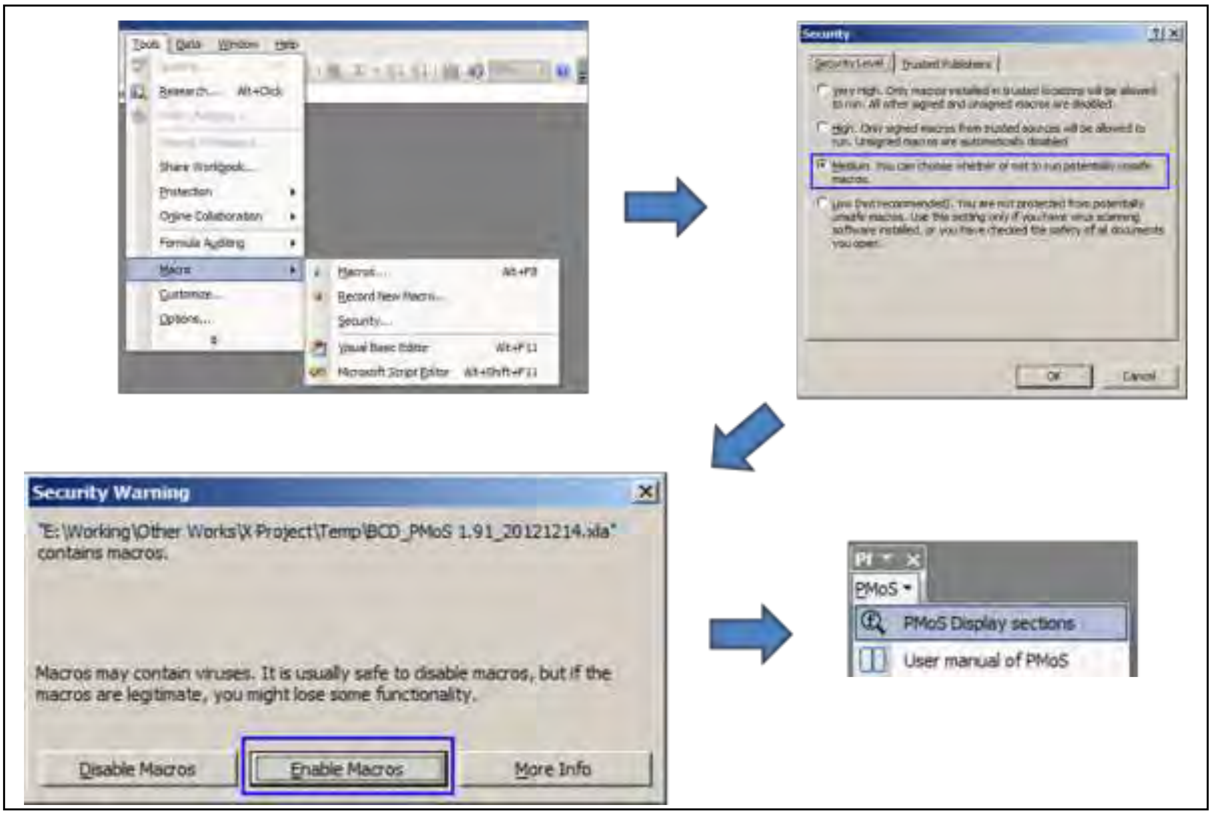

Figure 2.2.1 Setting of the Macro Security Level (Office 2003)

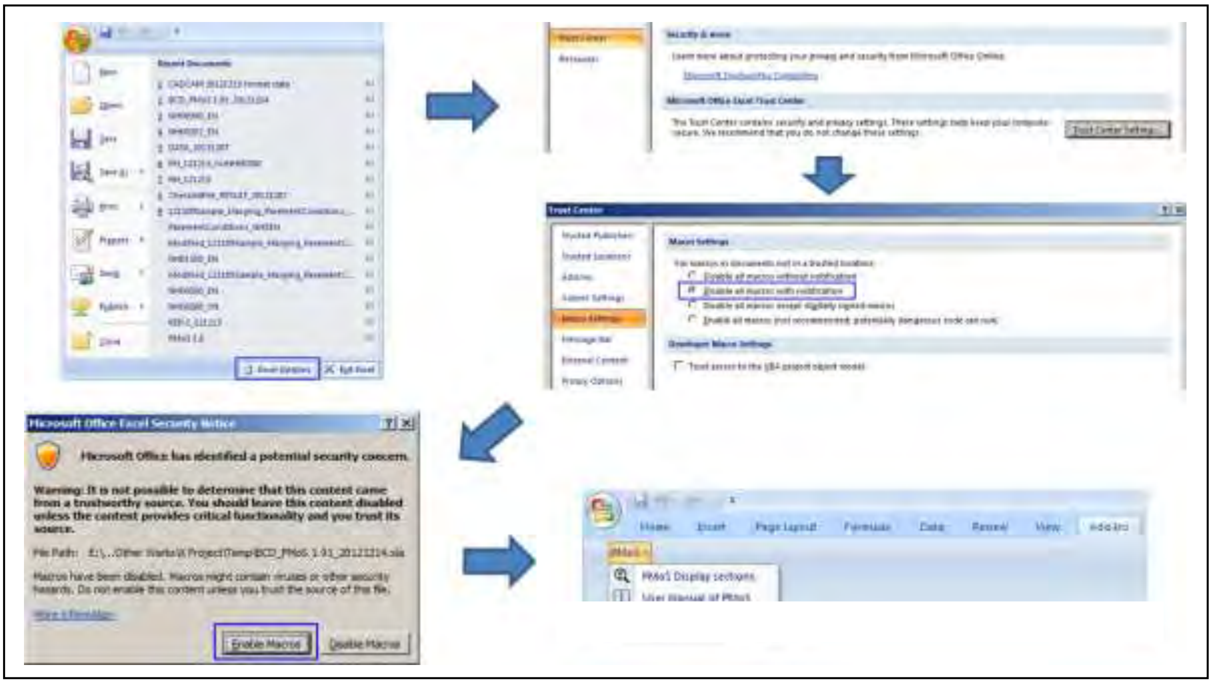

Figure 2.2.2 Setting of the Macro Security Level (Office 2007)

(1) Install Add-in

You can install PMoS software as MS Excel add-in by MS Excel option settings as shown below.

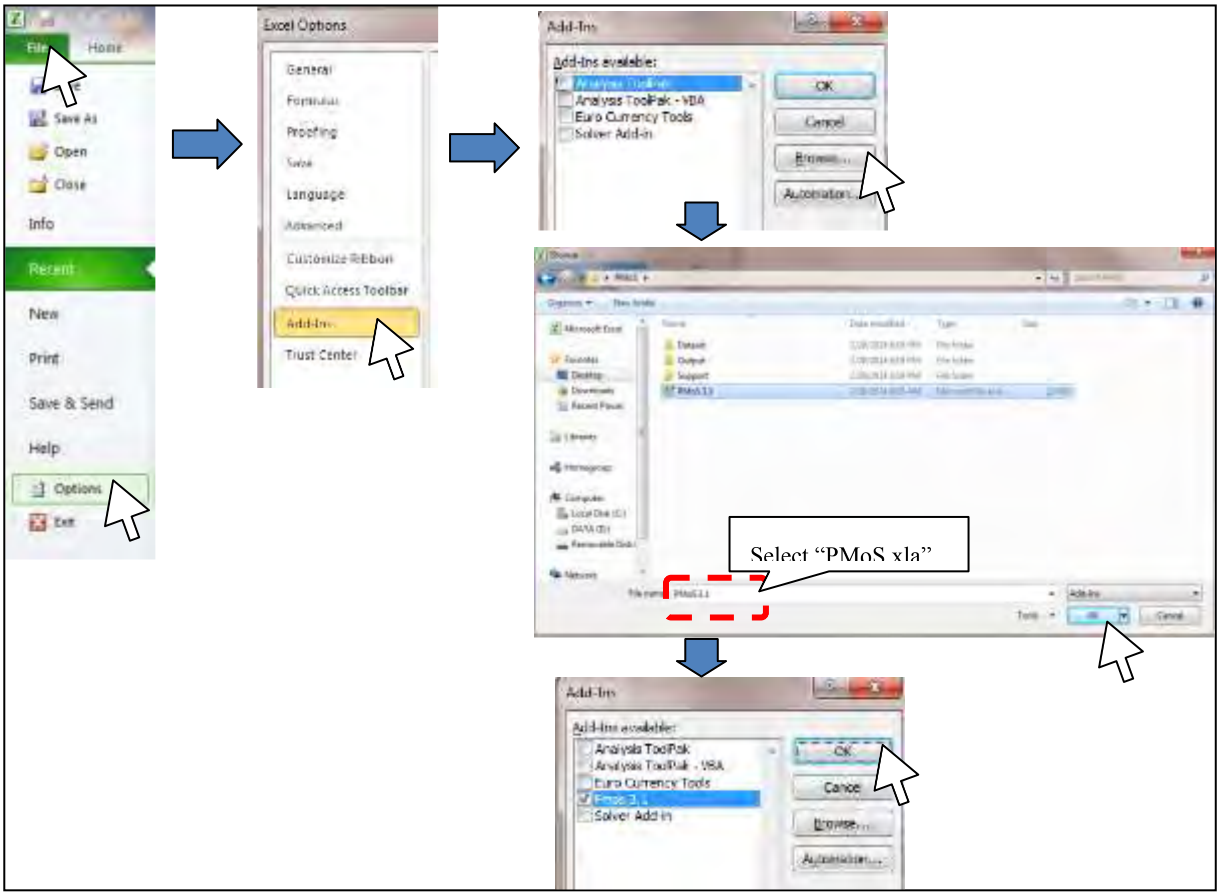

Figure 2.2.3 Installation of PMoS add-in (Office 2010)

CHAPTER 3 FUNCTION OF APPLICATIONS

3.1 FUNCTION OF CS

The function of the CS is to create integrated dataset from Road Database for PMoS software. Further descriptions are elaborated in CS user's manual.

3.2 PMOS DATASET

(1) PMoS Dataset Item

The CS creates PMoS datasets. PMoS dataset consists of Road Asset Data, Pavement Condition Data and Maintenance History Data. Detailed items are shown in following figure.

Road Asset Data													
Road ID	Road Name	Route No	Route Branch No.	Direction	Lane Position	Date of update	Location				Pavement type	Structure type	Crossing type
							from		to				
							Km	m	Km	m			
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**

Pavement Condition Data										
Road condition										
Year/month of survey	Crack Rate (%)				Rut Depth (mm)		IRI (mm)	FWD (μm)		
	Cracking	Patching	Pothole unrepaired	Total	Average	Maximum		Year/month of survey	D_{0max}	D_{150max}
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**

Maintenance History Data									
1st(2010)		2nd(2011)		3rd(2010)		4th(2009)		5th(2008)	
Repair Meth-od	Repair Classification	Repair Meth-od	Repair Classification	Repair Meth-od	Repair Classification	Repair Meth-od	Repair Classification	Repair Meth-od	Repair Classification
26	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**

Figure 3.2.1 Data Format of the PMoS Dataset

(2) PMoS Dataset Record

The data record of PMoS is created by 100m section basically. Actual length of each record depends on the pavement condition data.

3.3 FUNCTION OF PMOS SOFTWARE

The function of PMoS software is to visualize PMoS dataset. Actions of PMoS software are shown below;

1) Load PMoS Dataset

2) Display following information

2)-1 Road information

2)-2 Maintenance history

2)-3 Pavement condition

2)-4 Evaluation index for each factor such as IRI and Rut depth

3) Output

3.3.2 Legends of Visualization

(1) Road Asset Data

PMoS software visualizes structure type, crossing type and pavement type of road asset data.

1) Structure type

Structure type is classified into five (5) categories. In the case of blank data, it is regarded as "Embankment & Cutting".

id	EN_Value	VN_Value	Code	Color
	Structure Types			
1	Embankment & Cutting	Nền đắp & đào		
2	Bridge	Cầu	B	
3	Tunnel	Hầm	T	
4	Shade Fence	Lưới chống đá lở	R	
5	Other structures	Kết cấu khác	O	

2) Crossing type

Crossing type is classified into five (5) categories.

	Crossing Types			
1	Intersection	Nút giao	I	
2	Roundabout	Đảo xuyến	RA	
3	Viaduct	Cầu cạn	VD	
4	Railway Crossing	Vượt đường sắt	RC	
5	Toll Gate	Trạm thu phí	TG	
6	Others	Khác		

3) Pavement type

Pavement types are classified into seven (7) categories.

	Existing Pavement			
1	Asphalt Concrete Pavement	Mặt đường BTN	AC	
2	Asphalt Macadam	Đá dăm đen	AM	
3	Bituminous Pavement	Đá dăm thấm nhập nhựa	BP	
4	Cement Concrete	BTXM	CC	
5	Macadam Pavement	Mặt đường đá dăm nước	MP	
6	Aggregate Pavement	Mặt đường CPĐD	AP	
7	Earth Pavement	Mặt đường đất	EP	

(2) Maintenance history

Maintenance history is classified into nine (9) categories. Past three (3) year maintenance records are shown in output file.

	Repair Types of Maintenance			
1	Single Bituminous Surface Treatment	Láng nhựa 1 lớp	SBST	
2	Double Bituminous Surface Treatment	Láng nhựa 2 lớp	DBST	
3	Triple Bituminous Surface Treatment	Láng nhựa 3 lớp	TBST	
4	Bituminous Penetrated Macadam	Đá dăm thấm nhập nhựa	BPM	
5	Asphalt Concrete Overlay	Thảm tăng cường Bê tông nhựa	ASOL	
6	Structure Overlay (Replacement)	Tăng cường kết cấu (Thay thế)	SOL	
7	Gravelling Pavement Repair	Sửa chữa mặt đường đá sỏi	GPR	
8	Patching Repair Type	Vá mặt đường	PR	
9	Edge Break Repair Type	Sửa chữa vỡ mép mặt đường	EBR	

(3) Road condition

Road condition data consists of Crack, Rutting, IRI and FWD. Legend of Crack, Rutting, IRI and FWD are as shown below.

	Crack - Rutting - IRI			
1	Crack	Nứt		
2	Rutting	Hằn lún vệt bánh xe		
3	IRI	IRI		

	FWD	
1	D_{0max}	
2	D_{150max}	
3	$D_0 ≒ D_{150}$	

To evaluate each value, PMoS software sets criteria as diagnostic line in output file. The value can be changed by settings.

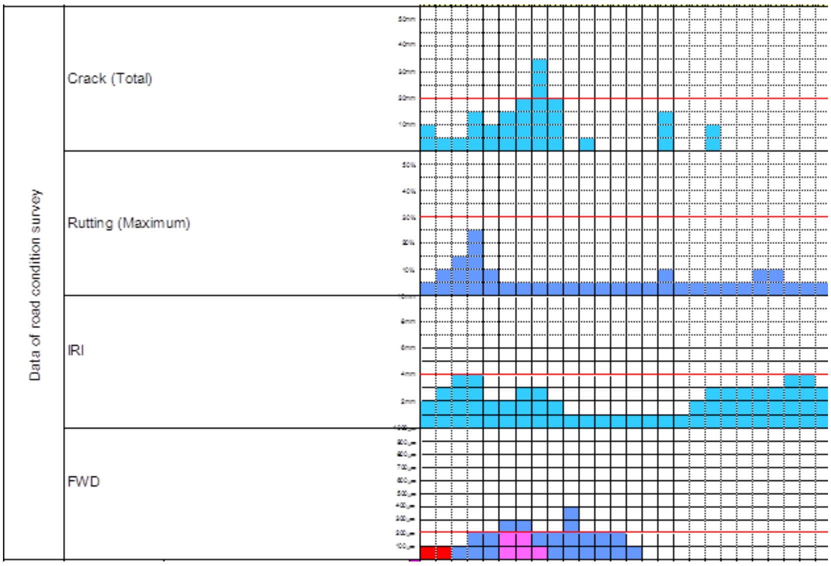

Figure 3.3.1 Road Condition Data in Output file (Image)

3.3.3 Output Format

Output file is processed in one sheet for 50 data records. Each sheet is formatted suitable for printing out in A4 size. In General, 50 records are equivalent to 5 km.

Information of each dataset unit, such as road name, route branch and location are recorded in the upper left in the sheet.

Road Name and Route No.	National Highway 3 -- 3	Location (From - To)	kM 0+0・kM 5+0
Route Branch No.	Main Road or Without Bypass :: Lane: D-1	Date Created	2013/9/10 15:52

3.3.4 Naming of PMoS Output File

PMoS software names its output file automatically with following naming rules. The output file is saved in the same folder of PMoS software.

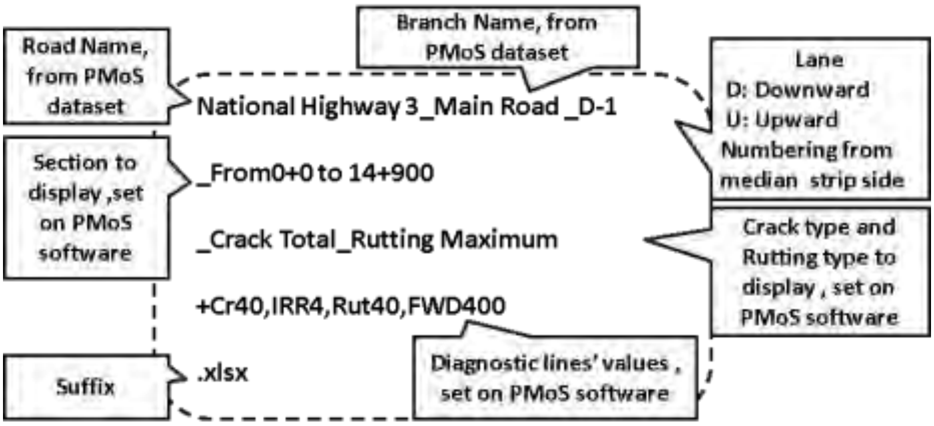

Figure 3.3.2 Naming Rule of PMoS Output File

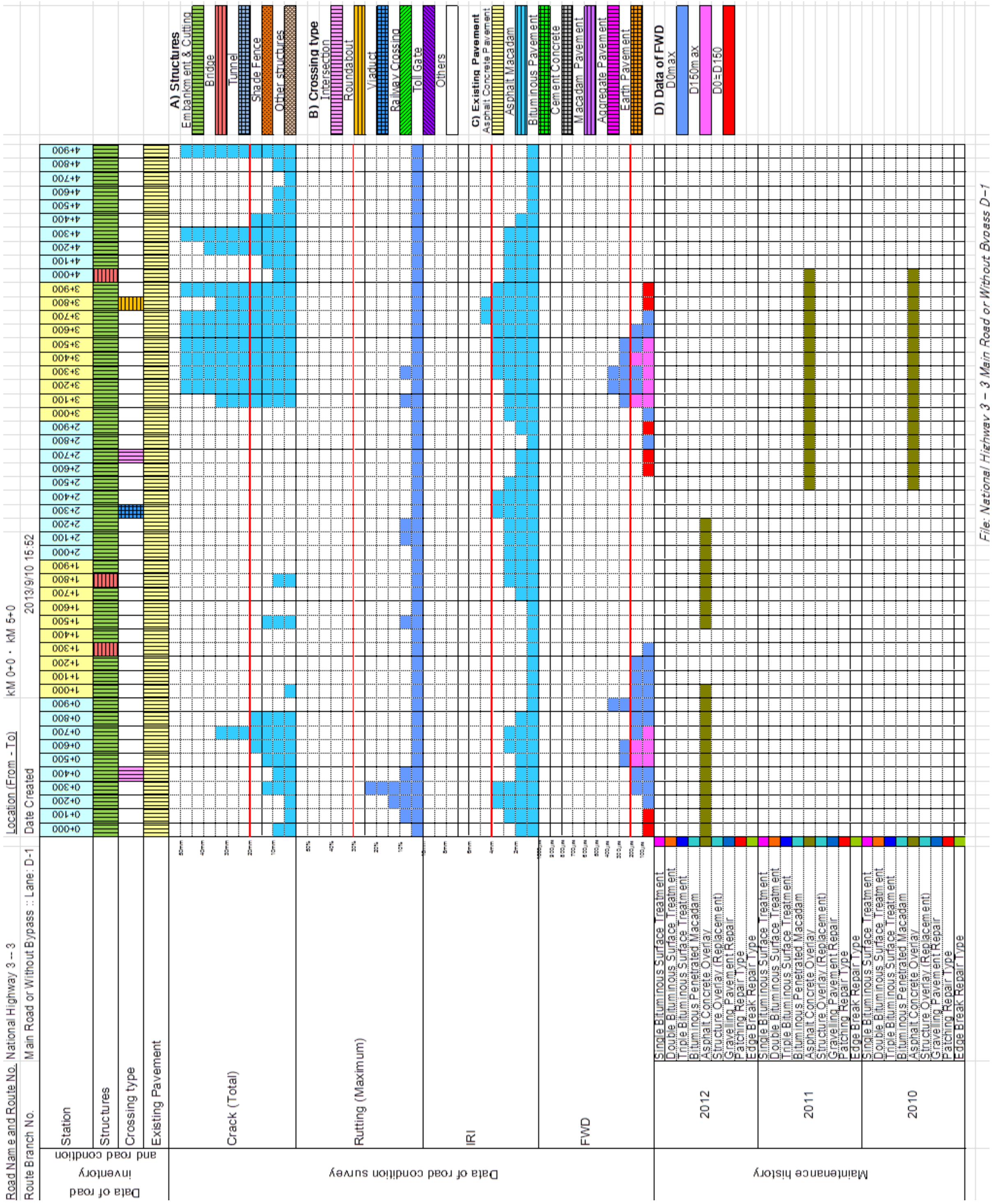

Figure 3.3.3 Output File Format (Image)

CHAPTER 4 PMOS OPERATION

4.1 PREPARATION OF PMOS DATASETS

PMoS visualize a PMoS dataset, prepared by CS. Operators shall prepare PMoS dataset first. The operation of CS is described in CS User's Manual.

4.2 OPERATION OF PMOS SOFTWARE

Start PMoS software by activating PMoS add-in or open PMoS.xla. If you close PMoS software, you can re-start it form add-in toolbar.

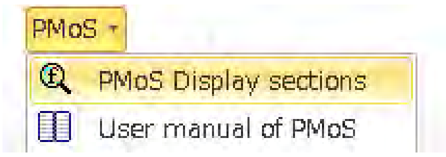

Figure 4.2.1 PMoS Add-in Toolbar

When you start the PMoS software, the following interface appears in the display. Set PMoS dataset and input setting.

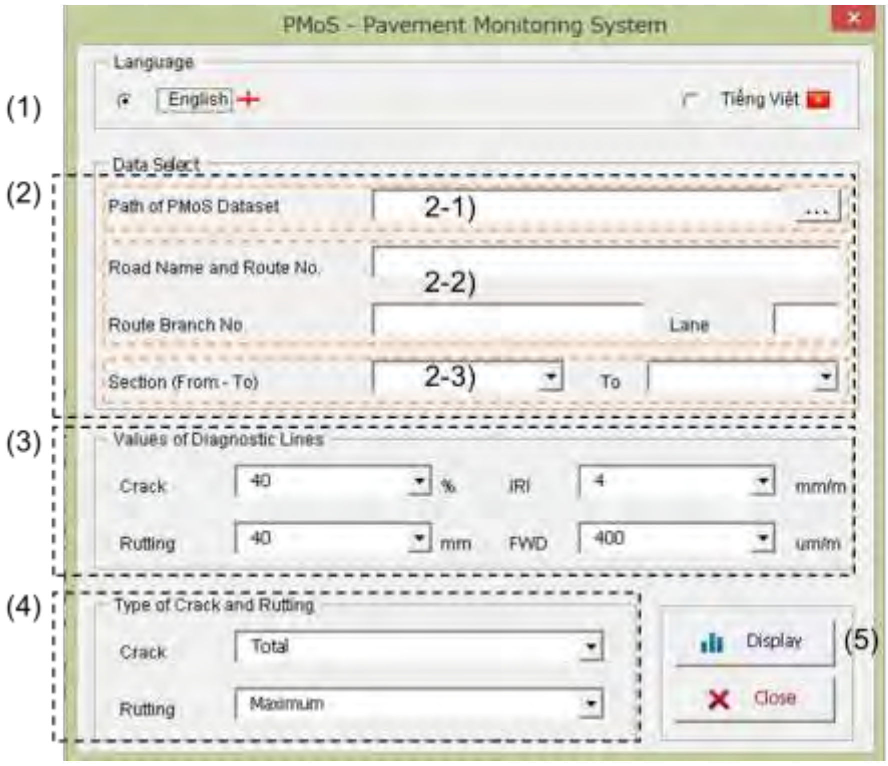

Figure 4.2.2 Interface of PMoS

(1) Select language

English and Vietnamese are available.

(2) Select Dataset for Visualization

2-1) Select PMoS Dataset

Select a PMoS dataset of designated route, branch and lane.

2-2) PMoS displays road information

Road name and branch No. and lane name from PMoS dataset.

2-3) Select sections to visualize

Select a section to display from pull-down menu.

(3) Select Values of Diagnostic Lines

Set values for diagnostics as for pavement management and maintenance criteria. Road name and branch No. are automatically displayed. Select the information for a lane and section from a pull-down menu.

(4) Select Types of Value for Crack and Rutting

Pavement condition data of "Crack" means crack ratio, which consists of crack ratio, patching ratio and pothole unrepaired ratio. Total of "Crack" is total of those three values. You can select among those values to display.

Pavement condition data of "Rutting" has two values of average and maximum. You can select one of them.

(5) Display of result

A result of the PMoS is displayed by pushing a "Display" button after inputting and selecting of all data.

4.3 ANALYSIS

You can arrange the values of diagnostic lines for each survey item depending on a condition and it shall be carried out in accordance with the revised standard for maintenance and repair works. It will help you to deicide a section which requires repair work and a method of repair work reference from the result of the PMoS.

CHAPTER 5 CONFIGURATION OF PMOS SOFTWARE

This system has been developed as MS Excel add-in by VBA of the MS Excel in order to ensure the ease of improvement and modification. This chapter shows the method for arrangement of each legend and some texts displayed.

5.1 SETTING OF SYSTEM SHEETS

a. In the opening PMoS (with Enabled VBA macros), press All + F11 to show VBA IDE (Visual Basic for Application Integrated Development Environment).

b. Choose This Workbook in VBA Project of PMoS.

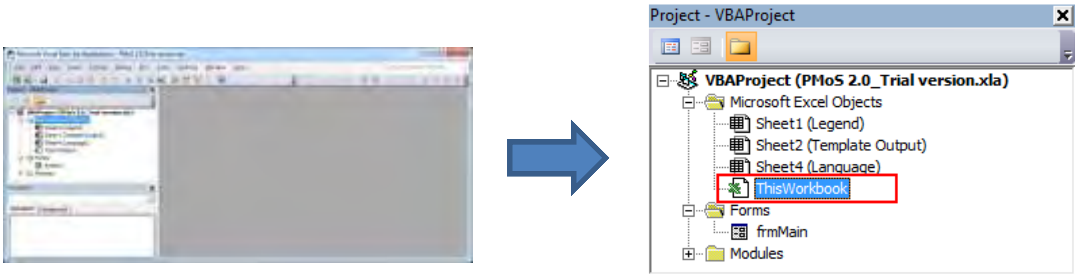

Figure 5.1.1 Flow of setting of the System Sheets

c. In Properties window, select the “IsAddin property”, and set it to” False”

d. As a result, the system sheets of PMoS will be shown in Excel as following image:

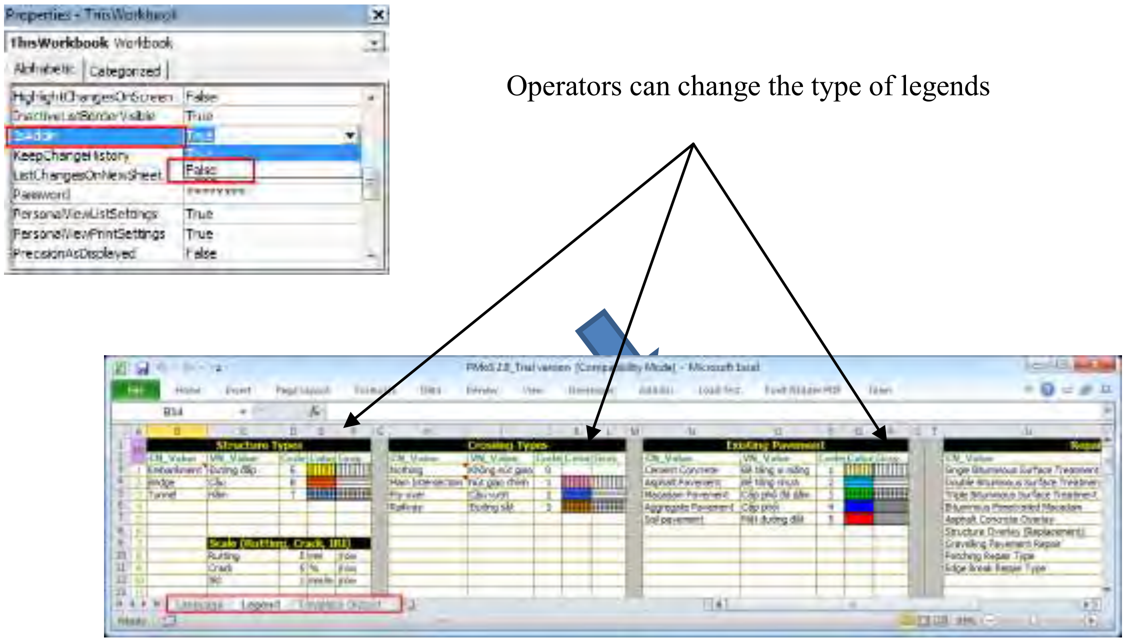

Figure 5.1.2 Flow of setting of the System Sheets

5.2 CONFIGURE LANGUAGE SHEET FOR TEXTS OF THE ITEMS

a. Select Language sheet, which is shown in Figure 5.2.1.

b. In the sheet, change the text of the item relating to component in PMoS window. There are two caption types corresponding to English and Vietnamese.

	Control Name	EN_Caption	VN_Caption
UserForm	fraLanguage	Language	Ngôn ngữ
	fraDataSelect	Data Select	Chọn dữ liệu
	labPath	Path of PMoS Database file	Đường dẫn đến File CSDL PMoS
	labRoadName	Road Name and Route No.	Tên đường và số hiệu tuyến
	labBranch	Route Branch No.	Số hiệu nhánh đường
	labLane	Lane Name	Tên làn
	labLocation	Location (From - To)	Đoạn tuyến (Từ - Đến)
	labTo	To	Tới
	fraLine	Values of Diagnostic Lines	Vị trí của đường phân tích
	labLineCrack	Crack	Nứt
	labLineRutting	Rutting	Lún vệt bánh
	labLineIRI	IRI	IRI
	labLineFWD	FWD	FWD
	fraType	Type of Crack and Rutting	Thông số Nứt và Lún vệt bánh để hiển thị
	labTypeCrack	Crack	Nứt
	labTypeRutting	Rutting	Lún vệt bánh
	btnDisplay	Display	Hiển thị
	btnClose	Close	Đóng

Figure 5.2.1 Window of Language Sheet

5.3 CONFIGURE LEGENDS

Select "Legend" sheet and arrange type of legend. PMoS software reads PMoS dataset and copies corresponding legend from this sheet, then past the format in proper cell of output sheet.

5.4 CONFIGURE OUTPUT TEMPLATE

Select "Template Output" sheet and arrange it. PMoS software copies this sheet and creates new output file.

5.5 SAVE REVISED DATA

a. Return VBA IDE

b. Choose "ThisWorkbook "in VBA Project of PMoS

c. In "Properties" window, select the "IsAddin" property, and set it to True

d. Save AddIn file

VOL. V

GUIDELINE
FOR
ROAD FACILITY INSPECTION

JAPAN INTERNATIONAL COOPERATION AGENCY
DIRECTORATE FOR ROADS OF VIETNAM
MINISTRY OF TRANSPORT (MOT)
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THE PROJECT FOR CAPACITY ENHANCEMENT IN ROAD MAINTENANCE IN THE SOCIALIST REPUBLIC OF VIETNAM

GUIDELINE FOR ROAD FACILITY INSPECTION

APRIL 2014

JICA PROJECT TEAM

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CHAPTER 1 BACKGROUND

Road maintenance and operation are to perpetuate road function by carrying out road inspection, cleaning, vegetation care, repair works, and accident and disaster restoration, thereby ensuring safe and healthy road conditions for the facility users. In addition, large-scale rehabilitation and reconstruction are also needed in order to upgrade road facilities and traffic functions in compliance with the changes in traffic conditions and road environments.

In order to ensure efficient and safe implementation of road maintenance operation, it is important to carefully identify the problems lying behind the current status of roads. Inspection works, therefore, play an important role not only in clarifying problems, but also in sending information and data to the planning systems needed for the planning of road maintenance and operation.

With this concept, the Project decided to develop road facility inspection technical standards in cooperation with WG 3.1. However, standardization of road facility inspection technology is quite new to the existing Specification of Road Routine Maintenance Standard, so that more in-depth discussion was expected before incorporating it into technical standards rather than the development of road routine maintenance manual. It was therefore agreed between both partied to develop a road facility inspection guideline for national highway maintenance.

Following this agreement, discussion was first carried out with the working group members on the framework of the road facility inspection guideline. Based on the framework, the draft guideline was then developed through 2 and half years of discussion.

This main report explains the framework of this road facility inspection guideline. The Road Facility Inspection Guideline developed in this study is attached in the "Manual and Guideline" edition. The Road Facility Inspection Guideline also includes the following materials;

(a) Standard Samples for Bridge Inspection & Evaluation

(b) Inspection Guideline of Inspection for Bridges & Other Facilities

CHAPTER 2 OBJECTIVES OF ROAD INSPECTION

The objectives of road inspection are to survey the current status of road conditions, to identify road and traffic problems and to obtain information and data for planning maintenance and operation plans following the principles of road maintenance and operation.

Major roles and functions of road inspection are shown below;

(a) To inspect current status of road facilities and identify defects and deteriorations;

(b) To diagnose the progress of defects and deteriorations;

(c) To plan road maintenance and repair work plans;

(d) To register inspection data into data bases

CHAPTER 3 CURRENT INSPECTION PRACTICES IN DRVN

(1) Road Inspection

Outline of current road inspection is shown in **Table 3.1.**

Table 3.1 Outline of Road Inspection

Road Structures	Names of Inspection	Frequencies	Implementation bodies	Inspection Points
A. Roads & Structures	Routine Inspection	Once a day	Road Patrol, RRMCs	
	Periodic Check	Monthly	RRMCs, Repair Team	Pavement Surface, Drainage system, Road Signals, Dikes, etc.
		Quarterly	RRMU/PDOTS, RRMCs	
	Special Check		RRMUs/PDOTs	Pavement & Sub-grade Strength, Evenness
B. Bridges	Routine Check		Repair team, Technicians	Bridge deck, Beams, Bearings, Abutments, Piers
	Periodic Check	Twice a year: Before and after rainy season	RRMUs/PDOTs	Erosion, scour of piers etc.
	Unscheduled Check	Unscheduled As required	VRA, RRMUs/PDOTs, RRMCs	Bridge defects and damages
	Special Check		RRMUs/PDOTs	Subgrade in soft soil or sliding curb, Strength of Pavement, Bridge
	Bridge Inspection	Initial inspection; To record initial status of structures before traffic operation.	RRMUs/PDOTs	Whole bridge
		Follow up inspections; 10 years later, then 5-7 year intervals	RRMUs/PDOTs	Whole bridge

Source: "Technical Standards on Road Routine Maintenance", May 28, 2003, MOT.

Table 3.2 Traffic Counting

Traffic Categories	Counting stations	Frequencies	Counting time
Primary station (High traffic sections)	30 – 50 km intervals, Ferry, Floating Bridge, Toll places	Once per month 5th, 6th, 7th of each month	1st day: 5:00-21:00 2nd day; 5:00-21:00 3rd day; 24 hours
Secondary station (Low traffic sections)	50 – 100 km intervals		

Source: "Technical Norm on Road Routine Maintenance", May 28, 2003, MOT

CHAPTER 4 PROBLEM IDENTIFICATION

The following are the problems identified.

(a) Road and bridge inspections have been carried out in accordance with the Technical Standards 2003. It prescribes the inspection procedures including inspection classification, inspection organizations and frequencies of inspections, but little about the details of inspection points and measurements, i.e. how to inspect and where to inspect. A guideline showing information on the inspection points and measurements using simple figures and tables will be needed.

(b) Routine and periodic inspections have been carried out by the staffs belonging to maintenance companies and RRMUs/PDOTs. Of these inspections, the periodic inspection often requires high engineering knowledge and expertise in performing the inspection and in making diagnosis of the structural deterioration. It is very important to incorporate professionalism and objective views into the periodic and the special inspections.

(c) Upon completion of road inspections, diagnosis of road structure deterioration is carried out to make a judgment on the extent of damages, followed by the selection of repair works. However, the diagnosis has been commonly done based on the engineer’s experience and judgment due to the lack of appropriate guidelines. There is no guideline available for diagnosis except for the one on pavement structures.

(d) Some regional agencies are said to have set out their own criteria for diagnosis, although further details were not confirmed. In general, criteria preferably to be incorporated in the diagnosis guideline should include; (1) conformity with design standards, (2) extent of deterioration, and (3) impact on socio-economy or nearby areas.

(e) Selection and prioritization of repair places and work types has been done mainly based on the engineer’s experience and judgment because of lack of appropriate standards. Also, under the current budget constraints, the selected works are basically the reactive maintenance works.

CHAPTER 5 OVERSEAS PRACTICES – ROAD MAINTENANCE PRACTICES IN JAPAN

(1) Current Status of Road Network in Japan

Total length of the road network in Japan was 1,210,251 kilometres in April 2010.

Of which, national roads, consisting of 22,787 kilometre sections are directly managed by MLIT and 31,949 kilometre sections are committed to prefecture governments, as shown in **Table 7.1-3.**

Expressway networks consisting of 7,802 kilometres nationwide are operated by expressway companies which were privatized in 2005. There are three expressway companies founded by the Government which are charged with inter-city expressway management. In addition, the Government founded three other expressway companies charged with metropolitan expressway management centring around Tokyo and Osaka, and Honshu-shikoku expressways. However, Legal status of the later three expressways are the national or prefectural roads, but are operated as toll roads. Table 7.1-3 shows high standard road networks in Japan.

Table 5.1 Road Network in Japan

Class	Length (km)	Maintenance and Operation
Expressways	7,802	Expressway companies
National Roads	54,981	
1. Designated sections	22,787 (42%)	MLIT
2. Non-designated sections	31,949 (58%)	Prefecture Governments
Prefecture Roads	129,366	Prefecture Governments
Municipal Roads	1,018,100	Cities, Towns and villages
Total	1,210.251	

(Note) Road length; as of April 1st, 2010, MLIT data

Breakdown of National roads: from Road Statistics 2008.

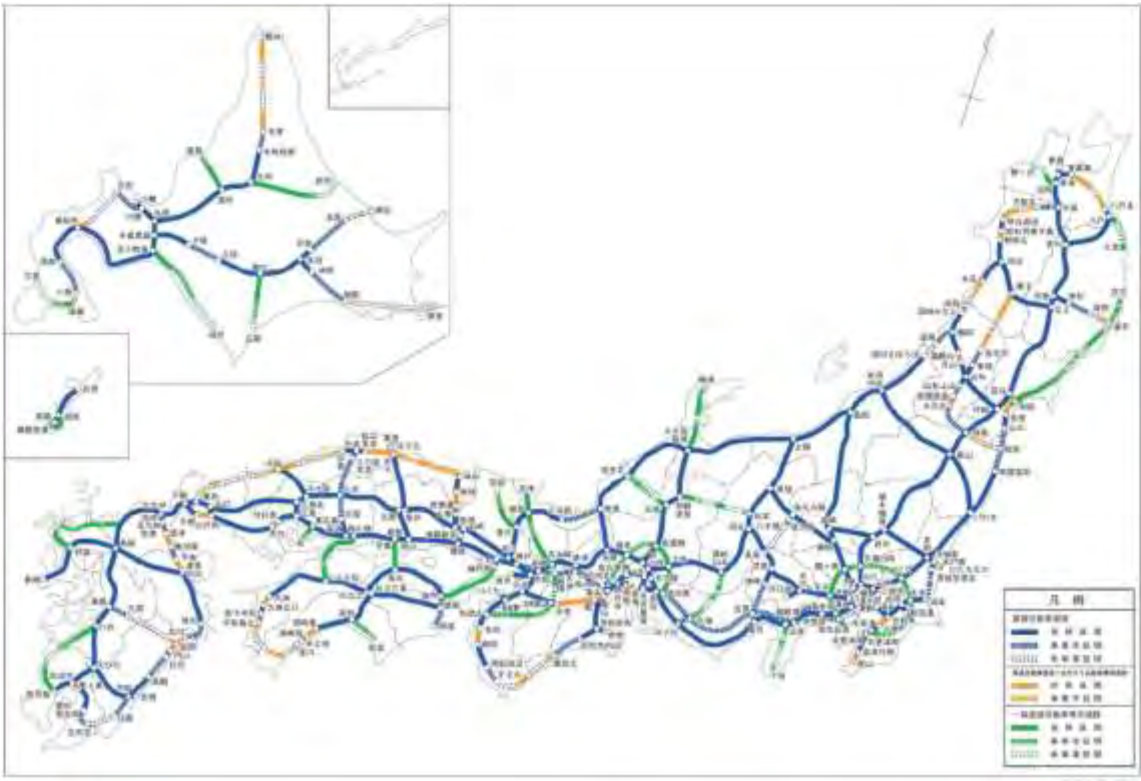


Figure 5.1 High Standard Road Network in Japan

(2) Road Infrastructures in Japan

1) Bridges

Table 5.2 shows the number of road bridges on the road network in Japan. There are 676,742 bridges on the road network, consisting of 148,223 bridges over 15 metres long and 17,643 bridges over 100 metres. Of these, 19,995 bridges have been directly managed by MLIT.

Table 5.2 Bridge Infrastructure

Class	All Bridges		Bridges over 15 m		Bridges over 100 m	
	Number	%	Number	%	Number	%
● Expressways	7,427	1	6,402	4	2,928	17
● National Roads (Designated)	19,995	3	10,794	7	3,191	18
● National Roads (Non-designated)	29,946	4	12,778	9	2,220	13
● Prefecture Roads	100,273	15	32,516	22	4,941	28
● Municipal Roads	519,101	77	85,733	58	4,363	25
Total	676,742	100	148,223	100	17,643	100

(Source) MLIT 2005 data.

2) Tunnels

Table 5.3 shows the number of road tunnel infrastructure on the road network. There are 8,784 tunnels on the road network, consisting of 1,777 tunnels over 500 metres long and 706 tunnels over 1,000 metres. Of these, 1,129 tunnels have been directly managed by MLIT.

Table 5.3 Road Tunnel Infrastructure

Class	All Tunnels		Tunnels over 500 m		Tunnels over 1,000 m	
	Number	%	Number	%	Number	%
● Expressways	739	8	428	24	235	33
● National Roads (Designated)	1,129	13	357	20	146	21
● National Roads (Non-designated)	2,213	25	526	30	192	27
● Prefecture Roads	2,346	27	360	20	111	16
● Municipal Roads	2,357	27	106	6	22	3
Total	8,784	100	1.777	100	706	100

(Source) MLIT 2005 data.

(3) National Road Maintenance and Operation by MLIT

Forty two percent of the national highways, 22,787 kilometres are directly managed by MLIT as designated sections**.** Figure 5.2 shows the organization structure of MLIT. Under the headquarters in Tokyo, there are eight regional bureaus stationed in major cities in the regions. Regional bureaus play the role of project owner and undertake road maintenance and repair work contracts with private companies including approval of design change, inspection and payment to contractors.

Under the regional bureaus, there are construction offices and maintenance offices. However, maintenance and repair field works have been outsourced to private companies, so that the main responsibility of these maintenance offices is to supervise maintenance and repair works carried out by private companies.

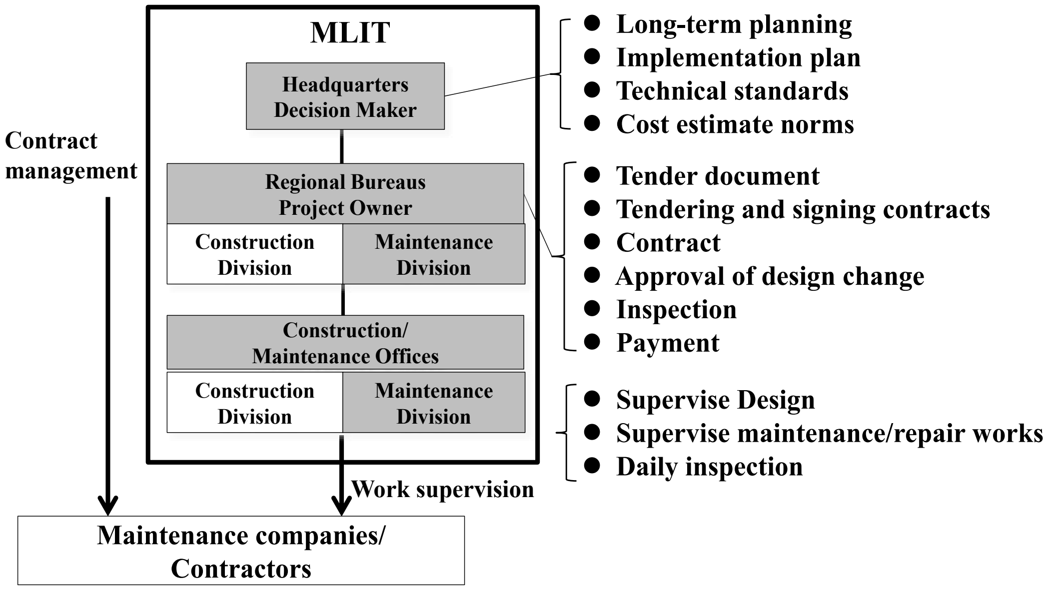


Figure 5.2 MLIT Organization Structure

(4) Maintenance and Repair Budgets for the National Road Network under MLIT Management

Figure 5.3 illustrates maintenance and repair budgets for the national roads under MLIT management. There used to be an over 2,000 billion Yen budget for maintenance and repair works for the national roads, but the budget allocation has recently declined to 70 percent of that level, 1,400 billion Yen, being influenced by the recent staggering economy.

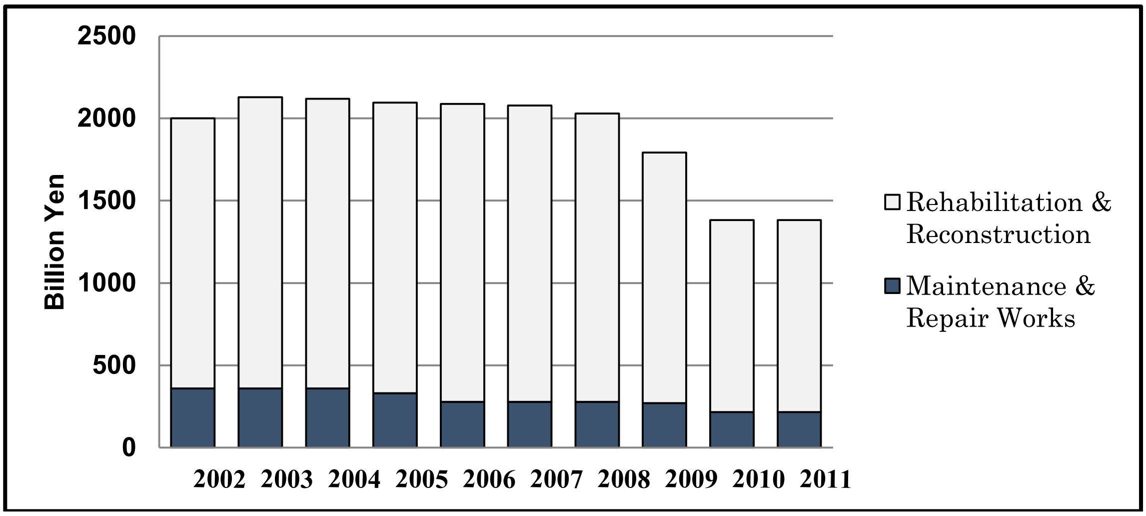


Figure 5.3 Road maintenance and repair budget for MLIT national roads

In addition, Figure 5.4 shows the shares of budget expenditures. Of the 2011 year budgets, 55 percent were spent on repair works and 45 percent were on maintenance budget. Of the maintenance expenditures, 28 percent of the budgets were spent on urgent repairs for natural disasters and vehicle accidents, followed by facility maintenance, 22 percent. On the other hand, breakdown of repair works indicates that 70 percent of repair work budget were spent on medium and large repair works.

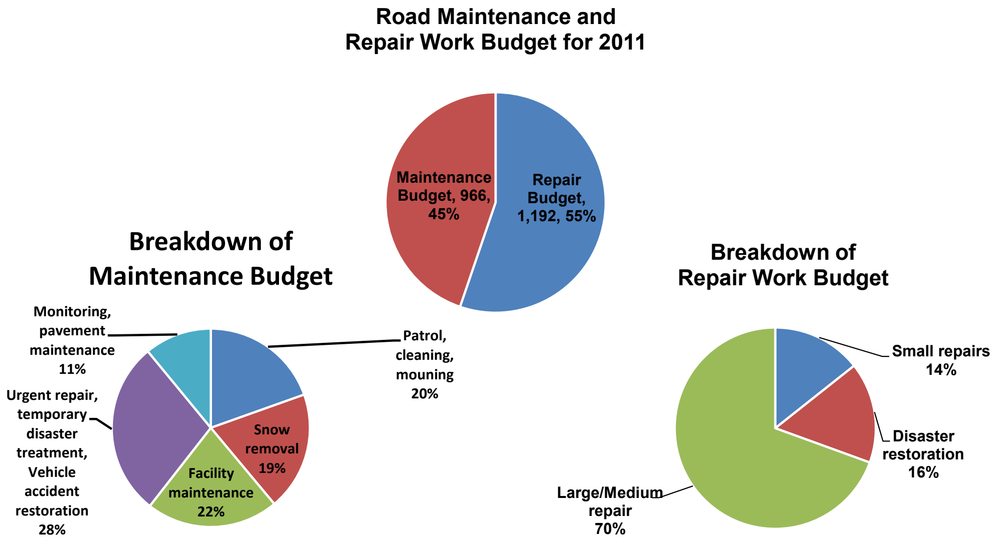


Figure 5.4 Maintenance and Repair Budgets for MLIT National Roads

(5) Inspection Manual for National Road Maintenance

MLIT standardized road inspection manuals by structure types as shown below:

- Bridge Periodic Inspection Manual
- Road Tunnel Periodic Inspection Manual
- Road Electric Facility Inspection Manual
- Road Management Facility Inspection Manual

MLIT plays a leading role in standardizing maintenance and inspection manuals and distributing them to the relevant road administrators in the regions. Standardization has been applied to not only maintenance and inspection manuals, but also construction work specifications which are parts of contract dossiers. Maintenance and inspection manuals are, in general, compulsory for MLIT including relevant ministerial level organizations, but not for road administrators in the regions. They are allowed to develop their own manuals, but in reality they tend to follow MLIT standards.

Currently, MLIT focuses more on the enhancement of bridge maintenance and repair technology as the aging of bridges progresses. The concept of asset management is applied to the national road assets, trying to find the best timing for investments for maintenance and repair works and to minimize life-cycle costs of road facilities, in particular bridges and road pavements. R & D on new technologies which aim to prolong facility life-cycles have been intensively carried out by its research institute in cooperation with private sectors.

The major components in the bridge inspection manual are as follows;

- Bridge members to be inspected
- Typical defects and deterioration to be focused on in the inspection
- Standard inspection measures
- Selection of inspectors
- Criteria for the diagnosis of the results of inspection
- Criteria on whether to implement repair works.
- Criteria on the need for additional surveys
- Registration of inspection data into databases.

(6) Typical Defects and Deterioration by Materials

MLIT inspection manuals in general show typical defects and deterioration by the types of materials to be particularly focused on during the inspections as shown in Table 5.4.

Table 5.4 Typical Defects and Deterioration by Materials (Bridge Inspection)

Material	No.	Defects & Deterioration	Material	No.	Defects & Deterioration
Steel	A1	Corrosion		C2	Pavement roughness
	A2	Cracks		C3	Pavement abnormality
	A3	Looseness, Falling		C4	Unusual pavement
	A4	Rupture		C5	Shoe functional defects
	A5	Deterioration of anti-corrosion	Common	D1	Abnormality at Anchorage zone
Concrete	B1	Cracks		D2	Change in colour, deterioration
	B2	Steel bar exposure		D3	Water leakage
	B3	Water leakage		D4	Unusual sound/vibration
	B4	Break off		D5	Unusual deflection
	B5	Damages to reinforcement		D6	Deformation, loss of members
	B6	Floor Deck Cracks		D7	Clogging
	B7	Creep, Voids		D8	Settlement, movement
Others	C1	Unusual expansion gaps		D9	Scouring

(7) Typical Defects and Deterioration by Facility Members

They also show facility members to be focused on and their typical defects and deterioration as shown in Table 5.5.

Table 5.5 Typical Defects and Deterioration by Facility Members (Bridge Inspection)

Facilities	Members	Points to be inspected		
		Steel	Concrete	Others
Pavement	Road surface			Roughness, Cracking, Rutting, Structural capacity
Bridges	Superstructure	A1-A5, C1, D1, D4-D6	B1-B7, C1, D1-D6	
	Substructure	A1-A5, D4-D6	B1-B3, B5, B7, D1-D6	
	Bearing	A1-A5, C4, D3,		

		D4-D8		
	Road surface	A1-A5, D6, C1, C2, D6,D7	B1-B3, B7, D2, D6	
	Drainage system	A1, A4, A5, D2, D3, D6, D7		
Road facilities	Lighting, Traffic signs	A1-A5, D2, D6		

(8) Inspection Manual for Expressway Facilities

Inspection manuals have been developed by expressway companies. Fundamental ideas of inspection are basically the same as those for national roads. However, the expressway facility inspection manual covers the points of inspection for the following eight facilities as shown in **Table** 5.6.

Table 5.6 Expressway Facility Inspection Manual

No.	Facilities	Focus Points
1	Road pavements	Pavement, slopes, road surface drain facilities
2	Slopes	Slopes, masonry works, retaining walls, ground anchors, debris and avalanche prevention measures, slope drain facilities
3	Bridges	Steel bridges, concrete bridges, substructures, concrete floor slabs, bearings, expansion joints, railing, inspection gallery, drain facilities, bridge falling prevention systems
4	Tunnels	Lining works, portals, interior plates, ceiling plates, drain facilities, pavement
5	Culverts	Concrete culverts, corrugated pipe culverts
6	Traffic safety facilities	Guard fences, headlight blinding prevention plates, passenger fall protection nets provided around median strips, passenger fall protection fences
7	Traffic management/ control systems	Traffic signs, CMS, pavement surface markings, road edge marker posts, distance markers
8	Other facilities	Noise barriers, snow protection, drain facilities adjacent to service roads and other roads

CHAPTER 6 RECOMMENDED FRAMEWORK FOR NATIONAL ROAD INSPECTION IN VIETNAM

The following form the framework of the national road inspection manual recommended by the JICA Project team. Each of the following subjects is elaborated hereafter in this working paper. The framework will be reviewed and modified in accordance with the discussion with the WG (3) counterparts, before further developing the DRVN road inspection manual.

- Definition of road inspection
- Road inspection methods
- Frequencies of road inspection
- Diagnosis of inspection results
- Selection of maintenance and repair works
- Maintenance and repair work data registration
- Inspection party and eligibility of inspectors
- Targeted facilities to be standardized in the inspection manual

CHAPTER 7 DEFINITION OF ROAD INSPECTION

Basically, the current DRVN technical standards are already equipped with the fundamentals of road inspection, so that improvement based on current inspection system fundamentals is recommended. The following are the categories of road inspections recommended by the Project Team;

(1) Initial Inspection

- ✓ Initial inspection is intended to thoroughly survey the initial status of road facilities upon completion of construction.
- ✓ Initial inspection needs to be done within two years after the opening of road facilities to the public, since it is known that initial defects come to surface within two years after the opening.
- ✓ The inspection should be carried out with short distance visual inspection.

(2) Routine Inspection

- ✓ Routine inspection is a daily inspection to quickly find any unusual incidents and defects on the roadway.
- ✓ It generally consists of on-board visual inspections and hammering tests.

(3) Periodic Inspection

- ✓ Periodic inspection is to survey damages to road facilities, including deterioration and defects, to evaluate them in comparison with predetermined judgment criteria, to select the most suitable repair methods for the damages and to preserve data in relevant databases. For these reasons, it is carried out at a fixed interval.
- ✓ The survey and diagnosis are in principle done for the main parts of structures.
- ✓ The periodic inspection provides base information for the planning of road maintenance and repair works.

(4) Unscheduled Inspection (Special Inspection)

- ✓ Unscheduled inspection is generally carried out in order to supplement the above inspections and to cope with emergencies, such as unusual weather, traffic accidents and natural disasters.

(5) Survey and Design (or Detailed Inspection)

- ✓ Survey and design is to further specify causes of structural defects or to evaluate the performance of expected repair works, when making a judgment on whether repair works are indeed effective, so that survey and design is, in general, carried out anytime required by the above-mentioned periodic inspection.

- ✓ Another objective of survey and design is to provide information for rehabilitation and reconstruction works. In particular, F/S, basic designs and technical designs need to be prepared for reconstruction works which include upgrading of facility functions. Also, technical designs are to be prepared for rehabilitation works intended to replace facilities without functional upgrade.

CHAPTER 8 INSPECTION METHODS

Outline of inspection methods are as follows.

Table 8.1 shows the types of inspection and the types of inspection method.

(1) On-board Visual inspection

On-board visual inspection is carried out by the maintenance staff in the patrol vehicles, so that it has a wide coverage in a short time period, but viewpoints are fairly limited. When detecting unusual incidents, maintenance staffs are requested to get out of their cars and to clarify the incidents.

(2) Distance View Inspection

This is a method of visual inspection from a distance and by getting out of the vehicle.

(3) Short-distance Visual Inspection

Using a pathway or scaffolding to check the status of the structure by visual observation or with binoculars close to the structure is a method of detection. In addition, it may employ a simple machine, equipment, etc. as required.

(4) Hammering

This is also a short distance inspection by listening to the sound of hitting the target structure with a hammer to determine the deterioration level of the structure (peel, creeping, loosening of bolts, etc.)

(5) Measurement with Non-destructive Equipment

Table 8.1 Inspection Methods by Type

Inspections & Surveys	Inspection methods
1. Initial Inspection	● Short-distance visual inspection ● Hammering inspection ● Pavement condition survey vehicle (for road pavement inspection)
2. Routine Inspection	● Vehicle on-board visual inspection, in principle. ● If anything unusual is detected, inspectors are requested to get out of the car and implement short-distance visual inspections to find the causes of incidents and the extent of damages.
3. Periodic Inspection	● Pavement condition survey vehicle (for road pavement inspection) ● Short-distance visual inspection ● Hammering inspection, Crack gage, measuring tape ● Non-destructive test equipment ● Photos
4. Unscheduled Inspection	● Short-distance visual inspection
5. Survey and design or Detailed Inspection	● Same as above

(Source) Project for capacity enhancement in Road Maintenance in Vietnam

CHAPTER 9 INSPECTION FREQUENCIES

(1) Recommended Inspection Frequencies

The JICA study team recommended the inspection types and frequency as shown in **Table** 9.1

Table 9.1 Inspection Frequencies

Inspections & Surveys	Frequencies
1. Initial Inspection	● Within 2 years or within the warranty periods specified in the construction contract dossiers after the opening of facilities to the public
2. Routine Inspection	Inspection frequencies are based on traffic volumes; ● More than 10,000 vehicles per day; every day ● Less than 10,000 vehicles per day; every other day
3. Periodic Inspection	Inspection frequencies are, in principle, as follows; ● Pavement condition survey; Once every 3 years ● Bridges/Tunnels; Once every 5 years ● Road safety facilities and road management facilities: Once every 10 years (Note) 1. However, if the facilities are once rated as "C" in the diagnosis of the periodic inspection, the next inspection should be carried out no later than two years after the previous inspection. 2. Also, if the facilities are once rated as "D" or "E" in the diagnosis of the periodic inspection, the inspection should be carried out no later than one year after the previous inspection. 3. However, upon completion of repair works, original frequencies stated above are applied for the above two cases.
4. Unscheduled Inspection	● Immediately after disasters
5. Survey and design or Detailed Inspection	● As requested by periodic inspection, rehabilitation and reconstruction

CHAPTER 10 DIAGNOSIS OF INSPECTION RESULTS

(1) Diagnosis Criteria

Table 10.1 Diagnosis Criteria

Rating	Diagnosis Criteria	Degree of Damages	Impact on functions	Impact on environment	Need of repair works (Urgency)	Measures
A	・ No damage or minor damages are identified.	Small	Small	-----	Low	・ No repair works
B	・ Medium damages are identified. ・ Serious progress of damages is not anticipated within coming 5 years. ・ Repair works are needed, but not urgent.	Medium	Medium	-----	Medium	・ Further survey ・ Planned maintenance /repair works (*1)
C	・ Medium to large damages are identified ・ Progress of damages is anticipated within coming 5 years. ・ Repair works are needed within 5 years.	Medium-large	Medium-large	-----	Medium	・ Further survey ・ Planned maintenance /repair works
D	・ Large damages are identified. ・ Structure functional deterioration is large. ・ Urgent repair works are needed.	Large	Large	-----	High	・ Urgent repair works
E	・ Large impacts on environment or road users are anticipated.	-----	-----	Large	High	・ Urgent repair works

*(Note) (*1): Planned maintenance and repair works means strategic and preventive works based on life-cycle cost analysis.*

CHAPTER 11 SELECTION OF MAINTENANCE AND REPAIR WORKS

The Project conducted a current status survey on pavement repair works employed in the past for the national road maintenance in Vietnam. Based on this survey, the Project developed the framework of the selection of pavement repair works and then the repair work selection algorithm for road pavement based on the framework as shown in **Table** 11.1**.**

(1) Algorithm of pavement repair work selection

(a) Standard repair works shown in the table are simply explaining standard repair works in designing annual repair plans. However, due to data limitation to develop algorithm, it is recommended to conduct a field study, to re-examine the standard repair works shown in the table and to conduct a detail design before implementing repair works if needed.

(b) Pavement repair works will be applied to the sections with MCI <= 5.0.

(c) When CR < 5%, no repair work will be applied in principle. However, as rutting depth progresses and heavy vehicle traffic increases, surface treatment and overlay works need to be implemented.

(d) When 5 % <= CR < 35 %, overlay works will be applied, however, cut & overlays will be applied to the heavy traffic volume sections.

(e) When CR progresses up to 35 % <= CR < 50 %, cut and overlays will be applied in order eliminate the damaged depth of pavements,.

(f) When 50 % <= CR, big repair works including Surface and Binder replacement, whole pavement layer replacement and Subgrade replacement will be applied. Big repair should be based on engineering calculation based on technical standards.

(g) Interval time since last repair to the new repair works, which is stipulated in Circular 10, will be examined manually on the basis of the outputs of this module.

(h) In the sections in the urban area with heavy traffic and heavily deteriorated pavement, cut and overlay will be applied in principle. Simple overlay will be applied to other sections.

(i) Prioritization in implementing repair works will be set based on MCI values.

(2) Definition of terminology shown in the table

· No repair	Repair works are not needed, but pavement monitoring needs to be continued
· Surface treatment	Routine maintenance, reactive maintenance siming to recover road pavement serviceability
· OL	New pavement layer will be placed on the existing pavement.

· Cut and overlay	New pavement layer will be places after cutting pavement deterioration to the specified depth.
· Surface and binder replacement	Pavement surface including binder are to be replaced. Design of this repair work should be made on structural design on the basis of technical standards.
· Whole layer replacement	Pavement whole layers are to be replaced. Design of this repair work should be made on structural design on the basis of technical standards.
· Subgrade replacement	Pavement and subgrade are to be replaced. Design of this repair work should be made on structural design on the basis of technical standards.

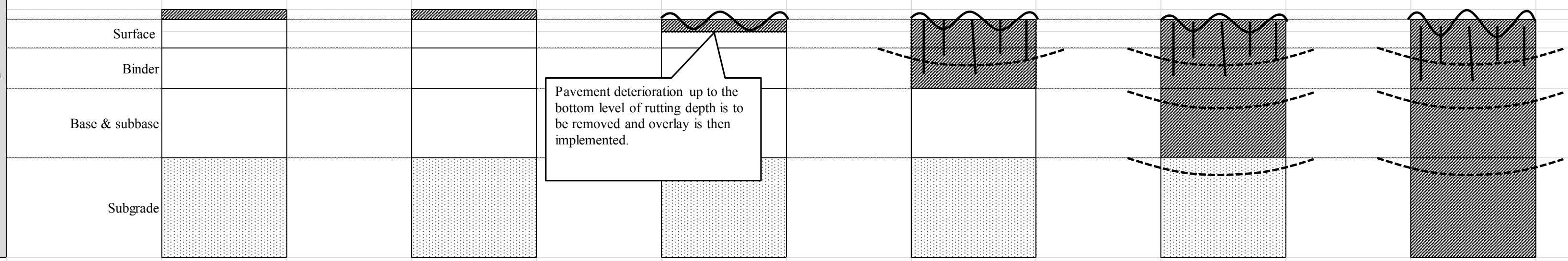
Table 11.1 Standard Repair Works for Asphalt Pavement Concrete (AC) to be applied to Road Class-I, II and III

Rutting Depth			Light defects				Medium defects				Heavy defects			
			Rutting Depth < 25 mm				25 mm <= Rutting Depth < 40 mm				40 mm <= Rutting Depth			
Traffic Volume (Heavy Vehicle: AADT)			TV < 100	100 <= TV < 250	250 <= TV < 1,000	1,000 <= TV	TV < 100	100 <= TV < 250	250 <= TV < 1,000	1,000 <= TV	TV < 100	100 <= TV < 250	250 <= TV < 1,000	1,000 <= TV
Crack rate (CR)	Light defects	CR < 5 %	No repair				No repair			Cut and OL 50 mm	OL 30 mm	OL 30 mm	OL 50 mm	Cut and OL 50 mm
		5 % <= CR < 15 %	No repair		Surface treatment		OL 30 mm	OL 30 mm	OL 50 mm	Cut and OL 70 mm	OL 50 mm	OL 50 mm	OL 50 mm	Cut and OL 70 mm
	Medium defects	15 % <= CR < 35 %	OL 30 mm	OL 50 mm	OL 50 mm	Cut & OL 70 mm	OL 50 mm	OL 50 mm	OL 70 mm	Cut & OL 70 mm	OL 50 mm	OL 50 mm	OL 70 mm	Cut and OL 70 mm
	Heavy defects	35 % <= CR < 50 %	Cut & OL 50 mm	Cut & OL 50 mm	Cut & OL 70 mm		Cut and OL 50 mm	Cut and OL 50 mm	Cut & OL 70 mm		Cut and OL 50 mm	Cut and OL 50 mm	Cut and OL 70 mm	
		50 % <= CR	(1) Surface & Binder replacement (2) Pavement whole layer replacement (3) Subgrade replacement				(1) Surface & Binder replacement (2) Pavement whole layer replacement (3) Subgrade replacement				(1) Surface & Binder replacement (2) Pavement whole layer replacement (3) Subgrade replacement			

(Source) Developed from Road Facility Design Manual, Gifu Prefecture, Japan

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
	Surface treatment	OL-30 OL-50 OL-70	Cut & OL-30 Cut & OL-50 Cut & OL-70	Cut & Surface and Binder replacement	Cut & Pavement replacement	Cut & Subgrade replacement

Repair work design



Classification	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
	Routine mainte.	Medium repair	Medium repair	Big repair	Big repair	Big repair
	Reactive mainte.	Non-structural repair	Non-structural repair	(Structural repair)	(Structural repair)	(Structural repair)

CHAPTER 12 INSPECTION STAFF ARRANGEMENT AND THEIR ELIGIBILITY

(1) Pavement Inspection

The following staff arrangement needs to be applied for the periodic road pavement condition survey to be carried out by a pavement condition survey vehicle.

1) Inspection staff arrangement

A basic staff arrangement per one party for the pavement condition survey by vehicle is shown in **Table** 12.1. The table shows a basic arrangement, so that the staff arrangement should be reviewed and adjusted to a reasonable level which can meet the scale of survey, the number of bridges and difficulty in survey implementation.

Table 12.1 Survey Staff Arrangement for Road Pavement Inspection

Survey stage	Inspectors per one party	The number of staff per Party
(1) Preliminary survey	● Chief inspector	1
	● Assistant inspector	3
	● Car driver and traffic controller	2
(2) Road condition survey	● Chief inspector	1
	● Assistant inspector	3
	● Car driver and traffic controller	2
(3) Data analysis and registration	● Chief engineer	1
	● Assistant engineer	16

1) Responsibility assignment

Responsibility assignment for chief inspectors and assistant inspectors is as follows;

(a) Chief inspector

A chief inspector is responsible for supervising overall pavement condition surveys including preliminary survey, road condition survey, data analysis and data registration.

(b) Assistant inspector

Assistance inspectors assist a chief inspector including preliminary survey, road condition survey, data analysis and data registration.

2) Eligibility

(a) Chief inspector

A chief inspector should be qualified for supervising pavement condition surveys and have at least 20 years of experience in pavement design, pavement construction or pavement maintenance. He should hold a training certificate on pavement condition surveying provided by DRVN and have experience in pavement condition surveys.

(b) Assistant inspector

An assistance inspector should be qualified for conducting pavement condition surveys and have at least 10 years of experience in pavement design, pavement construction or pavement maintenance. He should hold a training certificate on pavement condition surveying provided by DRVN.

(2) Bridge Inspection

The following plan needs to be applied for the periodic bridge inspection.

1) Inspection staff arrangement

A basic staff arrangement of a survey team for bridge inspection is shown in Table 12.2. The table shows a basic arrangement, so that staff assignment should be reviewed and adjusted to a reasonable level which can meet the scale of survey, the number of bridges and difficulty in survey implementation.

Table 12.2 Staff Assignment for Bridge Inspection

Inspectors per one party	The number of staff
(1) Chief inspector	1
(2) Assistant inspector	3
(3) Vehicle operator Traffic control staff	As required

1) Responsibility assignment

Responsibility assignment for chief inspectors and assistant inspectors is as follows;

(a) Chief inspector

A chief inspector is responsible for supervising overall inspection works including inspection of bridge main bodies and accessories and the diagnosis of the results of the inspections.

(b) Assistant inspector

Assistance inspectors assist a chief inspector including data registration into related databases, upon receiving instructions.

2) Eligibility

(a) Chief inspector

A chief inspector should be qualified for supervising bridge inspections and have at least 20 years of experience in bridge design, bridge construction or bridge maintenance. He should hold a training certificate on pavement condition surveying provided by DRVN.

(b) Assistant inspector

An assistant inspector should be qualified for conducting bridge inspections and have at least 10 years of experience in bridge design, bridge construction or bridge maintenance.

CHAPTER 13 TARGETED FACILITIES TO BE STANDARDIZED

Targeted facilities for inspection to be prescribed in the DRVN Inspection Guideline include the following facilities;

- Pavement
- Bridges
- Cut slopes and embankments
- Tunnels
- Box culverts and pipe culverts
- Traffic safety facilities
- Traffic management facilities
- Other facilities

Details of inspection for each of the above facilities including, focus points of inspection, defects and deteriorations to be focused on and diagnosis criteria and repair works are prescribed in subsequent chapters.

CHAPTER 14 PAVEMENT INSPECTION

The objective of pavement inspection is not only to detect pavement damages which may lead to traffic accidents promptly, but also to obtain data for strategic planning of maintenance and repair works of the road pavement. The following are the points to be focused on in implementing pavement inspection.

(1) Damages and Deterioration

1) Asphalt Concrete Pavement

(a) Potholes, peeling and depression

Potholes often have a serious influence on drivability, in particular to motorcycles and cause traffic accidents, so that inspection needs to be conducted with much attention.

(b) Differences in surface levels

Differences in surface levels often appear at the connection with bridges, at the places where there are crossing structures and at the transition between cut and fill, and often cause big shocks to vehicles. Shocks not only cause damage to road pavements and bridge concrete decks, but will be a source of noise and vibration to the roadside areas. The following are the points to note in carrying out the inspections.

- ✓ Carefully observe roughness in driving and vibration while driving
- ✓ Getting out of the car, carefully observe noise and vibration when vehicles pass

(c) Rutting

Rutting, caused by asphalt flow and abrasion and scattering of aggregate, allows water to puddle and water splash on the pavement surface, causing a decline in skid resistance and visibility during night driving. The following are the points to note in carrying out the inspections.

- ✓ Observe whether car loses driving control
- ✓ Observe steering ability when crossing lanes
- ✓ Observe puddles and splash of water when it rains

(d) Cracks

Asphalt pavement cracks allow water infiltration into the pavement body and have a negative effect on the pavement life-cycle. The following are the points to note in carrying out the inspections.

- ✓ Observe pavement cracks from slow moving vehicles on the road shoulder. If needed, stop the car and conduct a visual observation of the cracks.

- ✓ Drying time after rainfall for crack sections is in general much longer than that for the non-crack sections.
- ✓ Brief sketching or photographing crack conditions with measurement scales, which facilitates the computation of crack rates, will help support the diagnosis of the defects and deterioration of asphalt pavements.

(e) Longitudinal roughness and corrugation

Longitudinal roughness, when it becomes noticeable, often causes a decline in driving comfort and increased driving fatigue to vehicle drivers, thereby lowering driving safety. Large longitudinal corrugations not only cause discomfort to drivers, but cause lateral vibration in the vehicles and thus impair driving safety. Also, impact load often causes noise and vibration of the pavement, bridge structures and roadside environment. It is therefore necessary to carry out inspection carefully.

- ✓ Observe driving comfort and vibration while driving.
- ✓ Observe straightness of guardrails and road markings.

(f) Pumping

Pumping is the phenomenon often observed when water infiltrates into a subgrade layer through pavement layers. With vehicle load, small/fine particles of subgrade or base course materials which contain water will spout out through pavement surface cracks. Inspection should be carefully carried out when fine soil particles or sand in the cracks on the pavement surface are observed. Repair works need to be done promptly before damages develop into serious pavement structural damages.

(g) Blistering

This phenomenon often appears on the bridge pavements. When the water that remains between a bridge deck and the pavement vaporizes, pavement surfaces are often swollen. This often happens in the summer season. Blistered areas easily turn into potholes, so that inspection should be done carefully on the blistered areas of bridge pavements.

2) Concrete Pavement

(a) Differences in surface levels

Concrete pavements constructed on soft ground are subject to pumping at the joints between concrete slabs due to uneven settlement. As a consequence of uneven settlement, tie bars in the pavement are sometimes sheared or bend, causing a difference in the levels at joints between concrete slabs and thus impart shocks to running vehicles. Points of inspection to investigate the voids under the concrete pavements are as follows.

- ✓ Take core samples

- ✓ Excavate the side of concrete slabs and confirm voids
- ✓ Measure unevenness of concrete slabs
- ✓ Hammer concrete slabs and listen to the sound

(b) Cracks

Cracks in concrete pavements, coming out at the end surface of the concrete slabs due to the effects of tie bars, tend to develop in accordance with the growth in the traffic volumes of large vehicles, so that special attention should be directed to the surface of the concrete slabs during inspection. In addition, small cracks observed in the stage of construction tend to be increased by repeated loading of vehicle traffic. Data should be preserved to clarify the progress of cracks comparatively.

(c) Damages at concrete slab joints

Joints of concrete slabs are subject to repeated loading forces, so that attention should be directed to the joints of concrete slabs. Inspection should record the shapes of the damages and the trace of pumping phenomenon. In general, it is preferable to inspect joints of concrete pavements in winter, since joints gaps become wider in winter.

(d) Roadside drainage system

Inspection needs to be done on whether garbage or accumulated soils impair water flow and whether drainage functions are well maintained.

(2) Inspection Methods

Table 14.1 shows inspection items for each inspection category. In general, defects and deterioration of road pavement shows up in the pavement surface unlike other road facilities like bridges, so that routine inspections play the most important role in detecting pavement defects and deterioration. Inspection items under routine inspection are in principle implemented with on-board observance, while those under periodic inspection, marked as “XX” in the table, are measured by special equipment including a pavement condition survey vehicle. An in-depth survey like a FWD survey, which will sometimes be requested in the benchmarking process of the middle-term pavement maintenance planning, falls into a survey item under “Survey & Design” in the table.

Table 14.1 Inspection Methods

Structure	Member	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
Road Pavement	Asphalt pavement /Concrete pavement	**a.** Pot holes/ Peeling/ depressions		X		X	As requested
		b. Gaps in surface level		X		X	
		c. Rutting	XX	X	XX	X	As requested
		d. Cracks	XX	X	XX	X	

Structure	Member	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
		e. Longitudinal roughness (IRI)/ corrugation	XX	X	XX	X	
		f. Thin layer pavement peeling		X		X	
		g. Water puddles		X		X	
		h. Pumping		X		X	
		i. Blistering (*) In case of asphalt pavement.		X		X	
		j. Damage to joint seals		X		X	
		k. Decline in skid resistance					
		l. Decline in roughness index					

(Note) XX: Inspection items to be measured by pavement condition survey vehicle.

(3) Diagnosis of the Results of Inspections

Table 14.2 Evaluation of Damage Criteria

Structure	Member	Sort of damage	Evaluation of Damage Criteria		
			D	C	B
Road Pavement	Asphalt pavement/ Concrete pavement	i) Pot holes/ Peeling/ Depressions	There are pavement surface peeling more than 20 cm in diameter and 2 cm in depth.	There are damages, but do not reach "D" Rating.	-----
		ii) Differences in surface level	There are large differences in depth at the connections with structures which cause difficulty in handling and bounding of the vehicle. There are differences in depth over 20mm at the connections with bridges. There are differences more than 30 mm in level at crossing structures or cut/fill transition points.	There are differences in depth from 10 mm to 20 mm in depth at the connection with bridges. There are differences in depth from 10mm to 30mm in depth at crossing structures or cut/fill transition points.	-----
		iii) Rutting	There is rutting over 25 mm in depth.	There is rutting from 15mm to 25mm in depth.	-----
		iv) Cracks	There are cracks where cracking ratio is over 20 %.	There are cracks where crack ratio is from 10% to 20%	-----
		v) Longitudinal roughness/ Corrugation	-----	Bad drivability caused by longitudinal roughness. Corrugation depths between minimum and maximum is more than 30mm.	Minor longitudinal roughness, Corrugation depths between minimum and maximum is more than 30 mm.
		vi) Thin layer pavement peeling	-----	The thin layer does not function at all, because of peeling caused by rutting.	-----
		vii) Water puddles	-----	There is a partial water puddle in case of rainfall.	-----
		viii) Pumping	There is a trace of	There is a trace of	-----

Structure	Member	Sort of damage	Evaluation of Damage Criteria		
			D	C	B
			pumping debris of subgrade or base course materials and crocodile pavement surface cracks are observed.	pumping debris of subgrade or base course materials.	
		Blistering (*) In case of asphalt pavement.	When it turns into a pot hole, rating criteria of potholes are applied.	Large swelling of road pavement is observed and there is a trace of fine particle material spouting out through pavement.	Minor swelling is observed, but it does not reach the level mentioned left.
		Damage to joint seals	-----	Damage to joint seals including discharge of joint seals to pavement surface.	-----
		Decline in skid friction	Skid resistance has declined to the level of less than ì (V) 0.25.	Skid resistance has declined to the level between ì (V) 0.25 and 0.3.	-----
		Deterioration in roughness index	IRI has deteriorated to the level of more than 3.5 mm/m.	-----	-----

CHAPTER 15 BRIDGE INSPECTION

(1) Steel Bridge Superstructure

Objective structures under consideration in this inspection include steel girders, steel deck plates and steel piers. However, large-scale bridges, including suspension bridges and cable-stayed bridges, are out of the scope of this manual since the above mentioned bridges are so special that inspection manuals should be prepared separately, which are specialized for these bridges.

1) Defects and deterioration

(a) Abnormal deflection

Sagging or hogging deflection is observed for part of or the entire length of main girders.

(b) Abnormal noise

Abnormal banging noise or creaking noise is observed when vehicles pass.

(c) Abnormal vibration

Abnormal palpable vibration is observed.

(d) Deterioration of paint

Cracks, swelling and peeling are observed on the bridge paint including corrosion due to their effects.

(e) Corrosion

Concentrated corrosion is observed on the steel materials or reduction in cross section is observed on steel materials due to the effects of corrosion.

(f) Looseness and falling of rivets and HTBs

Loosening and falling of rivets or HTBs are observed at joints.

(g) Cracks

Steel material fatigue cracks are observed at the places where stress concentration occurs or where there are changes in steel material cross section. Also, cracks are observed, which are caused by the over stress brought by earthquakes and vehicle collisions.

(h) Deformation, buckling

Deformation or buckling are observed in the steel materials

(i) Water leakage, puddles

Water infiltration is observed in the places where it is hard to treat pooled water, such as those where steel members cross each other or inside steel piers.

2) Inspection Methods

(a) Inspection methods

Table 15.1 shows bridge inspection methods. As shown in the table, an initial inspection is one to be implemented within two years or within the warranty periods specified in the construction contract dossiers after the opening of services to the public. Inspection items for the initial inspection are the same as those for the periodic inspection, which plays the most important role in the bridge inspection. Routine inspection for bridge facilities needs to focus on abnormal sound and vibration due to its limitation in inspection.

Table 15.1 Inspection Methods

Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
Steel Bridge Superstructure	Steel girder/ Steel floor deck/ Steel piers (pylons)	a. Abnormal deflection	X		X	X	As requested
		b. Abnormal sound	X	X	X	X	
		c. Abnormal vibration	X	X	X	X	
		d. Abnormal expansion gaps	X		X	X	
		e. Movement	X		X	X	
		f. Water leakage, puddles	X		X	X	
		g. Bridge under clearance	X		X	X	
		a. Fatigue cracks	X		X	X	
		b. Deformation/ buckling	X		X	X	
		c. Looseness and falling of rivets and HTBs	X		X	X	
		d. Deterioration of paint	X		X		
		e. Corrosion	X		X		

(b) Inspection devices

Table 15.2 Inspection Devices shows inspection devices. However, it should be noted that a prime method of bridge inspection is short-distance visual inspection including hammering, so that too much reliance on the non-destructive equipment should be avoided. When detecting damages on bridge facilities, it is effective to apply devices to measure degrees of damages in quantity. Numerical data will help support the diagnosis of inspection results later on.

Table 15.2 Inspection Devices

Damages	Common Devices	Special Devices
a. Abnormal deflection **b.** Abnormal noise **c.** Abnormal vibration	● Levelling for camber measurement	● Vibration measurement ● Noise measurement

d. Deterioration of paint	● Video, Photos	● Measurement of impedance ● Measurement of salinity content
e. Corrosion	● Ultrasonic-wave measurement for steel plate thickness	● Stress measurement (Study on load bearing capacity)
f. Looseness and falling of rivets and HTBs	● Check bolt head-mark	
g. Cracks		● Ultrasonic flaw detection ● Stress measurement ● Study on the causes of cracks
h. Deformation, buckling		● Stress measurement (Study on load bearing capacity)
i. Water leakage, puddles		

3) Inspection Points

✓ **Table** 15.3 shows the focus points of bridge inspection where past research has clarified the types of damage that appeared frequently, so that special attention should be paid to these points.

Table 15.3 Focus points of inspection

Damages	Focus Points of Inspection
a. Abnormal deflection **b.** Abnormal noise **c.** Abnormal vibration	● Centre of the girder span ● End of the girder, in particular at expansion joints and shoes.
d. Deterioration of paint	● Whole section of the girder. ● Inside of box girders and steel piers.
e. Corrosion	● End of the girder (around shoes, end sway bracing and cross beams) ● Junctions of steel materials ● Around drain pipes ● Inside steel box girders ● Cross points of arch and truss beams
f. Looseness and falling of rivets and HTBs	● Junction of plates with rivets and HTBs.
g. Cracks	● Welding portions of steel materials as shown in from Figure 15.1 to Figure 15.7
h. Deformation, buckling	● Ends of the girders ● Centre of the girder span ● Over the carriageway
i. Water leakage, puddles	● End of the girders ● Manholes ● Joints ● Around outlet drains ● Cross points of steel materials (in particular for arch and truss bridges)

4) Diagnosis of the results of inspection

Table 15.4 shows the diagnosis criteria of the inspection results for steel girders, steel deck plates and steel piers. As regards cracks which appear on steel members, Table 15.5 elaborates the diagnosis criteria of the cracks caused by fatigue of steel members, followed by the illustrations of manifestations of fatigue shown in from **Figure** 15.1 to **Figure** 15.7**.**

Table 15.4 Diagnosis of the Inspection Results

Structures	Members	Damages	Diagnosis Criteria (Refer to Table 7.1.11)		
			D	C	B
Steel Bridge Superstructu	Steel girder/	f. Abnorm al	Less than L/500 where the bridge	Sagging can be clearly identified by	

Structures	Members	Damages	Diagnosis Criteria (Refer to Table 7.1.11)		
			D	C	B
re	Steel deck plates/ Steel piers (pylons)	Deflection	length is over 40 meters (*1)	visual inspection	
		g. Abnormal Sound		Abnormal sound arises when vehicles pass by.	
		h. Abnormal vibration		Abnormal vibration is identified by physical inspection or body feeling.	
		i. Abnormal expansion gaps	・ End girder support length is not long enough. ・ Parapet & girder contacted each other and are broken	・ Expansion gap is seen closed or open wide. ・ Parapet & girder contacted each other.	Expansion gap is moving wider or narrower than design specifications.
		j. Movement	Superstructure or substructure move significantly.	Superstructure or substructure moves slightly.	
		k. Leaking stagnant water		Water leakage or puddle is seen anytime regardless of weather conditions,	Water leakage or puddles is sometimes seen on rainy days.
		l. Clearance under bridge		Insufficient under clearance is observed.	
		m. Fatigue cracks	**Refer to Table 15.5**		
		n. Deformation/ buckling	Significant deformation or buckling arises and provides significant negative impacts on force-bearing capacity of structure.	Slight deformation or buckling arises	
		o. Looseness or falling of rivets and HTBs.		・ More than 2 rivets or bolts are missing on one connection plate	There is a missing bolt observed on one connection plate.
		p. Deterioration of paint		Cracks, peeling, swelling or rust are found over a wide area	Cracks, peeling, swollen or rust are found in limited area.
		q. Corrosion	Corrosion on the main members progresses significantly and gives significant negative impacts on the force- bearing capacity of the structure.	Reduction in steel plate thickness is found due to corrosion	The potential of corrosion advancing to the point of reduction in steel plate thickness is observed.

*(Note) (*1): Specification for Highway Bridge in Japan, MLIT*

Table 15.5 Diagnosis Criteria of Fatigue Cracks

Structures	Members	Damages	Diagnosis Criteria (Refer to Table 7.1.11)		
			D	C	B
Steel bridge	・ Welding portions on sole plates	Fatigue crack	Cracks reached web plates	Cracks appear	
	・ Girder end where cross section of web plate changes		Cracks reached web plates	Cracks appear	
	・ Welding portions with vertical stiffeners			Cracks appear	
	・ Welding portions with gusset plates		Cracks progress onto web plates	Paint cracks appear	
	・ Butt welding portions on lower flanges		Cracks appear	Paint cracks appear	
	・ Welding portions with steel deck plates		Cracks extend over two thirds of welding length	Cracks appear	
	・ Welding portions between vertical stiffeners and steel deck plates		Cracks appear on steel deck plates	Cracks appear	
	・ End of stringers where cross section of the girder changes		Cracks progress on the stringer web extending in the direction that could break the stringer	Cracks appear	
	・ Base of vertical members on the arch ribs		Cracks extend to arch chord or to the stiffeners of the girder	There is potential of breaking vertical members	
	・ Welding portions on shoe base plates			Cracks appear	
	・ Corners of steel piers		Cracks appear and may progress	Cracks appear	
	・ Others		Other locations where large cracks are found	Cracks appear	

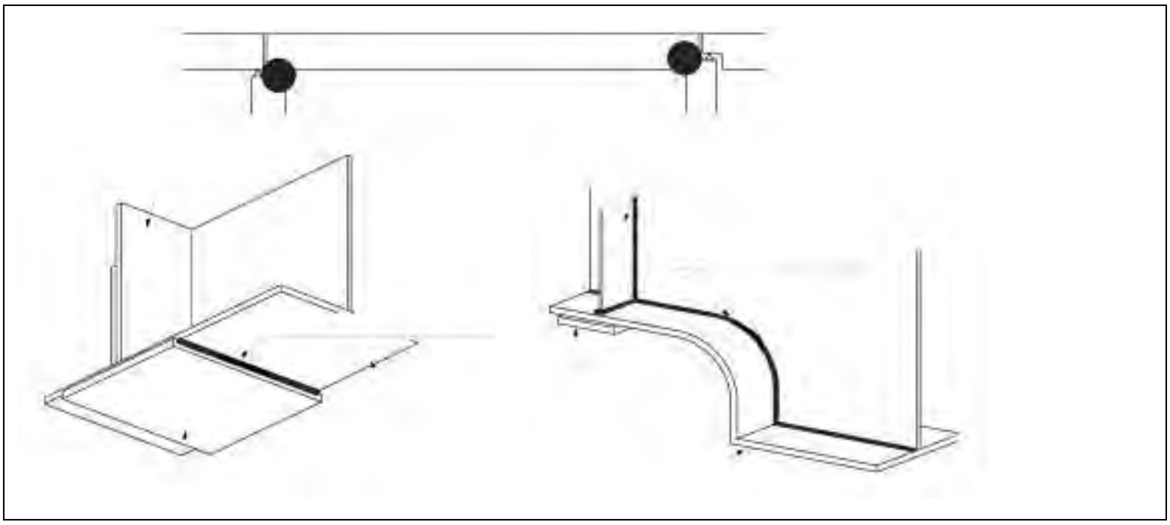


Figure 15.1 Cracks Appearing at Welded Portions of Sole Plates and at Changes in Cross-sections

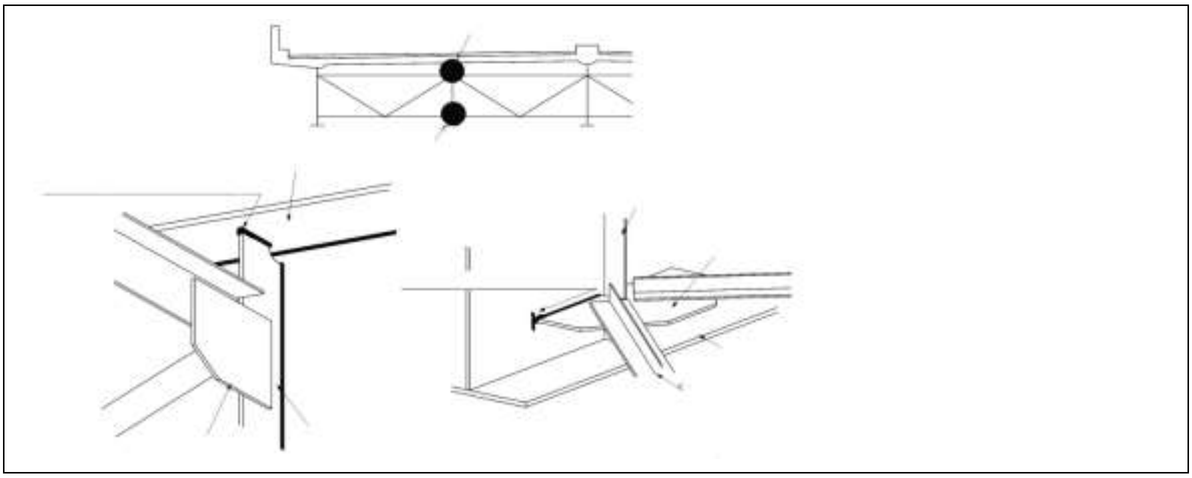


Figure 15.2 Cracks Appearing at the Welded Portions with Stiffeners and gussets

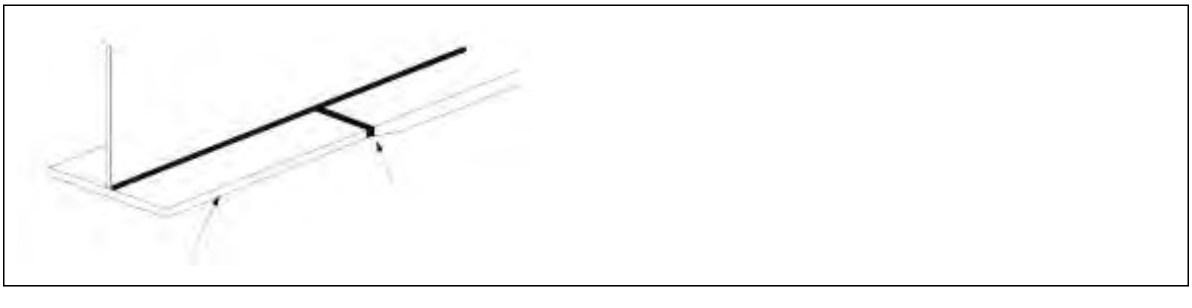


Figure 15.3 Cracks Appearing at Butt Welded Portions on Lower Flanges

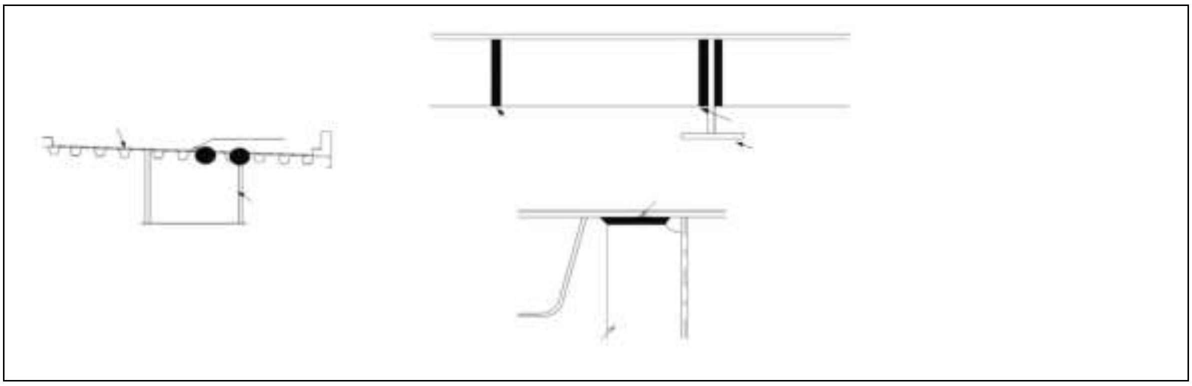


Figure 15.4 Cracks Appearing at Welded Portions with Steel Deck Plates

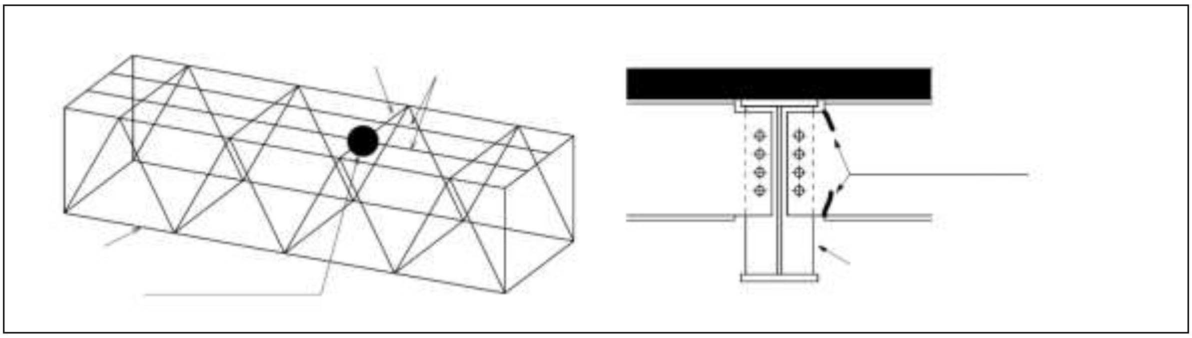


Figure 15.5 Cracks Appearing at the End of Stringers

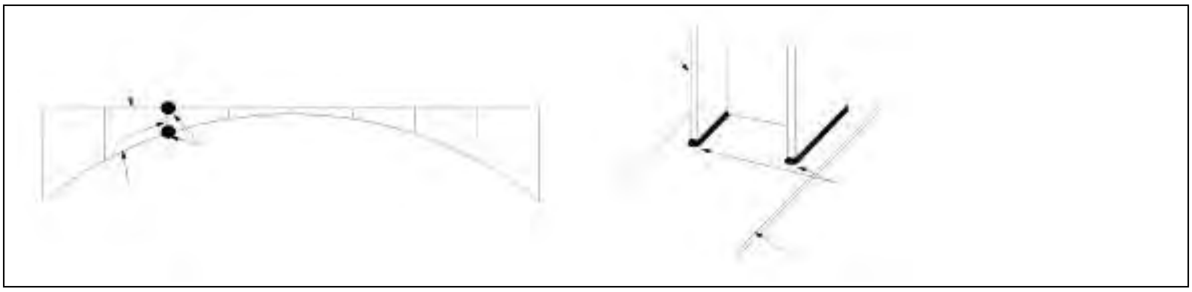


Figure 15.6 Cracks Appearing at the Base of Vertical Members on the Arch Ribs

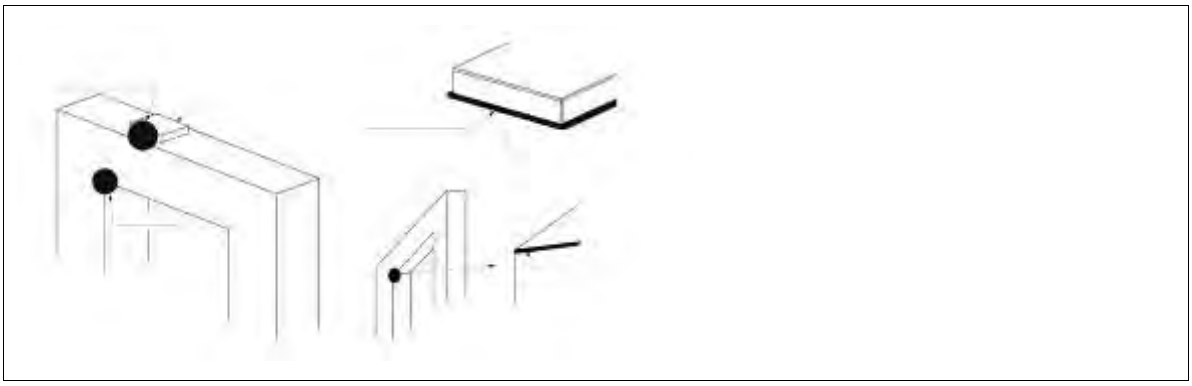


Figure 15.7 Cracks Appearing on Rigid-frame Piers

(2) Concrete Bridge Superstructure

1) Defects and deteriorations

A characteristic of concrete bridge superstructures is that steel members are embedded in concrete structures, so that repair works and reinforcement of structures will become hard if corrosion progresses to steel members inside. Also, the quality of concrete construction may have great impact on the force-bearing capacity of the concrete structures. Environmental conditions near bridges also have negative impacts on the progress of concrete deterioration, so that early detection of defects and deterioration along with understanding their environment would be a key for the better maintenance of concrete facilities.

Table 15.6 summarizes typical defects and deterioration often observed during bridge inspection. As seen in the table, there is a slight difference in defects and deterioration between bridge structures.

Table 15.6 Defects and Deterioration by Bridge Types

	a. Cracks	b. Water leakage and puddles	c. Free lime	d. Concrete Peeling/ Creep	e. Exposure of steel bars	f. Trace of corrosion	g. Deterioration and Discoloration	h. Abnormal deflection	i. Abnormal noise	j. Abnormal vibration	k. Abnormal expansion gaps	l. Settlement	m.Movement	n. Steel material failure	o. Steel Corrosion
Reinforced Concrete Bridges (RC Bridges)	X	X	X	X	X	X	X	X	X	X	X	X	X		
Pre-stressed Concrete (PC Bridges) / Pre-stressed Reinforced Concrete Bridges (PRC Bridges)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Hybrid structure Bridges (Steel plus Concrete)	X	X	X	X	X	X	X		X	X	X	X	X	X	X

(a) Defects and deterioration common to all bridges

i) Abnormal deflection

Sagging or hogging deflection which is observed due to concrete creep, internal stresses caused by concrete drying shrinkage and inadequate PC wire stresses.

ii) Abnormal noise

Abnormal banging noise or creaking noise which is observed due to damage to the joints or movement within the joints.

iii) Abnormal vibration

Abnormal vibration which is palpable and observable

iv) Abnormal expansion gaps

Expansion gaps between girders, abutments and joints which are too narrow or too wide.

v) Settlement

Uneven settlement observed at joints.

vi) Movement

Rotation or movement of structures occurs at bridge abutments and piers.

(b) Defects and deteriorations appearing on bridge members

i) Cracks

Cracks occur due to tensile stresses.

ii) Water leakage and puddles

Water leakage and puddles occur due to rain water infiltrating through concrete joints, penetrating cracks, expansion joints and damaged drain systems.

iii) Free lime

Free lime is a phenomenon causing the lime component of concrete to flow out of construction joints or out of penetrated cracks with water infiltrating into the concrete body.

iv) Concrete Peeling/ Creep

Surface of the concrete structure peels due to the effects of steel bar swelling caused by corrosion, concrete inner stresses or improper treatment of concrete construction joints.

v) Exposure of steel bars

Steel bar exposure caused by the effects of concrete peeling, creep or improper construction methods.

vi) Trace of corrosion

Trace of corrosion due to the effects of steel bar corrosion inside concrete bodies,

vii) Deterioration and Discoloration

Deterioration and Discoloration are caused by the corrosion inside concrete bodies, or pre-stressed concrete reinforcement steel members and improper construction methods

viii) Steel Corrosion

Corrosion is caused by the oxidation of steel materials buried in concrete structures or exposed to the air.

ix) Steel material rupture and projection

Improper grouting, salt effects, neutralization or water infiltration from cracks causes rupture of steel materials and projection of anchor devices.

2) Inspection Methods

(a) Inspection Methods

Table 15.7 Inspection Methods

Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
Concrete Bridge Superstructure	Reinforced concrete Pre-stressed concrete Composite	a. Abnormal deflection	X		X	X	As requested
		b. Abnormal sound	X	X	X	X	
		c. Abnormal vibration	X	X	X	X	
		d. Abnormal expansion gaps	X		X	X	
		e. Movement	X		X	X	
		f. Water leakage and puddles	X	X	X	X	
		g. Under clearance of bridge	X		X	X	
		h. Cracks	X		X	X	
		i. Concrete peeling	X	X	X		
		j. Exposure of steel bars and corrosion	X	X	X	X	
		k. Voids	X		X		
		l. Honey-comb	X		X		
		m. Free lime	X		X		
		n. Color change and deterioration	X		X		
		o. Rusty fluid	X	X	X		
		p. Steel material rupture and projection	X	X	X	X	

(b) Inspection devices

i) To begin with in inspecting concrete bridges, it is advised to study the bridge types in the design documents and to inspect the whole bridge with long-distance visual inspection. Then, inspection moves on to the members and materials of the bridge from general to detail and from long-distance visual inspection to short-distance visual inspection.

ii) Points of inspection should include the types, the locations (members and materials), the patterns (direction, shapes, colours) and the extent of defects and deterioration (spread, length, depth). The results of inspection need to be recorded qualitatively as much as possible with photos or sketches.

iii) Inspection should be done with short-distance visual inspection and hammering in principle, however, appropriate equipment needs to be applied if necessary in accordance the extent of defects and deteriorations. Equipment often used for detailed inspection is shown in Table 7.1-23 with sample diagnoses of the inspection results.

Table 15.8 Inspection Devices

Inspection Devices	Criteria of Diagnosis (Refer to Table7.1-11)		
	D	C	B
Measurement of neutralization with phenolphthalein liquid	-----	Neutralization progresses and reaches steel bars	Neutralization progresses, but does not reach steel bars
Measurement of the depth of steel bar coverage by non-destructive instrument	-----	-----	-----
Measurement of compression strength with Schmidt hammer	-----	Compression strength is far below its design value.	Compression strength is a little lower than its design value.

iv) If periodic inspections point out further surveys and designs in order to detect causes of defects and deterioration, to plan and design repair works and to determine timing of repair works, it is recommended to implement the measurement of neutralization depth by concrete core sampling, compression strength, modulus of elasticity, salt contents, alkaline contents and the amount of residual swelling. In addition, it is also recommended to study the environmental conditions surrounding the bridges.

3) Inspection Points

(a) Focus points

Table 15.9 shows focus points of inspection and their outlines.

Table 15.9 Focus Points of Inspection

Inspection Points	Outlines of Inspection Points
a. Girder end support	Locations subject to the horizontal forces caused by support reaction force, earthquakes and changes in temperature
b. Central support	Locations where negative bending moment and shear forces show maximum values. Also, stress conditions around the locations become complicated due to the concentrated support reaction force and cracks are prone to emerge.
c. Centre between supports	Locations where bending moments show maximum values and thereby bending cracks are prone to emerge.
d. A quarter point between supports	Locations where cracks emerge due to the changes in steel bar distribution. Also, improper movement of bearings causes cracks at these points.
e. Concrete joints	Locations where cracks, peeling and water leakage may arise due to concrete drying shrinkage
f. Segment joints	Similar cracks to the above arise at the segment joints during concrete casting.
g. Anchor portions	Around the structures which anchor PC cables, cracks are prone to emerge due to the high concentration of tensile stress.
h. Notched section	Locations where a girder cross section changes drastically, cracks are prone to emerge due to high concentration of stress.

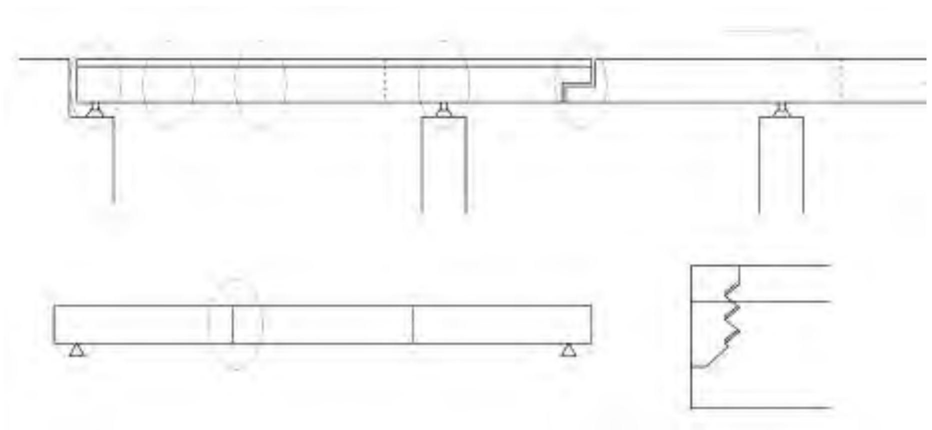
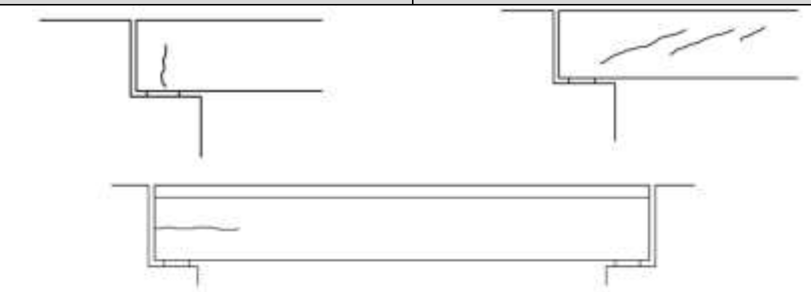
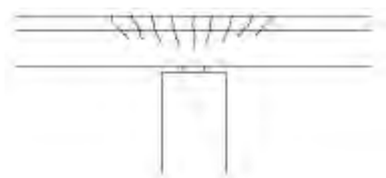
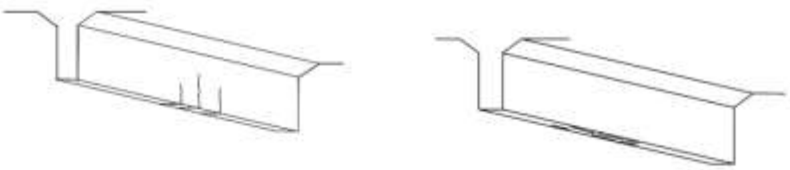
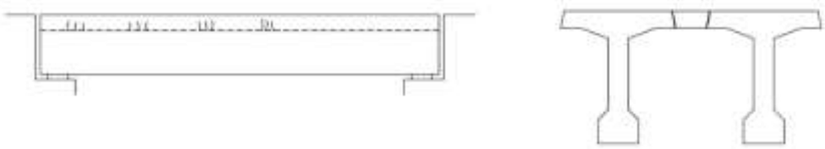


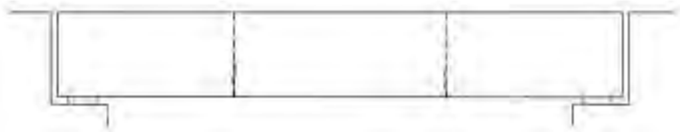
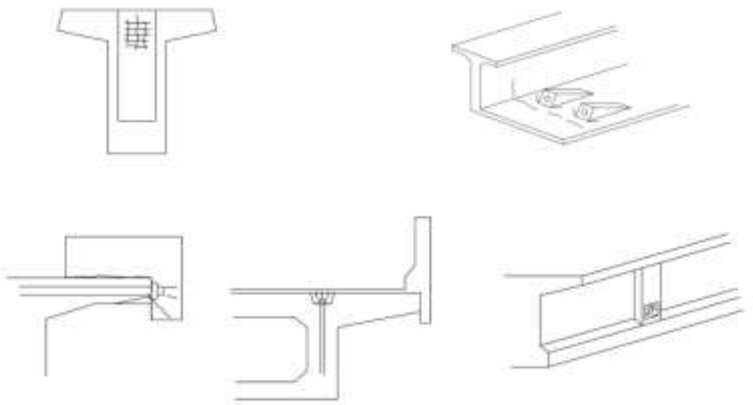
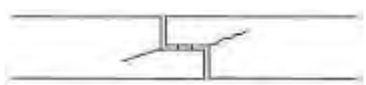
Figure 15.8 Focus Points of Inspection

(b) Crack Patters

Table 15.10 Crack Patterns

	Crack Pattern	Outline	Main causes of Cracks
a.	Crack pattern near girder end supports	Vertical cracks observed on the underside or both sides of a girder on a support.	Excessive concentration of stresses on a girder near a support, improper bearing functioning or earthquakes.
		Diagonal cracks observed on the webs of a girder on a support.	Excessive concentration of stresses or shortage of shear reinforcement steel.
		Horizontal cracks observed on the webs of a girder.	Bearing stress around anchor

	Crack Pattern	Outline	Main causes of Cracks
		 **Figure 15.9 Cracks near Girder End Supports**	
b.	Crack pattern near central support	Vertical cracks observed on the upper side of a continuous main girder near support.	Lack of reinforcement steel against negative bending moment on the upper flange of a girder near supports.
		 **Figure 15.10 Crack Pattern near Central Support**	
c.	Crack pattern at the centre of the span	Vertical cracks observed on the underside or both sides of a girder	Excessive bending moment
		Longitudinal cracks observed on the underside of a main girder	Lack of cross section or steel bar design volume of a main girder, salt effects or alkaline aggregate reaction
		 **Figure 15.11 Crack Pattern at the Centre of the Span**	
d.	Crack patter at a quarter point of the span	Vertical cracks observed on the underside or both sides of a girder	Lack of steel bar design volume
		 **Figure 15.12 Crack Pattern at a Quarter Point of the Span**	
e.	Crack pattern near construction joints	Cracks running vertically or horizontally along construction joints	Improper concrete adhesive power at cold joints.
		Cracks near construction joints on the girder or on the concrete slabs	Improper treatment of construction joints or lack of PC material tensile stress
			

	Crack Pattern	Outline	Main causes of Cracks
		Figure 15.13 Crack Pattern near Construction Joints	
f.	Crack pattern near segment joints	Cracks near segment joints	Lack of PC material tensile force
		 **Figure 15.14 Crack Pattern near Segment Joints**	
g.	Crack pattern near PC anchors	Crocodile cracks on an anchoring concrete after installing PC materials.	Concrete drying shrinkage, corrosion of anchor materials, improper treatment of construction joints
		Vertical or diagonal cracks near the projection of PC material anchors	High concentration of stresses on anchor portions
		Cracks near PC material anchors.	Lack of concrete protective covering
		Cracks on a anchoring concrete at joint portion of cross beams	Improper design of concrete, improper construction of anchoring concretes.
		 **Figure 15.15 Cracks near PC Anchors**	
h.	Crack pattern near the canti-lever sections	Cracks near the canti-lever sections	Concentration of stresses due to drastic changes in cross section.
		 **Figure 15.16 Cracks near the Canti-lever Section**	

4) Diagnosis of the results of inspection

Table 15.11 shows the diagnosis criteria for the damage to concrete super structures. Also, **Table** 15.12 shows particular criteria of cracks on the concrete superstructures.

Table 15.11 Diagnosis Criteria of Concrete Superstructures

Structures	Members	Damages	Diagnosis Criteria (Refer to Table 7.1-11)		
			D	C	B
concrete bridge Superstructure	Reinforced Concrete	a. Abnormal deflection	Abnormal deflection is observed.	Deflection is observed by visual inspection.	

Structures	Members	Damages	Diagnosis Criteria (Refer to Table 7.1-11)		
			D	C	B
	Pre-stressed Concrete Composite	b. Abnormal sound		Abnormal sound occurs when vehicles pass by.	
		c. Abnormal vibration		Abnormal sensible vibration is detected.	
		d. Abnormal expansion gaps		Expansion joint gap is too narrow or too wide.	Expansion joint gap is beyond the range of design values.
		e. Movemen t	Superstructure or substructure moved extraordinary.	Superstructure or substructure moved a little.	
		f. Water leakage and puddles		There is observed water leakage or puddles regardless of weather.	There is observed water leakage or puddles in rainy days.
		g. Under clearance of bridge		Insufficient under clearance is detected.	
		h. Cracks	Refer to		
		i. Concrete peeling		Wide concrete peeling is detected or peeling spreads.	Partial peeling is detected.
		j. Exposure of steel bars and corrosion		Steel bar exposure is detected and rusting of bars progresses.	Steel bar exposure is detected partially.
		k. Voids		Many large voids are detected.	Voids are detected, but not many.
		l. Honey-co mb		Many large honey-combs are detected	Honey-combs are detected, but not many.
		m. Free lime		Serious free lime is detected which seemingly corroded steel members.	Free lime is detected, but no serious.
		n. Colour change and colour deteriorati on		Concrete changes its colour on the surface near cracks.	Partial change in colour is observed.
		o. Rusty fluid		Serious rusty fluid is detected, in particular, from anchors of steel members or PC cables.	Some rusty fluid is detected.
		p. Steel material ruptures and projects	PC cables broke and anchors projected out of structures. Also, rusty fluid is observed at anchors with high potential of anchor projection.	Cracks and rusty fluid are observed at anchor portions,	

Table 15.12 Diagnosis Criteria of Concrete Cracks

Members	Locations	Damages	Diagnosis criteria (Refer to Table7.1-11)		
			D	C	B
Reinforced Concrete Pre-stressed Concrete	Near end girder support	Cracks	Large vertical or diagonal cracks are observed near bearings with free lime or rusty fluid.	Large cracks extending vertically or diagonally near bearings.	Small cracks extending vertically or diagonally near bearings

Members	Locations	Damages	Diagnosis criteria (Refer to Table7.1-11)		
			D	C	B
Composite	Near middle support		Large vertical cracks are observed on the upper flange of a main girder with free lime and rusty fluid.	Large cracks are observed on upper flange or main girder web.	Small cracks are observed on upper flange or main girder web.
	Centre between supports		Large vertical or horizontal cracks are observed on the lower flange of a main girder with free lime and rusty fluid.	Large cracks are observed on the lower flange or the web of a main girder.	Small cracks are observed on the lower flange or the web of a main girder.
	A quarter point between supports		Large vertical cracks are observed on the lower flange of a main girder with free lime and rusty fluid.	Large vertical cracks are observed on the lower flange of a main girder,	Small vertical cracks are observed on the lower flange of a main girder.
	Constructio n joints		Large cracks are observed near the construction joints with free lime or rusty fluid.	Large cracks are observed near the construction joints.	Small cracks are observed near the construction joints.
	Segment junctions		Cracks or trace of free lime are observed near the segment joints.	-----	-----
	Near anchors		Cracks are observed near the anchorage in shear direction	-----	Crocodile cracks are observed near the anchorage.
	Notch of a girder		Diagonal cracks are observed near the notch of a girder.	-----	-----

(3) Concrete Slab Decks

1) Damages and Deteriorations

(a) Cracks

In general, damages caused by repeated vehicle traffic first emerge under the surface of bridge concrete decks. Cracks progress from those running perpendicular to the bridge axis to those running in the bridge axis direction. Also, cracks gradually progress to small cracks like crocodile cracks.

(b) Free lime, corrosion

Cracks emerging under the surface of concrete decks will progress and penetrate concrete decks, causing water infiltration into concrete decks. Water, when penetrating the concrete decks, dissolves lime components into the water and accumulates limes under the surface of the concrete decks. When water infiltration lasts a long time it causes rusting of the steel bars. Traces of steel bar corrosion will come out to the surface of the concrete decks.

(c) Peeling, creeping and spalling of concrete decks

Salt components brought by concrete neutralization or from outside of the structure, cause corrosion to steel bars. Swelling of steel bars caused by corrosion then causes concrete peeling, creeping and spalling to concrete decks.

(d) Exposure of steel bars

As concrete damages turn serious, steel bars will be exposed to the air.

(e) Voids

Concrete voids often remain under the surface of concrete decks due to insufficient construction management of concrete decks.

(f) Pavement potholes

Potholes appear on the surface pavements when concrete coverage in the bridge deck is damaged due to upper steel bar corrosion in the decks.

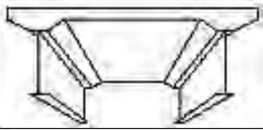
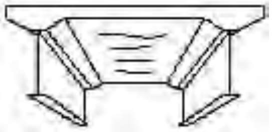
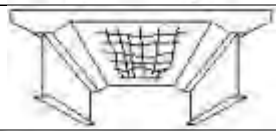
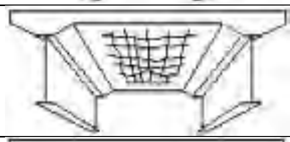
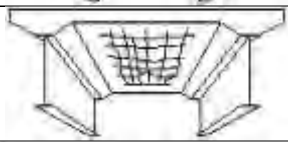
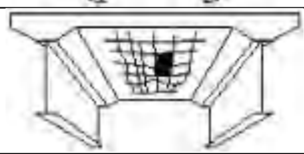
(g) Concrete creep at the upper flange of girder ends

Water infiltration into the space between upper flanges and concrete decks, which is caused by concrete creep, often causes rusting to the upper flange and traces of rusting appear on the surface.

2) Mechanism of crack progress on concrete decks

Table 15.13 shows the mechanism of crack progress on the concrete decks.

Table 15.13 Damage Progress Mechanism

	Crack Damage Progress	Schematic Views
	Initial Stage, no damage	
	Cracks, caused by drying shrinkage, appear perpendicular to the bridge axis.	
	Cracks progress due to traffic load, which comprise longitudinal and perpendicular cracks, forming a grid pattern.	
	Cracks penetrate the concrete decks to the surface due to traffic load.	
	Cracks further break down due to interaction between particles, gradually losing shear resistance force.	
	Due to traffic load which exceeds punching sheer force of deck concrete, spalling of concrete material occurs.	

(Source) Concrete decks and damages, Matsui and others, June 1998, Bridge and Foundation, Japan

3) Inspection Methods

Table 15.14 shows the inspection methods for concrete slab decks.

Table 15.14 Inspection Methods

Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
Concrete Slab Deck	Concrete slab deck	a. Cracks	X		X	X	As requested
		b. Peeling	X	X	X		
		c. Steel bar exposure and corrosion	X	X	X	X	
		d. Voids	X		X		
		e. Honey comb	X		X		
		f. Free lime	X		X		
		g. Rusty fluid	X	X	X		
		h. Color change and deterioration	X		X		
		i. Peeling at repaired portion	X	X	X		
		j. water leakage	X	X	X	X	
	Cantilever	k. drainer	X	X	X		

Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
	concrete slab						
Precast Concrete Slab Deck	Concrete deck joints	l. water leakage, free lime, rusty fluid	X	X	X	X	
	under the surface	m. water leakage, free lime, rusty fluid	X	X	X	X	

4) Inspection points

Table 15.15 shows inspection points, inspection items and inspection methods for concrete slab deck inspection.

Table 15.15 Inspection points

Locations	Inspection points	Inspection items	Inspection methods
Under the surface of concrete decks	Main bodies	Crack directions, spacing of cracks, water leakage, free lime, traces of rusting, concrete peeling, range of concrete spalling, range of steel bar exposure, range of voids.	Short-distance visual inspection standing on the scaffolding and hammering
	Canti-lever sections	Crack directions, spacing of cracks, free lime, traces of rusting, concrete peeling, range of concrete spalling, range of steel bar exposure, range of voids.	Short-distance visual inspection standing on the scaffolding and hammering
	Upper steel flange sections	Free lime, traces of rusting, range of voids, range of concrete peeling and creep.	Short-distance visual inspection standing on the scaffolding, abutment and piers.
Upper surface of concrete decks	Road surface	Scale of pavement, potholes and repair works in the past, direction of cracks, spacing of cracks.	Short-distance visual inspection on the bridge pavements.

5) Diagnosis of the results of inspection

Table 15.16 shows the diagnosis criteria for the defects and deterioration of concrete slab decks.

Table 15.16 Diagnosis criteria

Structures	Members	Damages	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
Concrete Slab Deck	Slab Deck	a. Cracks	Refer to **Table** 15.17		
		b. Peeling	-----	Extensive concrete peeling is observed.	Small scale concrete peeling is observed.
		c. Steel bar exposure and corrosion	-----	Sever steel bar exposure is detected with progress of corrosion.	Partial steel bar exposure is observed.
		d. Voids	-----	Large voids are detected.	Some voids are detected.
		e. Honey comb	-----	Large honey combs are detected.	Some honey combs are detected.
		f. Free lime	Large extent of free lime running in two directions with colour	Free lime running in two directions is detected with colour change.	Free lime running in one direction is detected with colour change.

			change.		
		g. Rusty fluid	-----	Severe rusty fluid is detected.	Some water leakage and rusty fluid are observed.
		h. Colour change and deterioration	-----	Concrete surface has changed its colour near cracks.	Concrete surface has changed its colour in limited areas.
		i. Peeling and creep at repaired portion	-----	Peeling or creep is observed at repaired portion	-----
		j. water leakage	-----	Water leakage is observed anytime regardless of weather.	Water leakage is observed on rainy days.
	Cantilever concrete slab	k. drainer	-----	Drainer does not function well and causes water leakage.	-----
Precast Concrete Slab Deck	Concrete deck joints	l. water leakage, free lime, rusty fluid	-----	Widely and clearly detected	Detected in a limited area
	under the surface	m. water leakage, free lime, rusty fluid	-----	Widely and clearly detected	Detected in a limited area

Table 15.17 Diagnosis criteria for Cracks on Slab Decks

Members	Locations	Damages	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
Reinforced Concrete Pre-stressed Concrete Composite	Near end girder support	Cracks	Large vertical or diagonal cracks are observed near bearings with free lime or rusty fluid.	Large cracks extending vertically or diagonally near bearings.	Small cracks extending vertically or diagonally near bearings
	Near middle support		Large vertical cracks are observed on the upper flange of a main girder with free lime and rusty fluid.	Large cracks are observed on upper flange or main girder web.	Small cracks are observed on upper flange or main girder web.
	Center between supports		Large vertical or horizontal cracks are observed on the lower flange of a main girder with free lime and rusty fluid.	Large cracks are observed on the lower flange or the web of a main girder.	Small cracks are observed on the lower flange or the web of a main girder.
	A quarter point between supports		Large vertical cracks are observed on the lower flange of a main girder with free lime and rusty fluid.	Large vertical cracks are observed on the lower flange of a main girder,	Small vertical cracks are observed on the lower flange of a main girder.
	Construction joints		Large cracks are observed near the construction joints with free lime or rusty fluid.	Large cracks are observed near the construction joints.	Small cracks are observed near the construction joints.
	Segment junctions		Cracks or traces of free lime are observed near the segment joints.	-----	-----

Members	Locations	Damages	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
	Near anchors		Cracks are observed near the anchorage in shear direction	-----	Crocodile cracks are observed near the anchorage.
	Notch of the girder		Diagonal cracks are observed near the notch of the girder.	-----	-----

(4) Substructures and Foundations

1) Damages and Deteriorations

(a) Damages and deterioration by types of structures

Damages and deterioration often observed on the substructures and foundations as follow;

i) Abutment and piers

- ✓ Cracks
- ✓ Peeling
- ✓ Steel bar exposure
- ✓ Voids
- ✓ Water leakage
- ✓ Free lime
- ✓ Traces of rusting
- ✓ Deterioration and discoloration
- ✓ Settlement
- ✓ Movement

ii) Foundation

- ✓ Settlement
- ✓ Movement
- ✓ Scouring
- ✓ Exposure

iii) Other facilities

- ✓ Cracks
- ✓ Peeling
- ✓ Water leakage
- ✓ Free lime

- ✓ Traces of rusting
- ✓ Settlement
- ✓ Movement

(b) Outline of damages and deterioration

i) Cracks

There are various influential factors causing cracks, such as those including drying shrinkage, tensile stresses, materials, construction methods, environment, designs, external working forces and so forth.

ii) Concrete peeling

Concrete peeling is caused by the swelling of rusted steel bars, concrete inner stresses and improper treatment of construction joints, causing peeling, spalling and the creep of concrete surfaces.

iii) Exposure of steel bars

Exposure of steel bars is caused by the spalling of concrete materials due to steel bar rusting and improper construction methods.

iv) Voids

Voids are caused by the improper filling of concrete materials during construction.

v) Water leakage

Water leakage is often observed at damaged drains, penetrated cracks, concrete construction joints, expansion joints and structural joints.

vi) Free lime

Free lime is an accumulation of lime components on the surface of concrete which is caused by water infiltrating into the concrete structure thorough cracks and construction joints.

vii) Traces of rusting

Rusting of steel bars buried in the concrete progresses and flows out from concrete cracks, showing the traces of rusting.

viii) Deterioration and discoloration

Deterioration of concrete, which may degrade concrete performance, is caused by chemical reactions. Discoloration is a phenomenon changing concrete colour by deterioration.

ix) Settlement

Settlement is observed on bridge structures including sub structures, foundations and their associated facilities.

x) Movement

Movement includes movements and rotations of substructures, foundations and associated facilities. Also, retaining walls and block masonries forced out fall in this category.

xi) Scouring

Scouring, which is caused by swift current, exposes structures including footings and foundations of bridges constructed in a river or the sea.

xii) Exposure

Exposures, which are often caused by disasters, are seen on footings and foundations.

2) Inspection Methods

(a) Inspection Methods

Table 15.18 shows inspection methods for bridge substructures and foundations.

Table 15.18 Inspection Methods

Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Unscheduled inspection	Survey & Design
Bridge Substructure	Abutment Pier	a. Cracks	X		X	X	As requested
		b. Peeling and creep	X	X	X	X	
		c. Steel bar exposure & corrosion	X	X	X	X	
		d. Voids	X		X		
		e. Honey combs	X		X		
		f. Free lime	X		X		
		g. Rusty fluid	X	X	X		
		h. Peeling at repaired portion	X	X	X	X	
Bridge foundation	Foundation	i. Scouring/ river bed settlement	X		X	X	
Associated facilities	Associated facilities	j. Settlement/ movement/ washed out	X		X	X	
Others	Reinforced portions	k. Reinforcement does not function well.	X		X		

(b) Inspection Devices

i) In order to detect settlement, movement and leaning of substructures, overall judgment needs to be made with attention directed to expansion gaps of bridges and to the structures in adjacent areas.

ii) It is also recommended to search the entire bridge structure under consideration for any damages by conducting supplementary inspections on the deformation and cracks on the drainage systems, block and stone masonries in the nearby areas by means of string line and level measurement.

iii) In principle, a short-distance visual inspection with hammering is to be applied. However, appropriate equipment needs to be applied if necessary in accordance with the extent of defects and deteriorations. Equipment often used for detailed inspection is shown in **Table** 15.19 with sample diagnoses on the inspection results.

Table 15.19 Inspection Devices

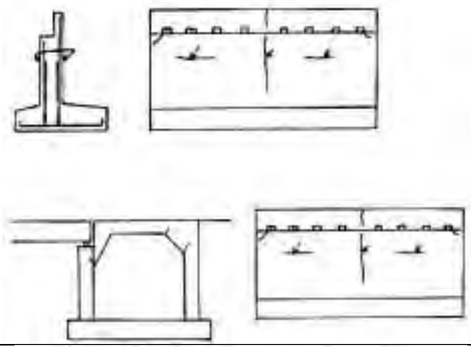
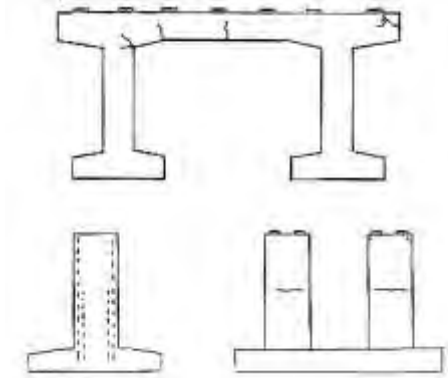
Inspection Devices	Diagnosis (Sample)		
Measurement of neutralization with phenolphthalein liquid		Neutralization progresses and reaches steel bars	Neutralization progresses, but does not reach steel bars
Measurement of the depth of steel bar coverage by non-destructive instrument			
Measurement of compression strength with Schmidt hammer		Compression strength is far below its design value.	Compression strength is a little below its design value.

iv) If periodic inspections point out further surveys and designs are needed in order to detect causes of defects and deterioration, to plan and design repair works and to determine timing of repair works, it is recommended to implement the measurement of neutralization depth by concrete core sampling, compression strength, modulus of elasticity, salt contents, alkaline contents and the amount of residual swelling. In addition, it is also recommended to study the environmental conditions surrounding the bridges.

3) Inspection points

Table 15.20 shows inspection points of bridge substructures and foundations which are specially focused on in these inspections.

Table 15.20 Focus Points of Inspection

Structure	Points to be specially focused	Figures
■ **Abutments** Reversed T-type abutment Rigid-frame abutment	a. Cracks near shoe beds b. Cracks on the sections changing steel bar volume c. Cracks due to lack of construction joints d. Cracks at the corners and on the sections changing cross sections e. Voids in backfill material	
■ **Piers** T-type piers Wall type piers Rigid-frame piers Column piers	a. Cracks near shoe beds b. Cracks on the base of cantilevered concrete c. Cracks at the corners and on the sections changing steel bar volumes.	
■ **Foundations**	a. Shortage of gaps between superstructures and substructures due to movement or leaning of substructures. b. Cracks near the base of concrete wings. c. Voids under the foundation d. Scouring and lowered river beds.	

4) Diagnosis of Inspection Results

Table 15.21 shows diagnosis criteria for the inspection of bridge substructures and foundations.

Table 15.21 Diagnosis of Inspection Results

Structures	Members	Damages	Diagnosis criteria (Refer to Table 7.1-11)		
			D	c	B
Substructure	Abutment Pier	a. Cracks	Large crack at support end or cantilevered base	Small cracks at small intervals reached to rebar depth	crack at long intervals do not reached to rebar depth
		b. Peeling and creep		Peeled or large creeping	Small creeping
		c. Steel bar exposure &		Sever exposure and corroded	Partial exposure

Structures	Members	Damages	Diagnosis criteria (Refer to Table 7.1-11)		
			D	c	B
		corrosion			
		d. Voids		Large cavity	Cavities exist
		e. Honey combs		Large honey combs	Honey combs exists
		f. Free lime			
		g. Rusty fluid		Extensive rusty fluid	Leaks water and rusty fluid exists
		h. Peeling at repaired portion		Peeling or creeping at repaired portion	
Bridge foundation	Foundation	i. Scouring/ river bed settlement	Footing or caisson or abutment base is scoured deeper than design	Footing or caisson or abutment base is scoured to exposure	
Associated facilities	Associated facilities	j. Settlement/ movement/washed out		Severe damage by settlement, movement or wash out	partially damaged by settlement, movement or wash out
Others	Reinforced portions	k. Reinforcement does not function well.		RC or steel sheet is not connected	

(5) Bearing

1) Damages and Deteriorations

(a) Steel bearings

- ✓ Breakdown of bearing body
- ✓ Damages to attachments
- ✓ Damages to grout concrete or mortar
- ✓ Abnormal expansion gaps
- ✓ Abnormal sounds
- ✓ Piling of dust and sand

(b) Rubber bearings

- ✓ Deterioration of rubber
- ✓ Damages to attachments
- ✓ Corrosion
- ✓ Damages to grout concrete or mortar
- ✓ Abnormal expansion gaps
- ✓ Piling of dust and sand

2) Inspection Methods

Table 15.22 shows inspection methods for bridge bearings. It is necessary to conduct short-distance visual inspections, in principle, to all bearings.

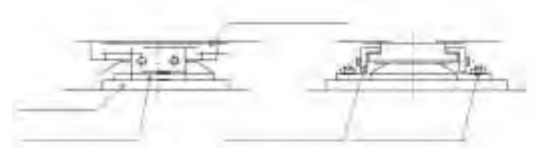
Table 15.22 Inspection Methods

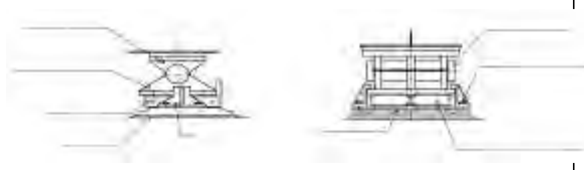
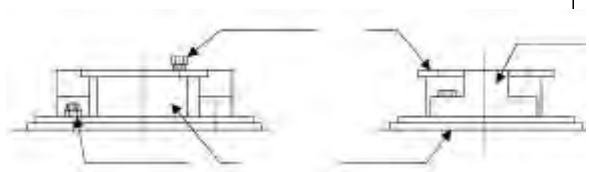
Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Survey & Design
Steel Bearing Shoes	Body	a. Damages	-----	-----	X	As requested
		b. Corrosion	-----	-----	X	
	accessory	a. Damages	-----	-----	X	
		b. Corrosion	-----	-----	X	
	Shoe base concrete	**a. Damages**	-----	-----	X	
	Others	**a. Abnormal gap margin**	-----	-----	X	
		b. Abnormal sound	-----	-----	X	
		c. debris or soil piling	-----	-----	X	
Rubber Bearing Shoes	Body	a. Damages	-----	-----	X	
		b. Corrosion	-----	-----	X	
	accessory	a. Damages	-----	-----	X	
		b. Corrosion	-----	-----	X	
	Shoe base concrete	a. Damages	-----	-----	X	
	Others	a. Abnormal gap margin	-----	-----	X	
		b. Debris or soil piling	-----	-----	X	

3) Inspection points

Table 15.23 shows the focus points of bearing inspection with illustrations.

Table 15.23 Focus Points of Inspection on Bridge Bearings

Bearing Type	Focus points of inspection	Illustration
Line Bearing shoe	● Damages and corrosion on lower shoe ● Damages on side block ● Damages on pinch plate ● Damages on stopper for the upper shoe ● Damages and corrosion of anchor bolts ● Damages to grout concrete or mortar.	
Metal bearing plate shoes	● Damages and corrosion on lower shoe ● Damages on bearing plates ● Improper contact of side block and breakage of side block bolts ● Damages on the stopper for the upper shoe ● Breakage of set bolts ● Damages and corrosion of anchor bolts ● Damages to grout concrete or mortar.	

Multiple roller shoe	● Damages and corrosion on upper shoe, lower shoe and base plate. ● Improper contact of side block and breakage of side block bolts ● Damages to the lower shoe ● Breakage of set bolts ● Damages to pins that impact functioning ● Damages and corrosion of anchor bolts ● Damages to grout concrete or mortar ● Damages on protective cover.	
Rubber shoe	● Damages and deterioration on rubber materials ● Displacement and deviation of rubber materials ● Bulging of rubber materials ● Abnormal space between upper shoe and rubber ● Damages on side block and breakage of set bolts ● Damages on the upper shoe stopper ● Breakage of set bolts ● Damages and corrosion of anchor bolts ● Damages on grout concrete or mortar.	

4) Diagnosis of the Inspection Results

Table 15.24 shows the diagnosis criteria for the bridge steel and rubber bearing shoes.

Table 15.24 Diagnosis of Inspection Results

Structures	Members	Damages	Judge (Refer to Table 7.1-11)		
			D	C	B
Steel Bearing Shoes	Body	c. Damages	Vertical load support function does not function well due to breakdown of shoe materials by loading	・ Shoe body moves up and down due to improper friction against horizontal movement. ・ Cracks are detected on the members supporting a vertical load.	Movement or rotation function slight malfunction
		d. Corrosion	Vertical load support function does not function well due to serious corrosion.	Vertical load support function declines due to corrosion.	Moving and rolling functions are declining due to corrosion.
	Accessories	c. Damages	-----	・ Breakdown of set bolts ・ Damages on side block and pinch plates. ・ Breakdown of anchor bolts	・ Looseness of set bolts, side block and anchor bolt nuts.
		d. Corrosion	-----	Cross section damage	Paint is partially deteriorated and corroded.
	Shoe base concrete	e. Damages	Vertical load supporting function does not work well due to breakdown of base concrete or mortar.	Some breakdown of base concrete or mortar is detected.	

Structures	Members	Damages	Judge (Refer to Table 7.1-11)		
			D	C	B
	Others	f. Abnormal gap margin	Upper and lower shoe move significantly so that vertical load supporting function does not function well.	Movement reaches beyond the allowable level, like collision with stopper.	Movement sometimes reaches beyond design values.
		d. Abnormal sound		Loud crashing sound is generated.	Shoe generated sound.
		e. debris or soil piling		Shoe is filled with soil or debris	Debris or soil is piled around shoe.
Rubber Bearing Shoes	Body	c. Damages	Rubber was compressed and broken and can no longer perform load supporting function.	Cracks, swelling, shearing gap and turn-up are observed on the whole rubber shoe.	Some cracks, swelling, shearing gap and turn-up are observed on the rubber shoe.
		d. Corrosion		Corrosion is observed on reinforcement plates.	Corrosion is observed on the upper shoe and the lower shoe.
	Accessories	c. Damages		・ Set bolts broken ・ Damages on pinch plates and side blocks. ・ Side block bolts are broken ・ Anchor bolts are broken or pulled out.	・ Looseness of Set bolts ・ Looseness of side block bolts ・ Looseness of anchor bolts
		d. Corrosion		Cross section reduced due to corrosion	Paint is deteriorated and corrosion arises.
	Shoe base concrete	b. Damages	Shoe base mortar or concrete is damaged so severely that it can no longer perform load supporting functions	Shoe base mortar or concrete is broken and voids are detected.	Shoe base mortar or concrete is cracked and peeling.
	Others	c. Abnormal gap margin	Shoe moves beyond allowable levels and can no longer perform vertical load supporting functions.	Movement reached beyond the allowable level, like collision with stopper.	Movement sometimes reaches beyond design values.
		d. Debris or soil piling		Shoe is filled with soil or debris	Debris or soil is piled around shoe.

CHAPTER 16 SLOPE INSPECTION

(1) Focus Points of Inspection

1) Embankment Slopes

Road embankment constructed with half cutting and half fill on the narrow inclined valleys in the mountainous area should be carefully inspected as rainfalls often causes high concentrations of water in the narrow valleys which has negative effects on the embankment. Inspection should be carried out on whether plants or grasses fully cover the slopes or whether soil erosion has occurred. Any changes seen on the surface of the embankment, such as cracks on the slope shoulder, differences in level or swelling, should be carefully monitored. In addition, if urgency is detected to ensure stability of the embankment by survey results, appropriate measures, such as the installation of drain borings, should be implemented to drain out water from embankments.

Focus points of embankment inspection are shown in **Figure** 16.1**.**

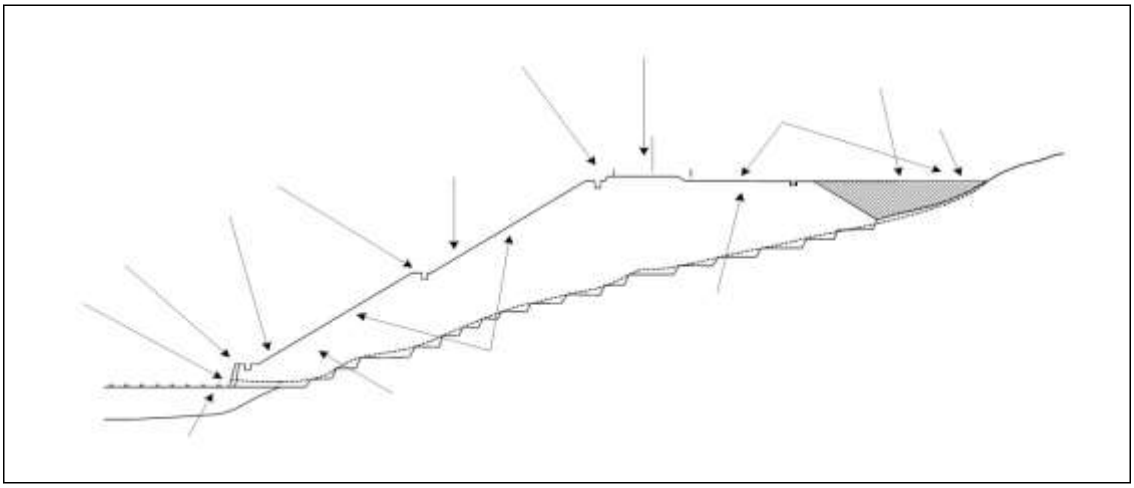


Figure 16.1 Focus Points of Inspection on Embankment Slopes

1) Cut Slopes

Cracks emerging on the slopes and forward swelling of cut slopes are the main symptoms of imminent slope failures. Cut slope failures often occur from the upper part of slopes including cut shoulders, so that it is necessary to investigate the existence of cracks in a wider area including natural slopes surrounding the cut slopes under consideration. Block masonries and concrete frames on the slope often show the first symptom of slope failures, so that it is particularly important to check for deformation of these structures.

To be noted here is the need to pay special attention to any spring water seen on the cut slope and water treatment on the cut shoulders, as heavy rainfall may raise ground water level near the slope and have negative effects on the stability of cut slopes. Care should be directed to any changes of water near the cut slopes including occurrence of spring water, water volume and turbidity, which may contribute to early detection of slope failures.

The focus points of cut slope inspection are shown in Figure 16.2.

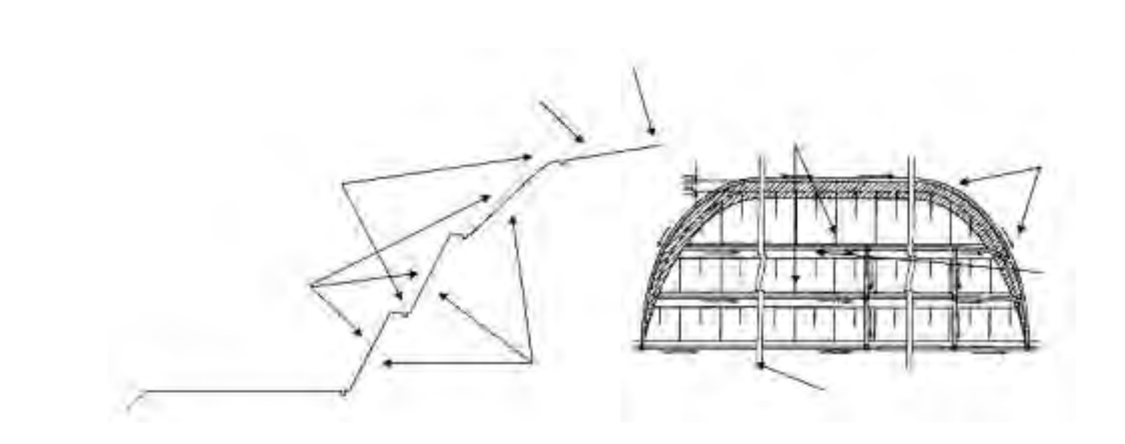


Figure 16.2 Focus Points of Inspection on Cut Slopes

(2) Damages and Deteriorations

Major damages and deteriorations by structure types to be focused on during the inspection are listed below;

1) General slopes without protection

- ✓ Slope failure
- ✓ Cracks, swelling and subsidence
- ✓ Gully erosion and falling of slope surface soils
- ✓ Deposit soil on slope berms
- ✓ Spring water
- ✓ Fall of planted trees
- ✓ Loose stones and rolling stones
- ✓ Growth of hydrophilic plants and weakening of slopes

1) Structurally protected slopes

(a) Precast and cast-in-place concrete crib works

- ✓ Cracks and Peeling of concrete materials
- ✓ Looseness, swelling and subsidence
- ✓ Improper drainage and spring water

(b) Concrete or mortar spray

- ✓ Cracks and Peeling of concrete or mortar materials

- ✓ Swelling and subsidence
- ✓ Water drain and spring water
- ✓ Voids

(c) Concrete block and stone masonry

- ✓ Cracks, looseness and swelling
- ✓ Settlement, movement and leaning
- ✓ Abnormal joints
- ✓ Scouring
- ✓ Improper drainage and spring water

(d) Wire cylinder and mat gabion masonry

- ✓ Deformation
- ✓ Wire corrosion and rupture
- ✓ Displacement
- ✓ Fall of fill material

2) Retaining walls

- ✓ Cracks, corner collapse, peeling, creeping
- ✓ Exposure of steel bars and corrosion
- ✓ Settlement, movement, leaning, abnormal joints
- ✓ Scouring, improper drainage, spring water

3) Drainage system

- ✓ Damages to drain bodies
- ✓ Improper connection between drains
- ✓ Accumulation of debris and garbage
- ✓ Water flow hindered by grass

(3) Inspection Methods

1) General slopes without protection

Table 16.1 shows the inspection methods for the general slopes.

Table 16.1 Inspection Methods for General Slopes

Structures	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unscheduled inspection	Survey & Design
Cut slopes Embankmen	General slopes	a. Collapse	X	-----	X	X	As required
		b. Cracks /	X	-----	X	X	

Structures	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unscheduled inspection	Survey & Design
ts		swelling /settlement					
		c. surface erosion	X	-----	X	X	
		d. dumping of soil on slope step	X	-----	X	X	
		e. spring water	X	-----	X	X	
		f. tree fall	X	-----	X	X	
		g. plant death	X	-----	X	X	
		h unstable rock rolling stone	X	-----	X	X	
		h. Glowing of hydrophilic plants and weakening of slope	X	-----	X	X	

2) Structural slope protection

Daily inspection is conducted by on board visual inspection. If unusual conditions were detected, inspection staffs are requested to get out of the car and to check them with visual inspection.

Table 16.2 Inspection Methods for Structurally Protected Slopes

Structures	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unscheduled inspection	Survey & design
Structurally Protected slopes	Concrete block frame in situ /concrete frame	a. cracks/ peeling	X	-----	X	X	As required
		b. loosening /swelling /settlement	X	-----	X	X	
		c. spring water/ drain water	X	-----	X	X	
	Mortar spray Concrete spray	a. cracks/ peeling	X	-----	X	X	
		b. loosen / Swelling /settlement	X	-----	X	X	
		c. Voids	X	-----	X	X	
		d. spring water/ drain water	X	-----	X	X	
Masonries	Concrete Block Masonries	a. Cracks/ swelling/ loosening	X	-----	X	X	
		b. Settlement/ movement/ leaning	X	-----	X	X	
		c. Abnormal joints	X	-----	X	X	
		d. Scouring	X	-----	X	X	
		e. Poor drainage or spring water	X	-----	X	X	
	Slope gabion works	a. Steel wire rupture or corrosion	X	-----	X	X	
		b. Deformation	X	-----	X	X	

3) Retaining walls

Table 16.3 shows the inspection methods for the concrete retaining walls.

Table 16.3 Inspection Methods for Retaining Walls

Structures	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unscheduled inspection	Survey & design
Concrete retailing walls	Reinforced concrete retailing walls	a. Cracks and corner drop	X	-----	X	X	As required
		b. Peeling	X	-----	X	X	
		c. Steel bar exposure	X	-----	X	X	
		d. Settlement or movement	X	-----	X	X	
		e. Abnormal joint gap	X	-----	X	X	
		f. Scouring	X	-----	X	X	
		g. Poor drainage or spring water	X	-----	X	X	

4) Drainage systems on the slopes

Table 16.4 shows the inspection methods for the drainage systems on the slopes.

Table 16.4 Inspection Methods for Drainage System on the Slopes

Structures	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unscheduled inspection	Survey & design
Drainage	Slope shoulder drainage/ berm drainage/ Vertical drainage	a. Damages	X	-----	X	X	As required
		b. Improper connection	X	-----	X	X	
		c. Debris/ soil accumulation	X	-----	X	X	
		d. Water flow hindered by grass	X	-----	X	X	

(4) Diagnosis of the Inspection Results

1) General slopes without protection

Table 16.5 shows the diagnosis criteria for the results of inspection on the general slopes.

Table 16.5 Diagnosis Criteria for General Slope Inspection

Structures	member	Sort of damage	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
General slopes		a. Collapse	Slope failure is detected with high potential for expansion	Small slope failure is detected which has less potential for expansion	
		b. Cracks / swelling /settlement	Cracks, swelling or settlement is observed which may lead to slope failure	Cracks, swelling or settlement is observed which may not lead to slope failure	

		c. surface erosion	Wide area surface erosion is observed and high potential of spread.	Partial erosion is detected, but may not spread.	
		d. Deposits of soil on slope steps	Deposits of soil and stone hinder the drainage installed on the slope steps.	Deposits of soil and stone are identified that do not hinder the drainage installed on the slope steps	Deposits of soil and stone are identified, but are small-scale and they do not hinder the drainage on the steps.
		e. spring water	Spring water is identified which increases in volume when rain falls and has a high potential for causing slope failures.	Spring water is identified which increase in volume when rain falls, but it is not a high potential for causing slope failures.	Spring water is identified, but it is not a high potential for causing slope failures.
		f. tree fall	There are fallen or tilted trees, making holes around roots which can induce water infiltration into the slopes and cause slope failures.	There are fallen or tilted trees, but they do not lead to slope failures.	Weeds which overran a wide area of slopes are identified.
		g. plant death	-----	Lawn coverage is less than 30%	Lawn coverage is more than 30% and less than 70%
		h. unstable stone/ rolling stone	There are many unstable stones or rolling stones identified.	There are unstable stones or rolling stones identified, but not many.	-----
		i. Growing of hydrophilic plants and weakening of slope	Slopes are weakened by spring water and covered with hydrophilic plants. They have a high potential for slope failures.	Slopes are weakened by spring water and covered with hydrophilic plants. Boring investigation is needed to determine underground water conditions.	-----

2) Structural slope protection

Table 16.6 shows the diagnosis criteria for the results of inspection on the structural types of slope protection.

Table 16.6 Diagnosis Criteria for Structurally Protected Slope Inspection

position	member	Sort of damage	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
Structural slope protection	Concrete block frame in situ /concrete frame	a. cracks/ peeling	Severe cracks or concrete peeling, which may be expected to cause concrete fall or collapse, are observed.	Cracks or concrete peeling are widespread over the area.	Cracks or concrete peeling is spread over part of the area.
		b. Looseness/ swelling/ settlement	Serious looseness, swelling or settlement is seen on the facilities which may lead to failures.	Looseness, swelling or settlement is seen on the facilities, but they may not lead to failures.	-----
		c. spring water/ drain water	A large amount of spring water is identified from facility joints, and water drain pipes on the facilities are filled with soil and have a high potential of causing slope failures.	-----	Spring water is identified from facility joints or drain pipes, but they do not lead to slope failures.
	Mortar	a. cracks/	Severe cracks, swelling or	Cracks, swelling or	Small cracks, swelling

position	member	Sort of damage	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
	spray/ Concrete spray	peeling	settlement is observed which may lead to slope failure	settlement are observed. They may not lead to slope failures soon, but may lead to failure in the long run.	or settlement is observed over part of the area which may not lead to slope failure
		b. loosening / swelling/ settlement	Slope edge push-out, swelling and shear gaps at construction joints are observed which may lead to slope failures.	-----	Slope edge push-out, swelling and shear gaps at construction joints are observed, but they may not lead to slope failures.
		c. Voids	-----	-----	A trace of soil flow-out is observed from drain pipes after rainfalls, and hammering inspection detects the existence of voids behind the surface concrete or mortar.
		d. spring water/ drain water	A large amount of spring water is identified from facility joints, and water drain pipes on the facilities are filled with soil and have a high potential of causing slope failures.	-----	Spring water is identified from facility joints or drain pipes, but they do not lead to slope failures.

3) Retaining walls

Table 16.7 shows the diagnosis criteria for the results of inspection on the concrete retaining walls.

Table 16.7 Diagnosis Criteria for Retaining Wall Inspection

Position	Member	Sort of damage	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
Concrete retailing wall	RC Retaining wall	a. Cracks/ corner failures	Severe crocodile cracks are detected, which reach inner steel bars with free lime and rusty fluid.	Small cracks running parallel with narrow gaps are detected, which reach inner steel bars.	Small cracks running parallel with wide gaps are detected, which do not reach inner steel bars.
		b. Concrete Peeling		Extensive concrete peeling or creep is identified	Partial peeling or creep is identified.
		c. Steel bar exposure and corrosion		Severe steel bar exposure is identified with the progress of corrosion.	Partial steel bar exposure is identified.
		d. Settlement/ movement/ tilting	Settlement, movement or tilting of facilities are identified which may possibly lead to collapse.	Settlement, movement or tilting of facilities are identified which may need further survey on the causes of the incidents.	Settlement, movement or tilting of facilities are identified, but they may not lead to collapse.
		e. Abnormal construction joints	Large joint gaps are identified which may lead to collapse.	Joint gaps are identified which may not lead to collapse soon, but may lead to it in the long run.	Joint gaps are identified, but they may not lead to collapse.
		f. Scouring	Serious scouring is identified at foundations	Scouring is identified at foundations or around	Limited or partial scouring is identified at

Position	Member	Sort of damage	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
			or around main bodies which may need urgent countermeasures.	main bodies, which may need countermeasures in the long run.	foundations or around main bodies, but the potential of progress is not expected.
		g. Drainage / spring water	A large amount of spring water is identified from facility joints, and water drain pipes on the facilities are filled with soil and have a high potential of causing slope failures.	-----	Spring water is identified from facility joints or drain pipes, but they do not lead to slope failures.

4) Drainage systems for the slope

Table 16.8 shows the diagnosis criteria for the results of inspection on the slope drainage systems.

Table 16.8 Diagnosis Criteria for Drainage System Inspection

Position	Member	Sort of damage	Diagnosis criteria (Refer to Table 7.1-11)		
			D	C	B
Slope drainage systems	・Slope shoulder drainage/ ・Slope step drainage ・Vertical drainage ・Catch basins	a. Damages to drainage body	Water overflow and rain water infiltration caused by damaged drainage systems are observed, and this may possibly lead to slope failures.	Damages of drainage systems are identified which hinder drainage functions.	-----
		b. Improper drainage joints	Water leakage from joints and water infiltration into slopes are observed which may possibly lead to slope failures.	-----	Water leakage is so small that it does not lead to slope failures.
		c. Debris/ soil accumulation	Large piling of soil and debris is observed which may lead to slope failures.	Piling of soil and debris is observed which may hinder drainage functions.	Limited or partial piling of soils and debris is detected, but it does not lead to slope failures.
		d. Hindrance of drain function by weeds	Drainage function is seriously hindered and this may lead to slope failures.	-----	Weed is identified, but it does not hinder drainage functions.

CHAPTER 17 TUNNEL

(1) Inspection Flow

Figure 17.1 shows the basic inspection flow.

The detailed inspection is basically conducted by the short distance visual inspection and hammering method, the target area decision is based on the first evaluation by surface photo analysis.

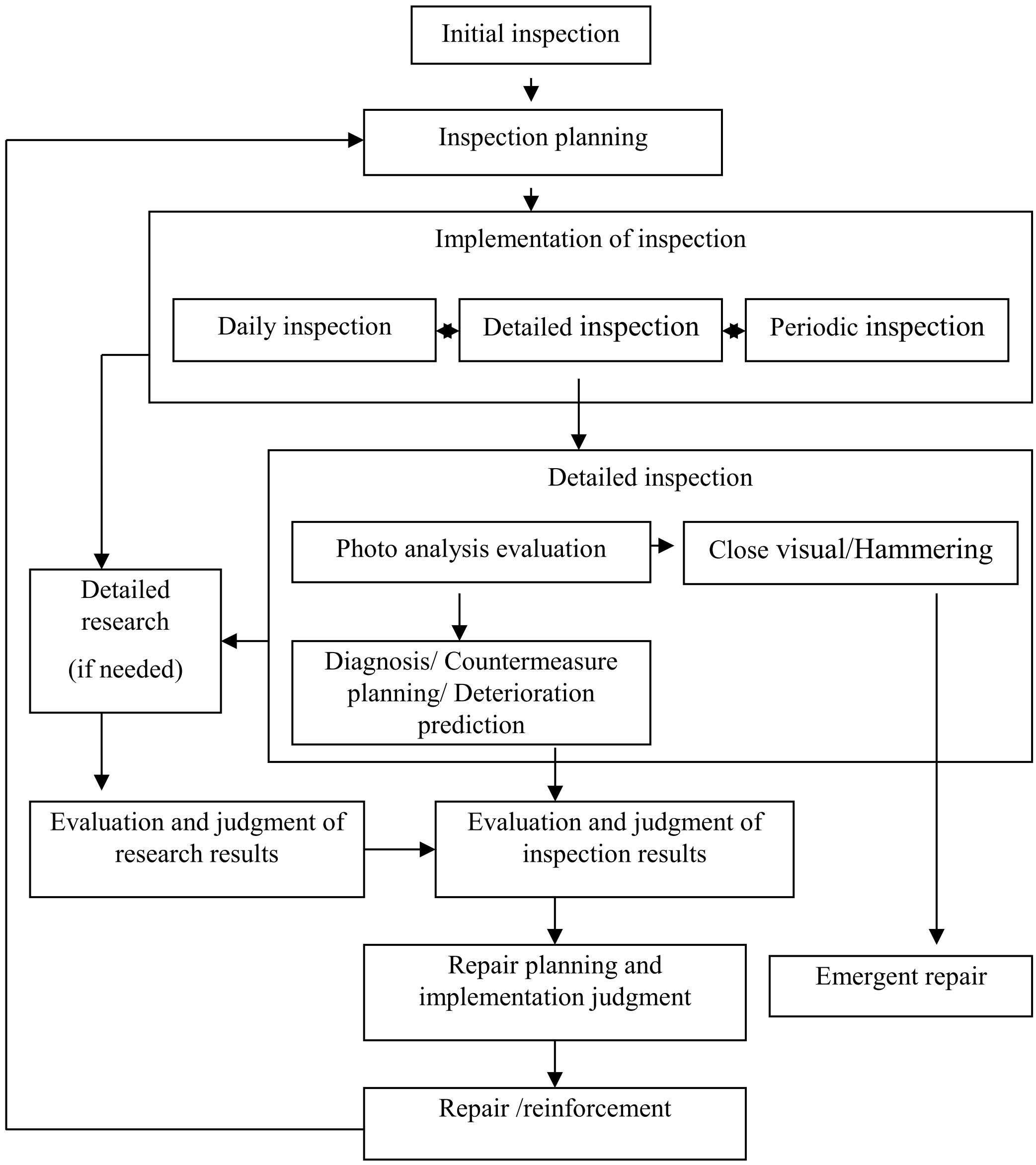


Figure 17.1 Tunnel Inspection Flow

(2) Inspection Focus Points

1) Focus points for inner lining

- ✓ The inner lining concrete is deteriorated by aging. The damages of aging are cracks, peeling, creeping, carbonation, leakage and free lime.
- ✓ The gaps and cracks on the drain gutter and or pavement are caused by pressure stress or partial stress for inner lining concrete. And cracks or gaps on the inner lining concrete are caused by tensile stress on the inner lining. This partial pressure is one of the main causes of tunnel damage, therefore, it is necessary to check carefully and when it is found it is better to shift from inspection to study stage.
- ✓ The leakage from inner lining is the cause of cavities inside the lining concrete then it will create partial stress in the inner lining. This leakage leads to damage to the facilities of the tunnel, pavement damages and slippery driving conditions.
- ✓ Poor quality construction at the construction stage such as repair of mortar on honeycomb in the concrete, improper pouring at the arch crown and gaps at construction joints by improper concrete forming leads to cracks, peeling, corner dropping, and leakage due to aging and vibrations.

1) Focus points on tunnel portal

- ✓ In case of weakened bearing capacity at the tunnel portal, uneven settlement will occur.
- ✓ The transverse cracks and gaps on the construction joint are caused by uneven settlement at the tunnel portal.
- ✓ It is necessary to check for signs of rebar corrosion because the tunnel portal is a reinforced concrete structure.
- ✓ It is better to check the surrounding slope at the inspection of the tunnel portal.

2) Focus points on inner lining plates

- ✓ The damages of inner lining plates are corrosion of fixing devices and bolts by leakage and deformation by vehicle impact.
- ✓ The damages on the tile inner plate are damages to the tile adhesive by leakage or vibration of vehicles and damages by vehicle impact. Cracks at joints or sealing of tile at the concrete or inspection footpath must be checked for. The creeping of tiles cannot be checked by visual inspection.

3) Focus points for Ceiling plate

- ✓ The damages to ceiling plate are mainly on the fixing devices or bolt corrosion.

4) Focus points for the drain system

- ✓ The slope of the gutter in a tunnel is gentle due to the gentle slope of the tunnel, therefore the debris or sediment in the ditch must be checked.

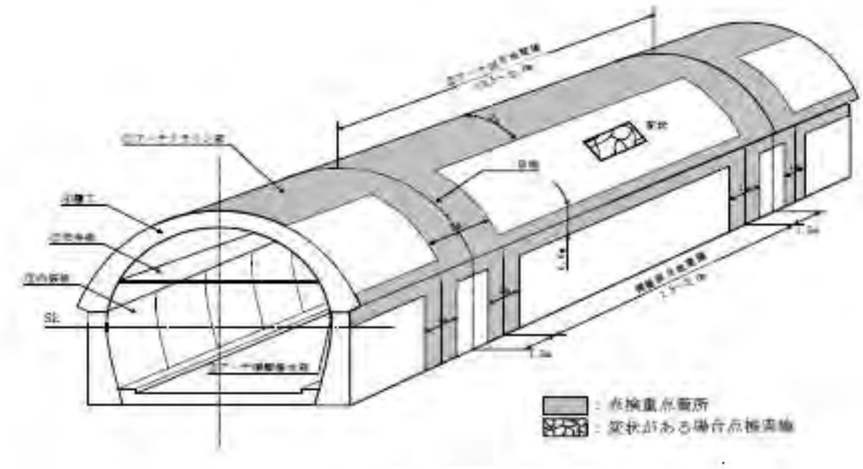
- ✓ It is necessary to check the concrete inner lining and partial stress when deformation or breaks in the gutter are found.

5) Focus points on pavement

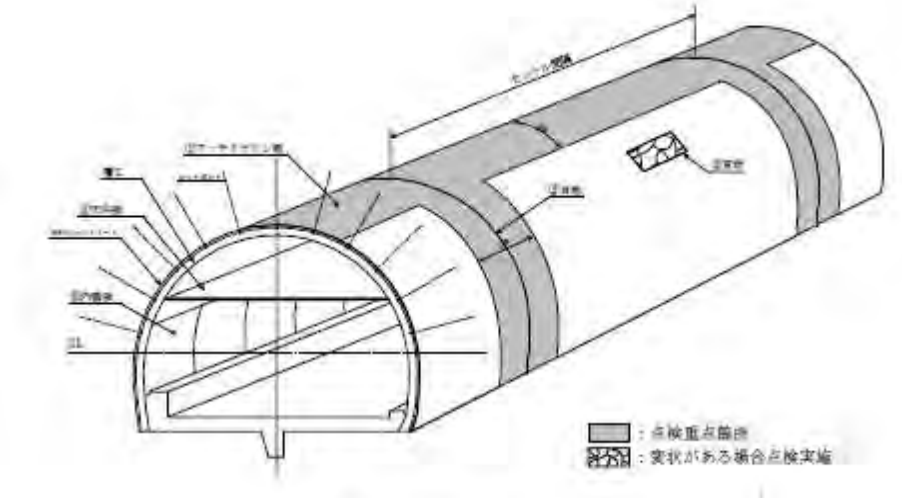
- ✓ When cracks, depressions or swelling in the pavement are found, it is necessary to check the other portion such as tunnel gate, inner lining and drain system for confirmation of the cause of the damages due to outer stress.

(3) Focus Points on Damages

1) Focus points for tunnel inner lining



Sheet Pile Tunnel



NATM Tunnel

Figure 17.2 Tunnel Inner lining Focus Points

(a) Cracks /Corner Drop/ Peeling/ Floating

Concentrated cracks that are progressing rapidly or wide tensile cracks or wide sheer cracks are judged D. A large volume of concrete peeling or floating can lead to severe damage to the tunnel so this case is categorized as D. If the cracks or peeling are caused by partial stress or cavities, they will lead to severe damage so detailed research will be needed

(b) Leakage/ Free Lime

Large volume leakage leads to the creation of large cavities or partial stress so they are categorized as D.

(c) Tilt / Movement/ Settlement

If the tunnel gate is inclined by visual inspection or has transverse cracks in the inner concrete lining at the joint section to the gate, it will lead to tunnel failure, the rating is D.

(d) Gaps and Cracks

Large cracks or gaps in the pavement or drain gutter are signs of large stresses on the tunnel structure. Therefore the rate is D

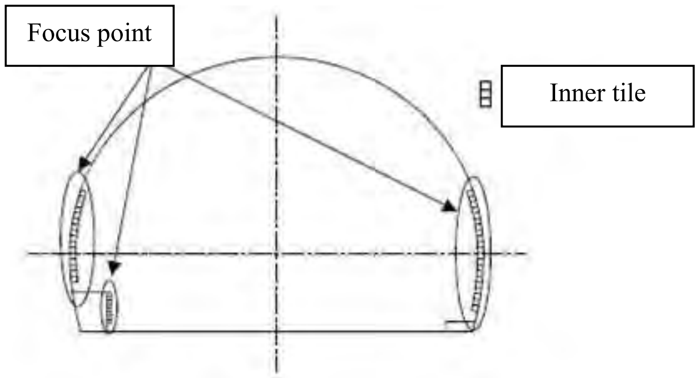
2) Tile inner plate covered tunnel

- ✓ The focus points of tile cover in the tunnel inspection are the construction joint cracks or tile cracks or tile sealing cracks.
- ✓ When tile creeping is clearly apparent, it must be removed for fear of hitting vehicles and is to be rated an emergency.
- ✓ When the creeping of tile is wide spread, the cause of the creeping is aging or temperature influence so that the area of creeping will expand the rating is C.
- ✓ When the cracks in the inner concrete lining or inspection foot path reach the tile background concrete, they will be a cause of creeping of tiles, and also it is necessary to check the cracks on pavement.
- ✓ The inspection method is visual inspection for peeling or creeping or sealing damage, and then the detailed inspection will be conducted by the following method.（inspection points are shown in **Figure** 17.2**.**

(a) Inspection method

- ✓ The inspection method for tiles is light hammering like a wiper action with a the test hammer （Figure7.1-25）
- ✓ The sound of hitting the joints is important and they should all sound the same. If the sound is different in one location something there is a problem there.

- ✓ When an abnormal tile is found, hit it carefully and if it can be removed, do so. The sealing is also checked for damage by hammering at the same time. Be careful with the tile to prevent breaking it during the inspection.



Test hammer

Figure 17.3 Focus Points and Test Hammer

Table 17.1 Tunnel Inspection Method (Lining)

Structure	Position	Member	Sort of damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
Tunnel	Concrete lining		d. Cracks/ corner drop	X	X		X
			e. Peel	X	X		X
			f. Joint gap	X	X		X
			g. Leakage/ free lime	X	X		X
			h. Deterioration material	X	X		X

Table 17.2 Tunnel Inspection Method (Portal)

Structure	Position	Member	Sort of Damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
Tunnel	Portal /entrance		a. Cracks/ corner drop	X	X		X
			b. Peeling	X	X		X
			c. Rebar exposure	X	X		X
			d. Settlement/ movement / tilt	X	X		X

Structure	Position	Member	Sort of Damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
			e. Joint gap	X	X		X
			f. Scouring	X	X		X
			g. Drain/ spring water	X	X		X

Table 17.3 Tunnel Inspection Method (Other Portion)

Structure	Position	Member	Sort of Damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
Tunnel	Inner lining plate		h. Body damage (plate type)	X	X		X
			i. Body damage (tile type)	X	X		X
			j. Accessory	X	X		X
	Ceiling plate		k. Body damage	X	X		X
			l. Accessory	X	X		X
	Drain system		m. Body damage	X	X		X
			n. Debris and soil dumping		X		X

(4) Repair・Reinforcement Ranking

The ranking of repair and reinforcement for selection of countermeasure methods are determined by the detailed inspection and the periodic inspection results through cause, classification and progress of damage, the flow of research and repair is shown in the following figure.

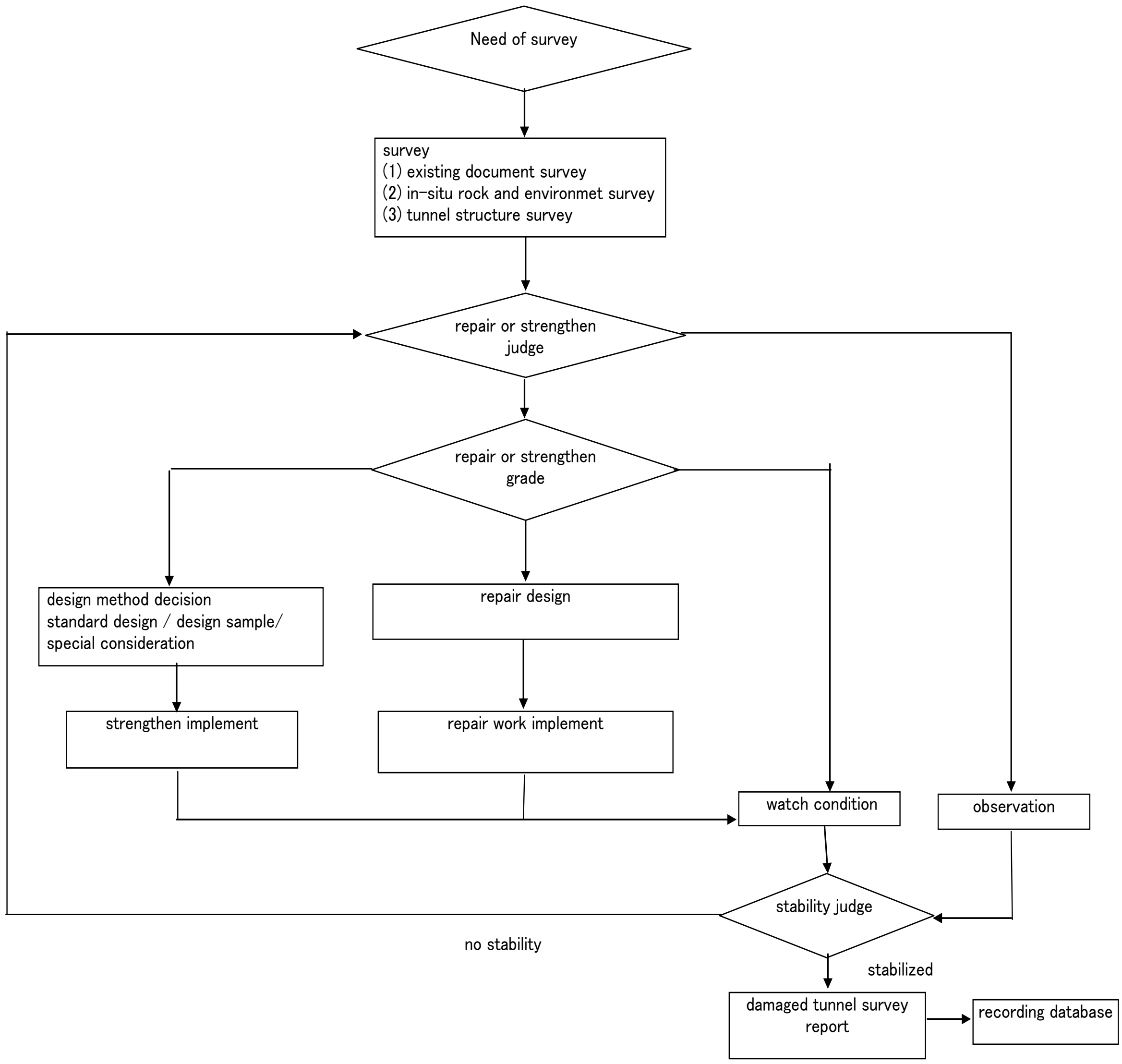


Figure 17.4 Flow of Selection for Repair and Reinforcement

CHAPTER 18 BOX CULVERTS

(1) Focus Points on Inspection

- ✓ If the base soil support layer is weak or the support strength is not even, transverse direction cracks are generated.
- ✓ The opening, gaps, sealing material dropping, leakage from sealing and free lime coming from culvert structure joints and cracks in the concrete are the phenomenon of box culverts that are experiencing uneven settlement and or tilting.
- ✓ In the case of the water way box culvert, there can be damage to the connection points due to leakage or scouring. This leads to damage and weakness of support strength or damage to neighbouring structures such as water way and retaining wall damage.
- ✓ Box culvert settlement can lead to insufficient clearance or vehicle collision.
- ✓ The general damages to the concrete structures are the same as to concrete bridges described in **Table** 15.12.

(2) Focus Points for Damages

The focus points for box culverts are shown in Figure 18.1.

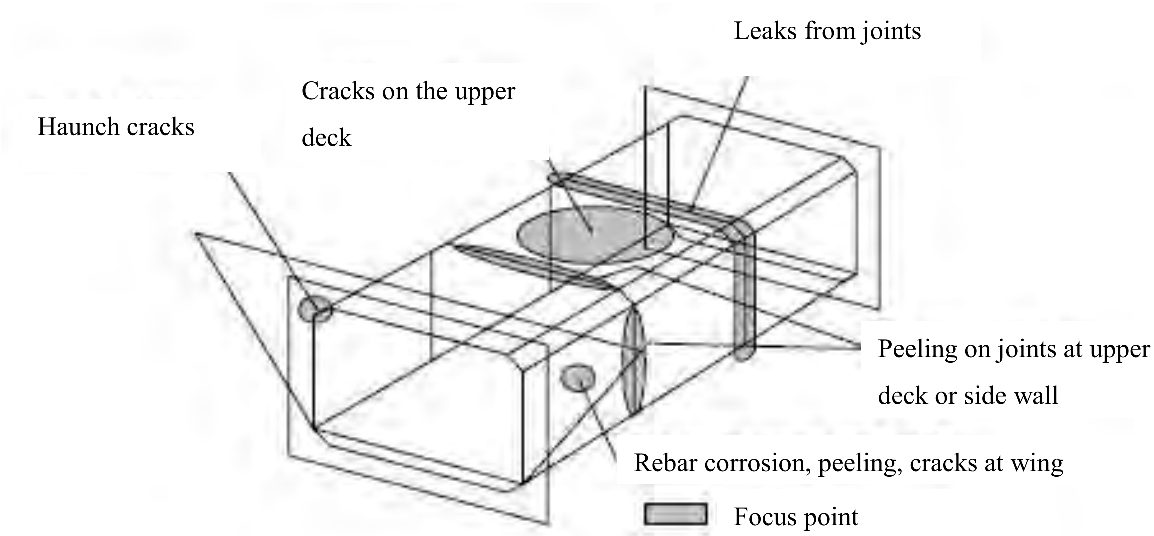


Figure 18.1 Box Culvert Focus Points

1) Settlement

(a) The box culvert does not have pile support. Usually a box culvert is set higher than the designated position to compensate for some settlement. However, sometimes there is more settlement than expected. If there are gaps between the approach road and the culvert it is rated C.

(b) If there is settlement or weakness of support strength due to leakage from the ceiling and or in case of settlement of neighbouring masonry or retailing walls, those are rated C.

2) Damage to Joints

If the structure joint openings or gaps become larger, leakage will occur.

3) Damage to concrete

RC concrete box culvert damages are rated the same as bridge substructure shown in Table 15.12.

4) Others

"RC concrete pipe culvert" is the same as reinforced concrete box culvert. If the pipe culvert damages at the connections leads to drainage malfunction, it is ranked E.

Table 18.1 Inspection Method (RC Box Culvert)

Structure	Position	Member	Sort of damage	Initial inspection	Daily inspection	Periodic inspection	Research & design
Box Culvert	RC pipe culvert		o. Cracks/ corner drop		X	X	
			p. Peeling		X	X	
			q. Rebar exposure		X	X	
			r. Settlement		X	X	
			s. Connection joint damage		X	X	
			t. Drain damage		X	X	

Table 18.2 Inspection Method (Pipe Culvert)

Structure	Position	Member	Sort of damage	Initial inspection	Daily inspection	Periodic inspection	Research & design
Box Culvert	Corrugated pipe culvert		u. Structure damage		X	X	
			v. Corrosion		X	X	
			w. Settlement		X	X	
			x. Connection joint damage		X	X	

			y. Drain damage		X	X	
			z. Drain damage		X	X	

Table 18.3 Inspection Method (Concrete Box Culvert)

	Defects & Deterioration	Diagnosis criteria		
		C/D	B	A
Reinforced concrete box culverts	Cracks	Serious alligator cracks are observed	cracks at short intervals reach rebar depth	cracks at long interval do not reach rebar depth
	Concrete Peeling/ Creep		Large scale Peeling or creeping	Some peeling or creeping
	Exposure of steel bars/ Corrosion		Severe rebar exposure and corrosion	Partial rebar exposure
	Concrete Voids		settlement/ movement / tilt can be seen	
	Water leakage/ Free lime		severe leakage or free lime and corrosion	Some leaks and free lime
	Settlement/ scouring		Severe settlement/ movement / tilt to cause stagnant water or a gap between the culvert and the road Severe scouring at wing or slope	settlement/ movement/ tilt to disturb drainage or scouring at wing or slope
	Abnormality at joints		joint gap exudes seal	joint gap is not in progress
Reinforced concrete pipe culvert	Cracks	Checkered cracks	cracks at short intervals reaches rebar depth	cracks at long intervals do not reach rebar depth
	Concrete Peeling		Large scale Peeling or creeping	Some peeling or creeping
	Exposure of steel bars/ Corrosion		Severe rebar exposure and corrosion	Partial rebar exposure
	Settlement		Severe settlement that disturbs drainage function	settlement that reduces drainage function
	Joint defects		severe leakage from connections	leakage from connections
	Water flow obstruction		Severely damaged with stagnant water inside pipe	damage that reduces the drainage
Colgate pipe culvert	Structure damage		Large scale deformation or severe cracks in the structure	Deformation or cracks in the structure
	Corrosion		Severely corroded	Some corrosion
	Settlement		Severe settlement that disturbs drainage function	settlement that reduces drainage function
	Connection joint damage		severe leakage from connections	leakage from connections
	Drain damage		Severe damage and stagnant water inside pipe	damage to reduce the drainage

CHAPTER 19 TRAFFIC SAFETY

The traffic safety inspection flow is shown in **Figure** 19.1.

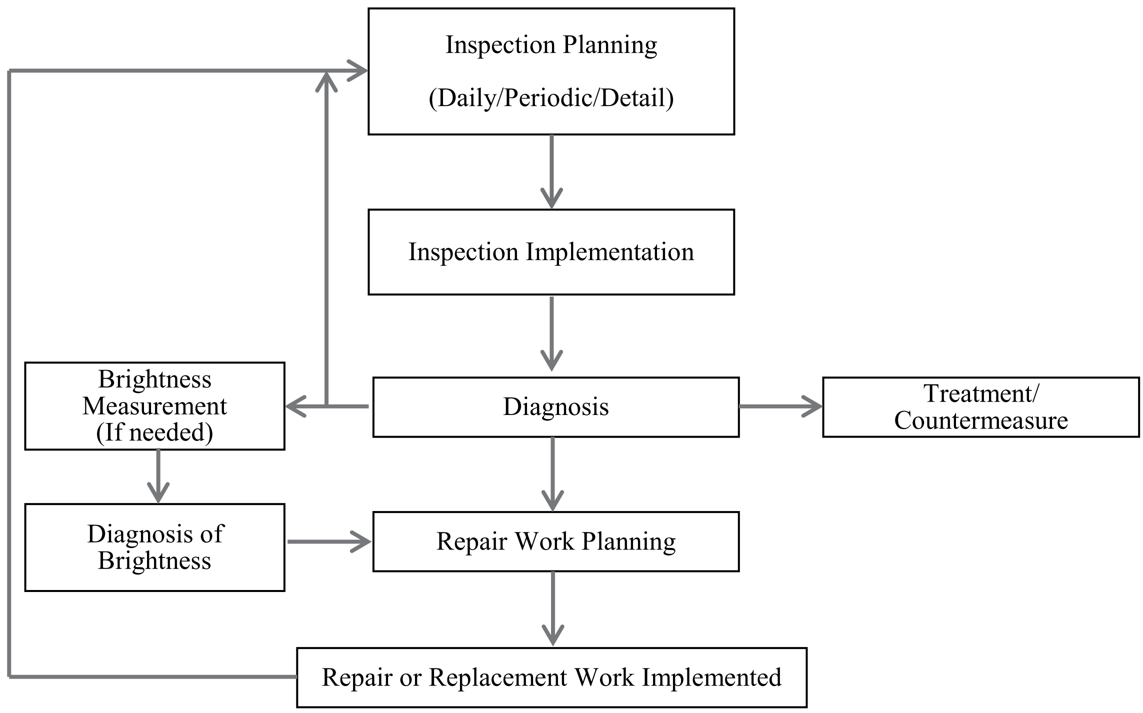


Figure 19.1 Traffic Safety Inspection Flow

This work is focused on the guardrail.

(1) Focus Points for Inspection

(a) Guardrail damages are the mostly deformation by the force of vehicle impact in an accident, so it is easy to find. However, there is a possibility neighbouring support poles and brackets have been damaged, therefore it is necessary to check not only the damaged point but also neighbouring points.

(b) If when the inspector climbs on the centre of the guard cable span, the upper cable sinks to reach the lower cable, that behaviour is called sagging.

(c) It is better to check the thickness of the support pole w an ultrasonic thickness meter when the support pole has been found to have corrosion during the visual inspection because the strength of the guard rail is dependent on the support pole.

The corrosion speed of guardrail pole is deeply depended on the setting position on the ground level when it has unevenness.

(2) Focus Points for Damage

(a) When there is deformation or severe damage to beams, pipes or cables or tilting of the support pole, it cannot fulfil the task of a guard rail which is the prevention of vehicles from crossing into oncoming traffic and the to enhance the security of passengers on board. This is rated rank D.

(b) When there is damage, deformation, bending and or tilting of the beams, pipes, cables and/or supporting poles, but the guardrail still provides some level of reduced protection it is rated C.

(3) Accessory and base damages

When there is damage, parts lost, or loosening of bolts which leads the main structure damage, it is rated C.

(4) Corrosion

There is a potential for loss of cross sectional area when there is severe corrosion in the beam, pipe, cable and/or support pole. If the corrosion spreads across a wide area, it is rated C because this leads to a decrease in the function of the guardrail. The cross section loss is confirmed by thickness measuring, furthermore, the corrosion diagnosis is judge referring to the photos. It is important to determine the total corrosion situation and spreading area. The diagnosis of the reduction in function refers to collision test results where the affected area of the collision is almost 20m.

Table 19.1 Inspection Methods for Traffic Safety

Structure	Position	Member	Sort of damage	Initial inspection	Daily inspection	Periodic inspection	Research & design
Traffic safety	Guard rail	Guard rail	Structure	-	X	X	-
			Accessory	-	X	X	-
			Corrosion	-	X	X	-
			base portion	-	X	X	-
		Guard cable	Structure	-	X	X	-
			Accessory	-	X	X	-
			Corrosion	-	X	X	-
			Base portion	-	X	X	-
		Wall type railings	Cracks/ /corner drop	-	X	X	-

Table 19.2 Diagnosis for Traffic Safety

Structure	Position	Member	Sort of damage	Judge D	Judge C	Judge B
Traffic safety	Guard rail	Guard rail	Structure	Severe damage or tilt at the support pole, beam or pipe	damage or tilt at the support pole, beam or pipe	Slight damage or tilt at the support pole, beam or pipe
			Accessory	There are loosened or damaged Fixing devices or missing bolts	-	There are some loosened Fixing devices or bolts but none are missing

			Corrosion	-	Corrosion is wide spread	Some corrosion found
			Base portion	There is a pull out of anchor or wash out of base that could lead to failure	-	There is limited pull out of anchor or wash out of base
		Guard cable	Structure	Severe damage , tilt or sagging at support pole or cable	damage, tilt or sagging at support pole or cable	Limited damage, tilt or sagging at support pole or cable
			Accessories	There are loosened or damaged Fixing devices or missing bolts	-	There are some loosened Fixing devices or bolts but none are missing
			Corrosion	-	Corrosion is wide spread	Some corrosion found
			Base portion	There is pull out of anchors or wash out of base that could lead to failure	-	There is pull out of anchors or partial wash out of base
		Wall type railings	Cracks/ /corner drop	There are checkered cracks and cracks are connected	cracks at short intervals that reach rebar depth	cracks at long intervals that do not reach rebar depth

CHAPTER 20 TRAFFIC CONTROL FACILITIES

(1) Focus Points for Inspection

1) Traffic Signs

(a) The traffic signs should always be recognized as being in a good condition by the road users. Therefore it is necessary to check carefully any reduction in brightness due to lighting facility damage, paint deterioration, dirt, reflection sheet damage or sheltering by road side trees or other structures.

(b) It is better to confirm the brightness at night by on board visual inspection because the reflection rate at night is the most important thing for road signs.

(c) And it is also important to check for loosening of the bolts and nuts at newly opened roads because there are cases of loosening at new roads.

2) Road Marking

(a) The main reason for deterioration of road marking is due to tire friction. The breading of asphalt is one of the causes of road marking damage on asphalt pavement.

(b) The inspection of road marking is easy to conduct by on board visual inspection. It is possible to check the fading by on board visual inspection in the day time and it is important to check the reflection rate at night so it is better to confirm using a simple brightness measuring device.

3) Driver Sight Guide

(a) The curve sight guide is to lead the driver sight by reflection from the vehicle lighting, therefore the effectiveness of the site guides is reduced if there is a decrease in the brightness of the reflection.

(b) The check points in addition to reflection are structure tilt and dirt, and more as follows;

- ✓ The deformation and strain of the support pole (if the structure is maintaining its original shape but slight deformation leads to a change of angle.)
- ✓ It is better to check the brightness and reflection during the night patrol.

4) Kilometre Posts

(a) The damage conditions are similar to the driver sight guide

(b) The kilometre post does not directly affect accidents but it is an important facility for identifying the location in the road of an accident, inspection point or repair work.

(2) Focus Points for Damages

1) Traffic Signs

(a) The criteria for judging of the road sign boards and/or support pole dropping, deformation, tilting or severe damage applies the guard rail standard in addition to the rating of damage that depends on the illegibility due to peeling, dirt or deterioration of the reflection sheet. If it can be read the rating is B, if it cannot be read the rating is C.

(b) The reflection rating C is measured as 11.0 cd/m2 for F type and gate type signs and 4.0 cd/m2 at the multi-pillar type.

(c) The criteria for judging corrosion or damage to accessories and base structures are the same as the traffic safety facility guard rail

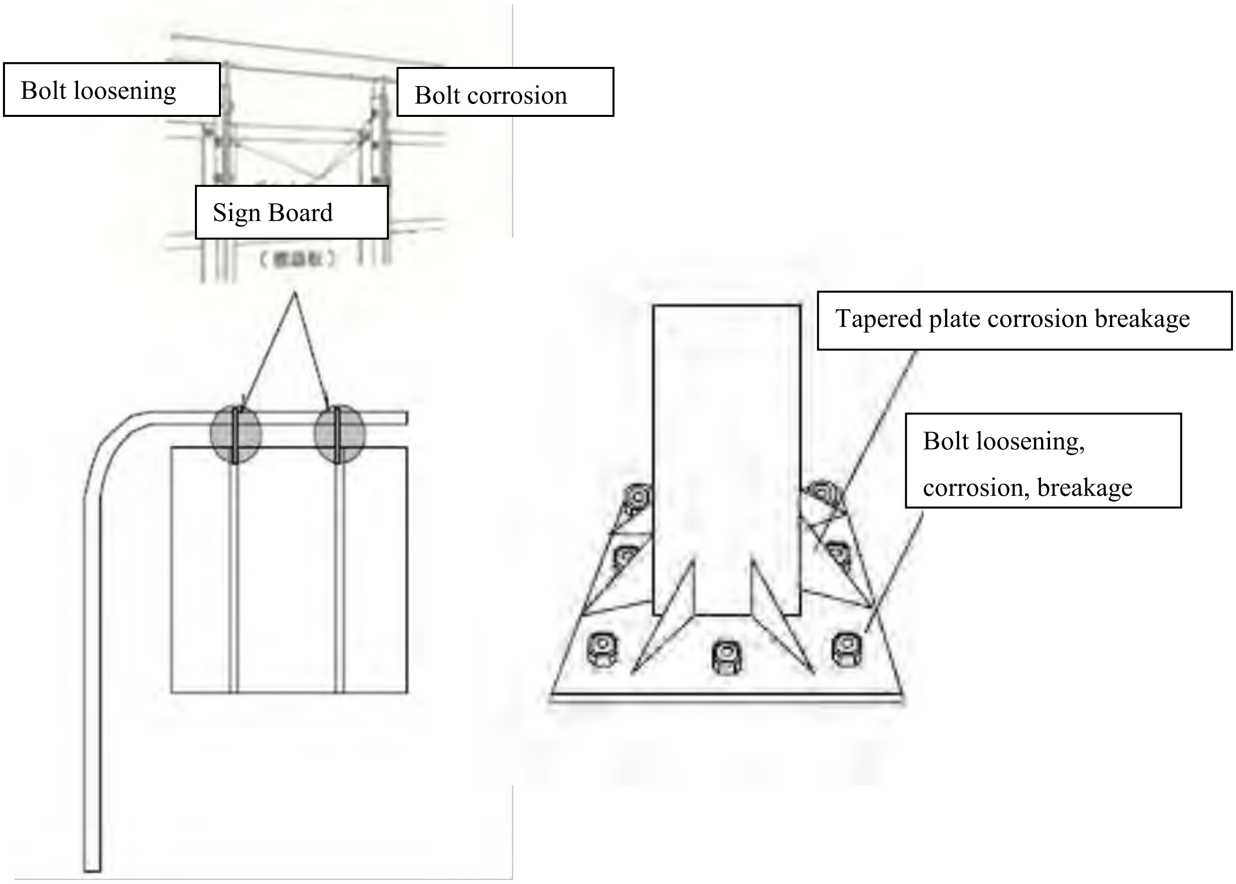


Figure 20.1 Traffic Sign Check Points

2) Road Marking

The fading, cracks or deterioration of traffic paint occur continuously, so it is rated C but if it is only partially degraded, it is rated B.

3) Driver Sight Guide

Damages to the reflector or supporting pole or tilting of the pole are rated C. The continuous damage that there are 4 to 5 damages is rated D and partially damage that are 1 to 2 damages is rated C.

4) Kilometre Posts

The kilometre post gives the road address to identify the exact place for proper and rapid maintenance and relief for accidents and disasters and also it is useful for reporting and recording.

Therefore, the criteria for judging the kilometre posts applies the same criteria as the driver sight guide.

Table 20.1 Diagnosis for Traffic Signs

Structure	Position	Member	Sort of damage	Judge		
				D	C	B
Traffic control	Traffic sign		Structure	Severe damage or tilt of the support pole, beam or plate	Damage or tilt of the support pole, beam or plate reflection sheet is peeling dirty, discoloured so that it is not possible to read the sign	Slight damage or tilt of the support pole, beam or plate but the reflection sheet is peeling, dirty, or discoloured so that it is not possible to read the sign
			Accessory	There are loosened, missing or damaged Fixing devices or missing bolts		There are some loosened Fixing devices but no missing bolts
			Corrosion		Corrosion spread widely	Partial corrosion found
			Base portion	There is pull out, damage or loosening of the anchors or wash out of the base that could lead to failure		There is damage to the anchors or partial wash out of the base
	Road sign		Traffic paint deterioration		Pale, peeling, discolouration and cracks are progressing	Some Paleness, peeling, discoloration or cracks
	Sight guide on curves		Structure		Deformation tilt, damage and dust are continued	There are partial Deformation tilt, damage and dust
	Kilometre posts		Structure		Deformation, tilt, damage or dust are progressing	There is some Deformation tilt, damage or dust

CHAPTER 21 TRAINING FOR ROAD FACILITY INSPECTION

The training consists of classroom lectures and on the job training on site, and it takes 2 sessions over 3 days. The site inspection target structures are the bridges, box-culverts, slope protection structures, traffic safety and traffic signs.

(1) Classroom Lecture

(a) The classroom lecture was held on the 19th of July 2013.

(b) The location was a conference room in the DRVN building.

(c) The trainees included 10 members from (DRVN, RTC central RRMU2)

(2) The contents

(a) The current status of road inspection in Vietnam

(b) The introduction of national road inspection in Japan

(c) The introduction of road inspection guideline (Bridge inspection card)

- ✓ The inspection guideline is used for the practical diagnosis of deterioration by using sample photos from Japan and the guideline is a reference to the standard. This time the JICA team indicated that the guideline can be effective in Vietnam because the judgement is based on the practical sample photos.
- ✓ The guideline for bridges was well-received. And then the PMU asked the JICA team to prepare guidelines for other structures, which the JICA team agreed to do.

(3) Questionnaire

In the classroom lecture, the RTC asked if the repair work should be based on the degree of deterioration in spite of recognition of the deterioration ranking based on the inspection guideline.

(4) OJT

The OJT was held on the 28th and 29th of November 2013. Originally, the JICA team planned to hold the OJT for structures for which the JICA team had prepared the requested guidelines regarding slope protection and traffic facilities in September, but DRVN asked to hold the OJT, including the bridge guidelines, in November 2013. Therefore, the JICA team planned to hold the OJT in 2 places.

The OJT consisted of two days of training, the classroom lecture for inspection methods (10 attendants) and site inspection (21 attendants).

1) The contents

Morning session

(a) Slope protection structures

(b) Traffic safety facilities

(c) Box culverts

Afternoon session

(d) Bridges (concrete bridges)

The day before the OJT a classroom lecture for inspection methods was held. The training lecture included the target structures, target deterioration, inspection methods and the recording of inspection sheets.

The OJT consisted of 2 sites which covered Box-culverts and surroundings in the morning session and the bridges in the afternoon session.

2) The method of OJT

The JICA team explained the deterioration, which were inspected and evaluated by the JICA expert in advance, using inspection recording sheets where the countermeasure was described. And furthermore, the JICA team explained the inspection guideline in detail such as the usage of tools and the description of the inspection record white board at the site in cases of deterioration.

3) Questionnaires

The questionnaires were focused on the countermeasures and causes of deterioration in the recording inspection sheet.

The JICA expert described the countermeasures in the sample recording inspection sheets, however, this was based on the opinion at the time of inspection and this is not a final decision. There are various kinds of countermeasures for repair work. The JICA expert wrote the opinion by selecting the measures based on engineering judgement. The trainees asked if there was only one countermeasure for one solution, but there are many options for repair work methods based on the conditions of traffic volume, emergency, safety of work, work smoothness, construction budget and construction area.

The countermeasures, which formed a solution for the problems, cannot be planned based on the cause of deterioration. The students should have the imagination ability to consider the history and determine the cause based on the surrounding conditions.

The JICA expert said in the classroom and on site that it is better to emphasize the use of imagination to determine cause and countermeasures. It is necessary to increase the talents of the inspectors that already have experience and knowledge. Therefore it is also necessary to provide periodic training regarding inspection.

4) Result of OJT and training

It can be said that the recognition of inspection guidelines is successfully achieved by OJT using the practical samples. However the countermeasures for structures are not described yet and it will be an item for the future. The concept of selecting repair work is not easy to understand because the solution is not for a single form of deterioration. It is important to train the inspectors that already have experience and knowledge but this is not an easy target. However, the need for that kind of inspector will increase in Vietnam in the near future and that leads the great success.

5) Proposal

The inspection is a basic part of the PDCA cycle which consists of inspection – plan-budgeting-repair work. The target of maintenance management is to prevent traffic interruption by analysing the deterioration and by repairing the defects. The inspection part can introduce a step to record the grade of deterioration and to record the deterioration data. In the pavement part, the repair flow of deterioration based on the type of damage has been described, but it is very hard to make a flowchart for the repair work for other structures in the field because the causes of damages are various and the countermeasures also include many methods so that there is no typical flowchart for repair work in Japan. But it is necessary to continue the introduction of maintenance technology transfer for spreading the options of methods because there are several types of repair methods based on the causes of the deteriorations. Therefore, it is also important to build the capacity of the inspectors for the reception of new technology. The inspector should have experience as well as suitable talent for diagnosis. A precondition of having experience is to maintain continuous employment, therefore, it is important to become a licensed professional inspector. The establishment of inspection licenses is one of the options.

It will be very important to increase the numbers as well as quality of inspectors in Vietnam because it will be a keen issue regarding maintenance for deterioration in the next 10 to 20 years future for the rapidly constructed road structures which were built in the last ten years. It would be very effective to use Japanese experience where deteriorated structures are already being found. Traffic congestion and time loss can be foreseen because rapid development and drastic traffic changes have occurred in Vietnam. It is important to continue the input of inspection engineer training for preventing the heavy traffic congestion and time loss in South East Asia due to the lack of road capacity and in this way, delay of road maintenance can be avoided

REFERENCE I

Illustration for Inspection of Slope, Traffic Facility and Lighting

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REFERENCE 1 : INSPECTION CONCEPT SKETCH R1-1

REFERENCE 2 : DAMAGE DIAGNOSIS SAMPLE R2-1

REFERENCE 3: CONFORMATION MAKING INSPECTION R3-1

CHAPTER 1 INSPECTION TARGET

Segment	Subcategory
Slope	・Cut slope ・Banking ・Ground anchoring
Slope stabilizer	・Retailing wall ・Rock shield ・Rock cover ・Rock fall prevention General Engineering ・Other slope stabilities
Culvert box	（Culvert box）

(1) Diagnosis:

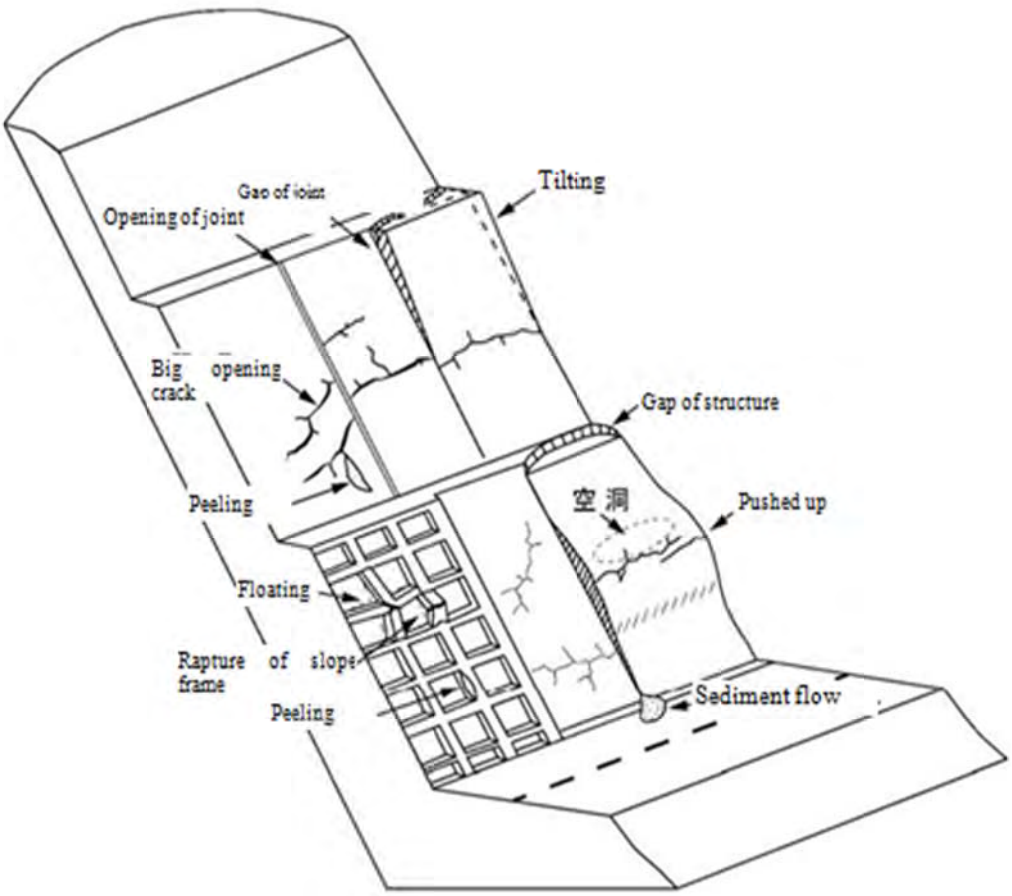


Figure 1.1 Checkpoint of cut slope

Rank e: from opening crack the sediment of bedrock spilled out. The coverage of spraying surface is cracked out the back ground of concrete became hollow.
The mortar of spray itself became unstable and it will be dropped whole surface, and the bedrock has been weathered so that the whole slope failure is expected.

(2) Horizontal crack and pushed out of spray slope covering

Photo 1.1

(3) Gap and push out of joint of spray surface (Ranking e)

There is a gap at joint of pushed out surface and opened until the horizontal crack and the back ground of spray became hollow. The whole spray surface became unstable and for fear of dropping whole slope surface and the bedrock is also weathered so that the whole slope failure is expected.

Photo 1.2

(4) Open crack, peel and hollow at spray surface and exposure of bedrock. (Ranking D)

Open cracks are generated and the background became hollow at the partially dropped and the bedrock has been exposed. The whole spray surface has become deteriorated and unstable; there is a fear of whole surface failure.

The frame of slope protection has been deteriorated and the mortar has been dropped, and the unstable mortar debris is remained. There is a fear of dropping that mortar.

Photo 1.3

(5) The deteriorated mortar debris at slope protection frame. (Ranking D)

CHAPTER 2 EMBANKMENT

(1) Diagnosis: Next damages are rated D or E.

(2) Road surface crack and settlement

Frequent by damaged portion is the main checkpoint.

(1) Slope and slope end failure

Slope or slope end has been failed and there is a spring water and weakened portion.

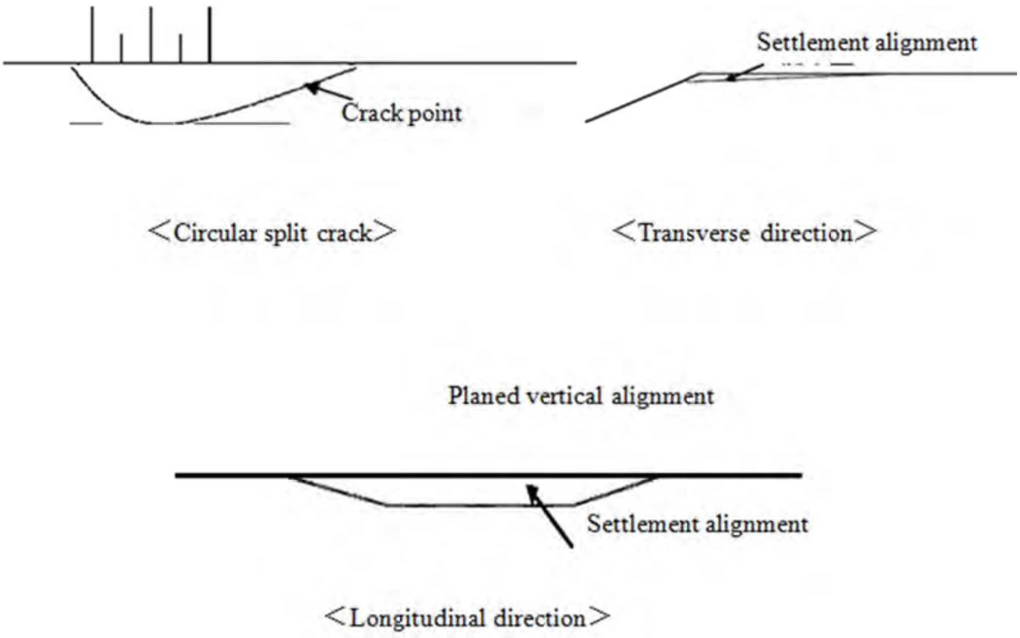


Figure 2.1 Slope and Slope end failure

Photo 2.1 Whole slope failure

Photo 2.2 Drain system failure due to slope settlement

Photo 2.3 Embankment material is washed away due to weakened slope end and spring water.

Photo 2.4 Slope and failure and spring water

CHAPTER 3 GROUND ANCHOR

(1) Diagnosis: Ranking E.

- ✓ Anchor skip out and the bearing plate has cracks or rapture (Photo 3.1and Photo 3.2).
- ✓ Head capping of anchor is deteriorated. (Photo 3.3)
- ✓ Easy to move at anchoring head or bearing plate.

Photo 3.1 Ground anchor ship

Photo 3.2 Failure of passive earth pressure structure

Photo 3.3 Failure of concrete head

CHAPTER 4 RETAINING WALL

(1) Diagnosis : The following are rate E.

- Typical cracks at wall (Photo 4.1).
- Wall of retailing wall or top cover has damage or tilting (Photo 4.2)

Photo 4.1 Wall crack

Photo 4.2 Tilting of railing foundation

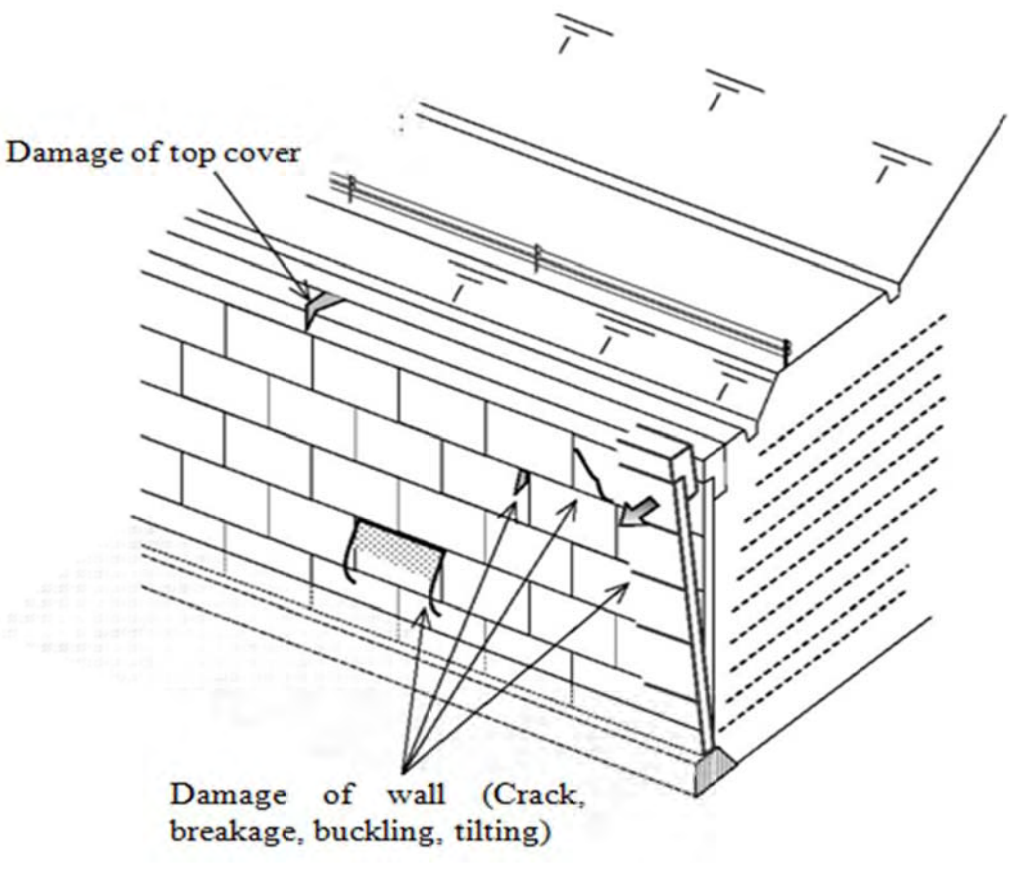


Figure 4.1 Diagnosis of retailing wall

CHAPTER 5 ROCK FALL PREVENTION

(1) Damages cause the fear for instability of structures such as deformation, tilting, joint open. (Photo 5.1 - Photo 5.3)

(1) Damages cause the member dropping such as floating peeling crack of concrete (Photo 5.4 - Photo 5.5)

(2) Damages on steel members cause the member dropping such as corrosion, crack rapture, and loosen, dropping. Relaxation of net, wire rope, accessary pylon, anchoring. (Photo 5.6 - Photo 5.8)

(3) The damages on the base rock or attached member cause the rock dropping, such as rock failure, base concrete scouring. (Figure 5.1)

Photo 5.1 Member deformation and tilting (Rock fall prevention)

Photo 5.2: Member deformation and tilting (Rock fall prevention)

Photo 5.3 Rock fall prevention net, (pylon tilting net rapture wire rope breakage)

Photo 5.4: Concrete peeling, cracks (retailing wall)

Photo 5.5 Peeling, crack on concrete (retailing wall)

Photo 5.6 Steel member corrosion (rock fall prevention H beam base)

Photo 5.7 Corrosion and rapture of steel member (rock fall prevention net)

Photo 5.8 Corrosion and rapture of steel member (rock fall prevention net)

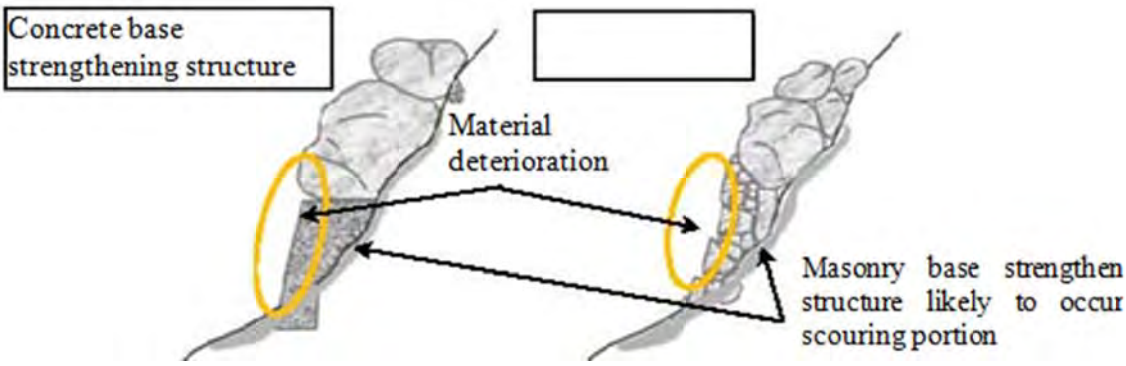


Figure 5.1 Scouring of rock fall prevention or failure of base strengthening structure

CHAPTER 6 CULVERT BOX

(1) Diagnosis: Rated E

- Floating or peeling crack at side wall or railing. (Photo 6.1 : Crack from freezing).
- It is better to check floating, peeling, crack by hammering.

(1) Constant spring water from

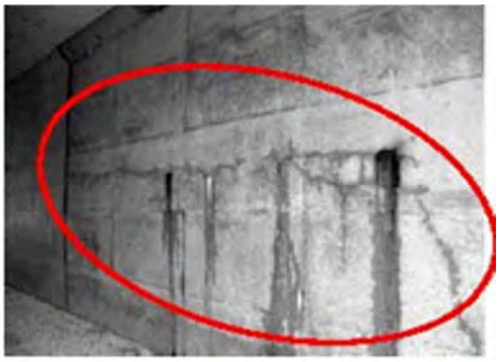


Photo 6.1 : Crack from freezing

Photo 6.2

The Constant spring water is the portion, which has been damaged at the bedrock and the slope is unstable. And the upper slope is already failed those are the damaged slope.

(2) Upper slope failure

Photo 6.3 Upper slope failure

(3) Crack on the slope protection frame (rank S or study)

The crack at slope protection frame is the phenomenon of water force occurrence. These cracks should be studied or surveyed.

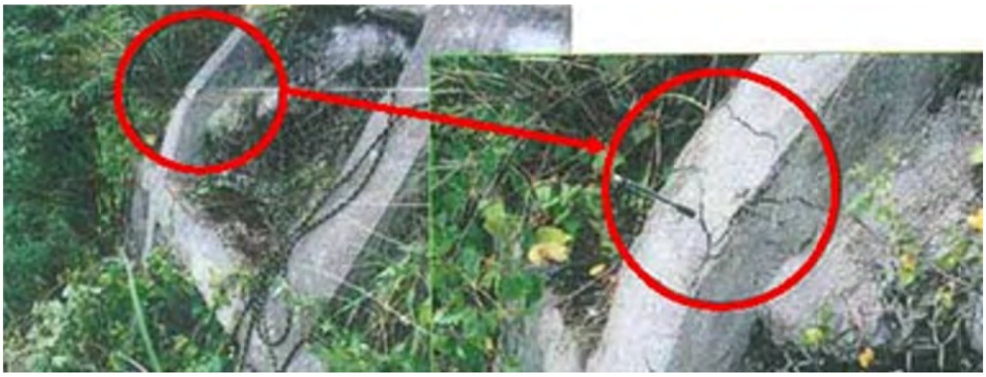


Photo 6.4 : Huge spring water at slope (Rank D or E)

(4) Slope protection frame breakage

The below pictures are the breakage of frame, this means that the frame is already broken and no supporting of upper structure. The study and countermeasure is needed.


Photo 6.5 Slope protection frame breakage

(5) Example of crack on the slope protection frame

Photo 6.6 Example of crack on the slope protection frame

(6) Pre-costed slope frame failure

The deformation of frame occurred, which causes the slope failure.


Photo 6.7 Example of deformation of frame (Rank E)

(7) Reference photo 1.3: Example of damages of drainage system

Photo 6.8 Drain ditch gap

Rank E and it should be repaired.

Photo 6.9 Drain ditch malfunctioning

Rank D. Should be cleaned.

CHAPTER 7 EMBANKMENT

(1) Crack and settlement on road surface

As shown in the picture.

(1) Spring water

Spring water is not good condition.

- Spring water (Rank D or E)

One or more spring water flow can be seen.

- Leaking (Rank B)

Wet slope but no water flow can be seen.

- No leaking (Rank A)
- Slope crack, pushed out
- Drainage damages and Checkpoints are described in the pictures.

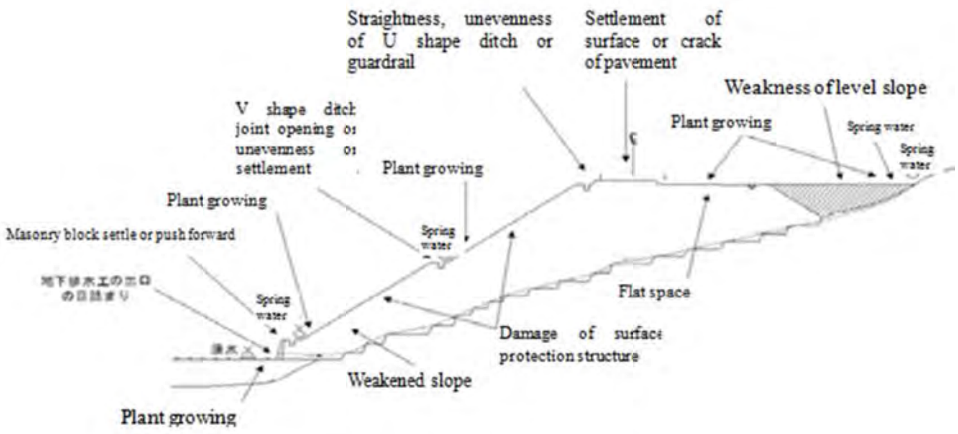


Photo 7.1 : Check point of Embankment

(2) Ground anchor (Ranked E)

- Bearing plate corrosion (reference Photo 7.2)
- Anchor head is leaking or free lime or planting (Reference Photo 7.3 & Photo 7.4)
- The leaking of anti-rust oil can be seen. (Reference Photo 7.5)

Photo 7.2 Corrosion of bearing plate

Photo 7.3 Spring water

Photo 7.4 Free lime generated

Photo 7.5 Anti-rust oil leaking

(3) Retaining wall (Rank E)

- Scoured at base foundation (Reference Photo 7.6)
- Sediment flowed from the drain pipe or joint opening (Reference Photo 7.7)
- drain system malfunction (Reference Photo 7.8)
- back ground soil or road surface settlement (Reference Photo 7.9)

Photo 7.6 : Scouring of base foundation

Photo 7.7 : Joint opening and sediment flow

Photo 7.8 Drain system malfunction

Photo 7.9 Road surface settlement

(4) Culvert box

- Lack of cross section due to chemical reaction
- Leaking water come from culvert body
- Between culvert box and embankment there is severe gap or damages of embankment (Reference Photo 7.10)
- Gap, opening, or side slast at the joint and that caused the water leak or sediment penetration (Photo 7.11)
- Between approach road surface gap is occurred (Reference Photo 7.12)
- Peeling, floating, cracks are seen at the wing section and the gap at embankment and that leads the sediment flow (Reference-Photo 7.13)

Photo 7.10 : Example of damages of embankment

Photo 7.11 Flow of water and sediment or joint opening

Photo 7.12 Inside and road surface

Photo 7.13 : Example of peeling, floating, cracks at the wing section

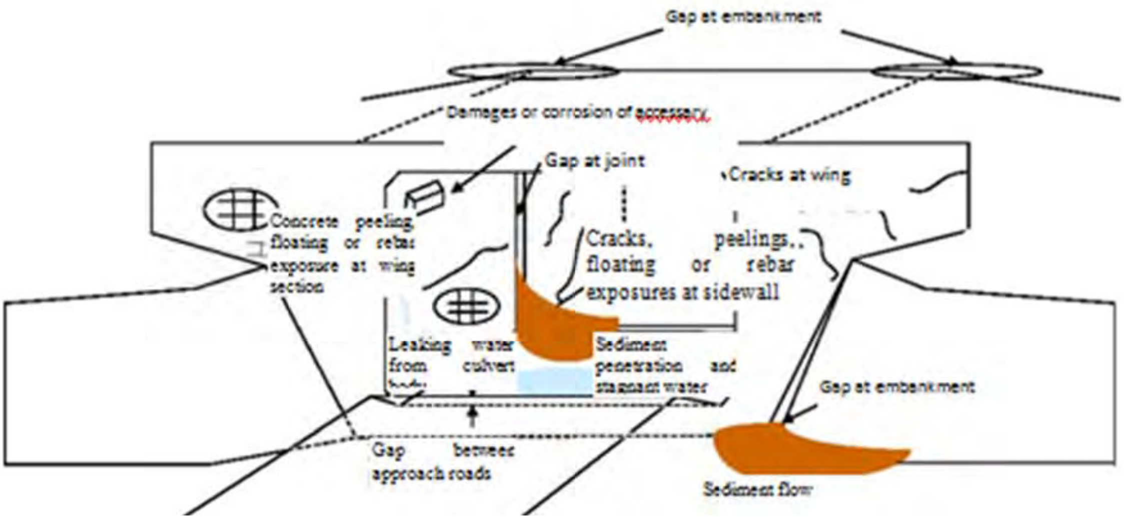
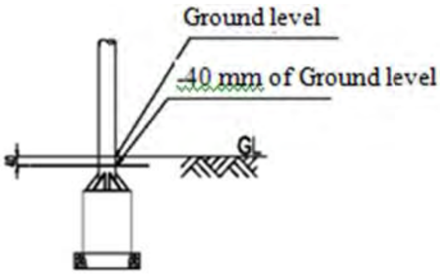


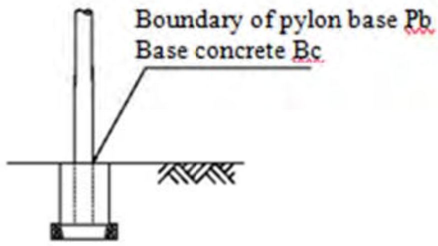
Figure 7.1 Checked point with culvert box

REFERENCE 1 : INSPECTION CONCEPT SKETCH

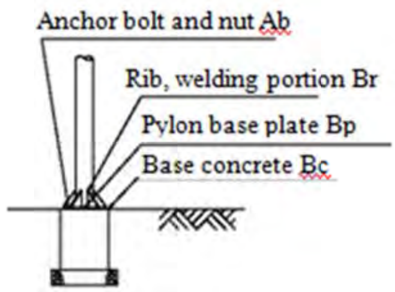
(1) Common



Back filled base foundation

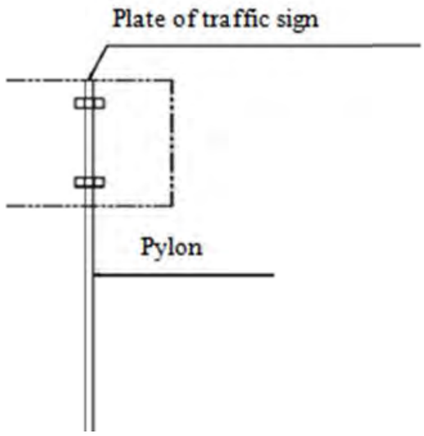


Exposed base foundation

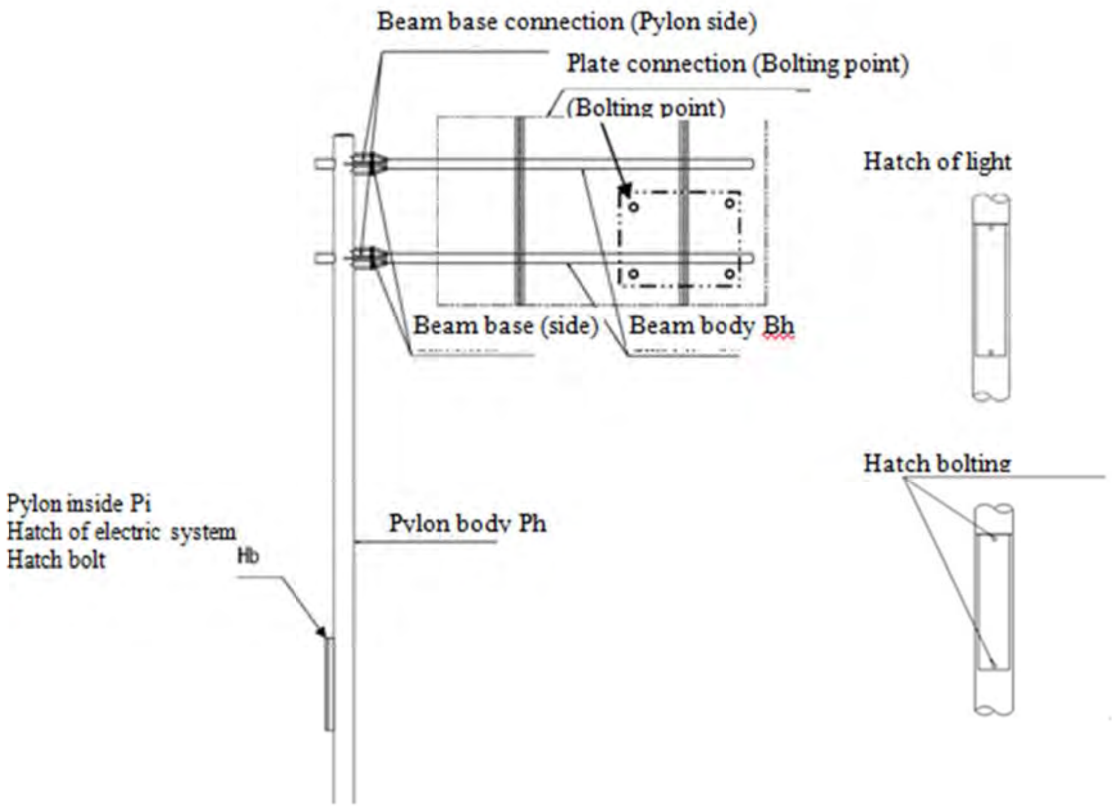


Ref.Figure 1 Pylon base

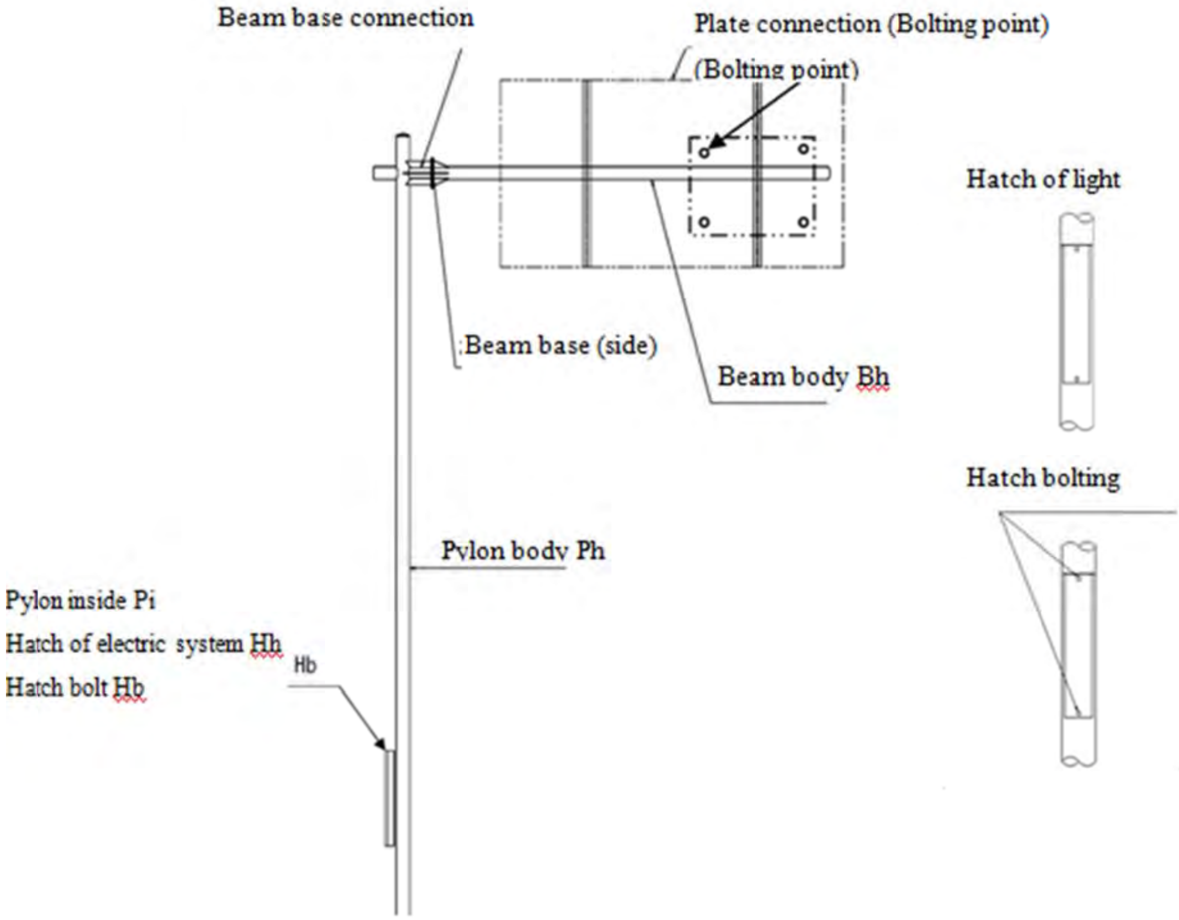
(2) Traffic sign and traffic information



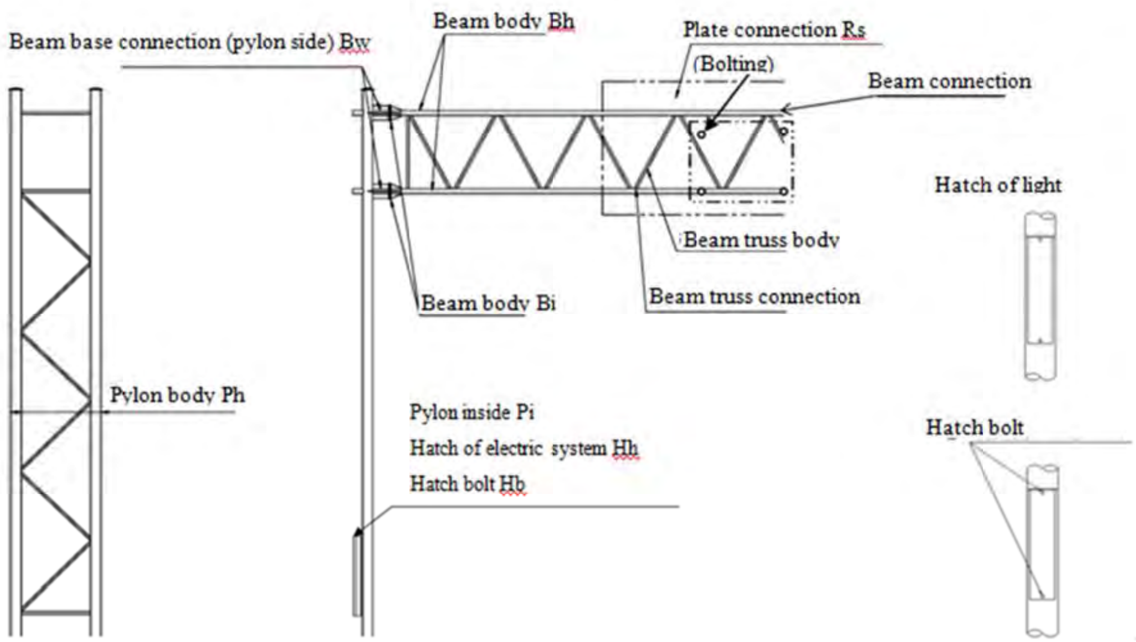
Ref.Figure 2 Road side



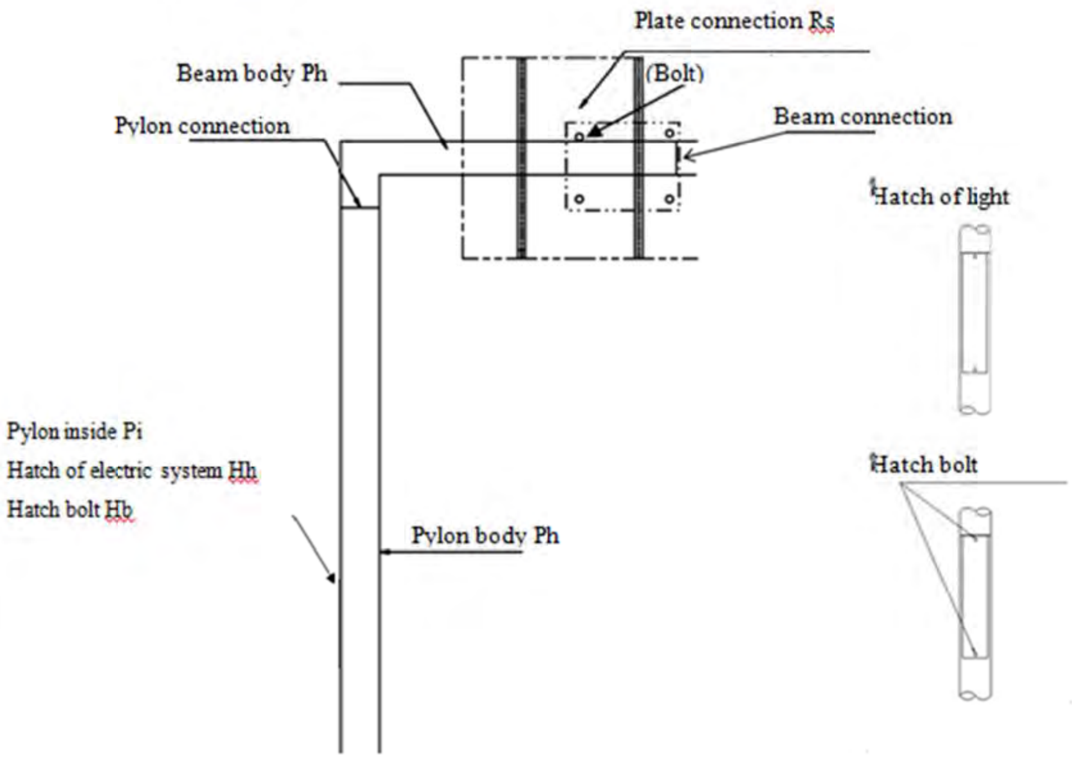
Ref.Figure 3 Overhang type



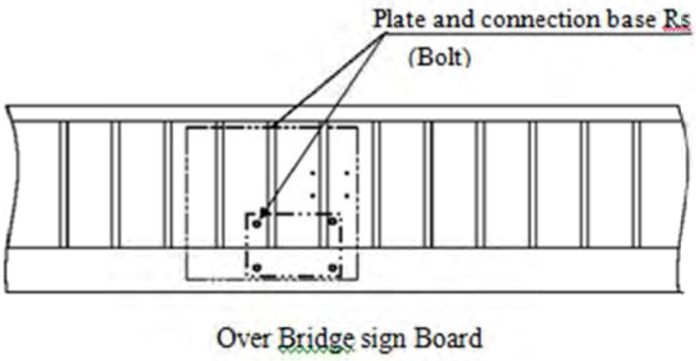
Ref.Figure 4 Overhang type



Ref.Figure 5 Rigid Frame Type (Truss type)

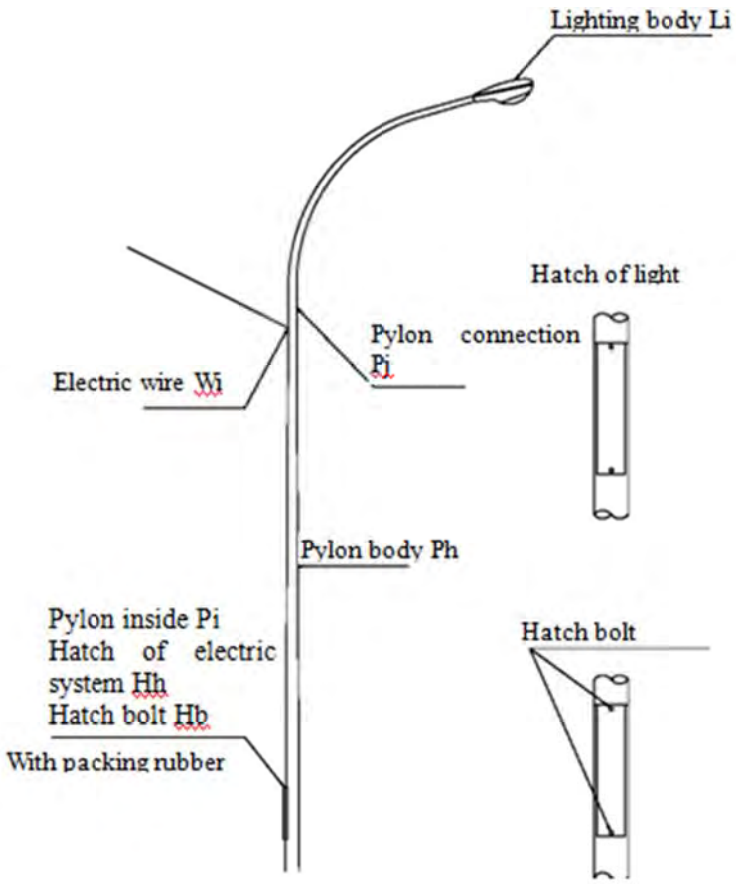


Ref.Figure 6 Rigid Frame Type (Beam type)

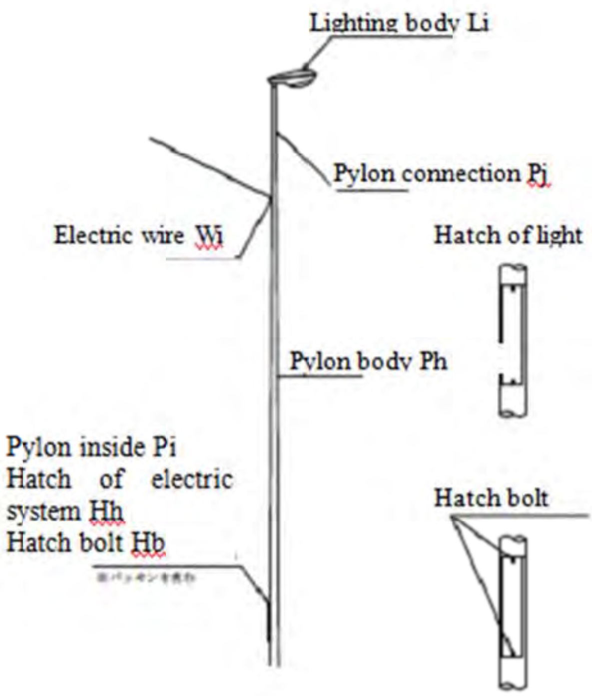


Ref.Figure 7 Hanging type

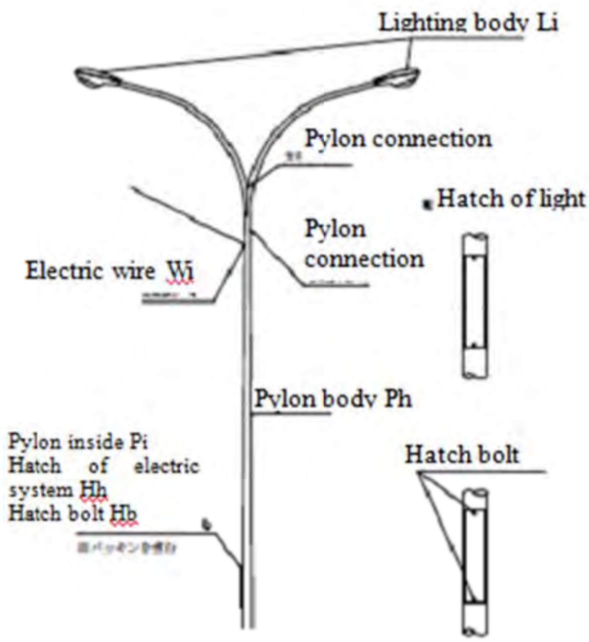
(3) Lighting system



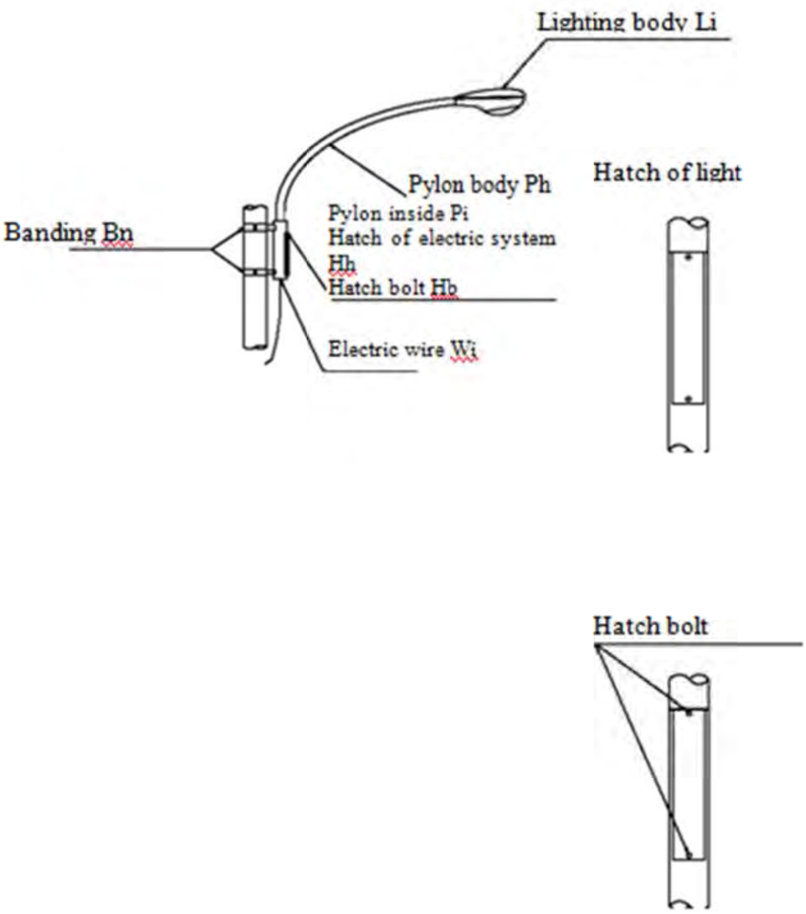
Ref.Figure 8 Pole type (tapered pole)



Ref.Figure 9 Straight pipe



Ref.Figure 10 Pole type (tapered pole)



Ref.Figure 11 Attached type

REFERENCE 2 : DAMAGE DIAGNOSIS SAMPLE

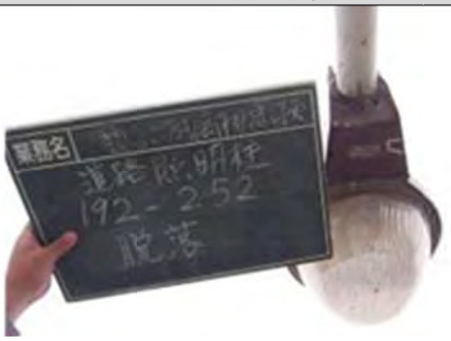
(1) Lighting system (Crack)

	Crack	Portion	Lighting body or connection	
III			Situation	Crack and fear of dropping
			Cause	Road traffic vibration
			Countermeasure	Change the lighting.
			Note	
II			Situation	
			Cause	
			Countermeasure	
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(2) Lighting body or connection (Corrosion)

	Corrosion	Portion	Lighting body or connection	
III			Situation	Lack of cross section corrosion
			Cause	Aging
			Countermeasure	Lighting change
			Note	
II	 		Situation	Partially corrosion
			Cause	Aging
			Countermeasure	If the progress of corrosion is estimated, repair is needed.
			Note	
I	 		Situation	Good.
			Cause	
			Countermeasure	
			Note	

(3) Lighting body or connection (Loosen, dropping)

<table>
<tr><th></th><th>Loosen, dropping</th><th>Portion</th><th colspan="2">Lighting body or connection</th></tr>
<tr><td rowspan="4">III</td><td colspan="2" rowspan="4">
</td><td>Situation</td><td>Lighting connection, bolt dropping.</td></tr>
<tr><td>Cause</td><td>Road traffic vibration.</td></tr>
<tr><td>Countermeasure</td><td>Bolt refastening or anti-loosening measure is needed.</td></tr>
<tr><td>Note</td><td></td></tr>
<tr><td rowspan="4">II</td><td colspan="2" rowspan="4"></td><td>Situation</td><td>Light cover bolt is loosen.</td></tr>
<tr><td>Cause</td><td>Road traffic vibration.</td></tr>
<tr><td>Countermeasure</td><td>Bolt refastening or anti-loosening measure is needed.</td></tr>
<tr><td>Note</td><td></td></tr>
<tr><td rowspan="4">I</td><td colspan="2" rowspan="4"></td><td>Situation</td><td>Good.</td></tr>
<tr><td>Cause</td><td></td></tr>
<tr><td>Countermeasure</td><td></td></tr>
<tr><td>Note</td><td></td></tr>
</table>

(4) Strut of cross beam (Rapture, broken)

<table>
<tr><th></th><th>Rapture, broken</th><th>Portion</th><th colspan="2">Strut cross beam (Rapture, broken)</th></tr>
<tr><td rowspan="4">III</td><td rowspan="4" colspan="2"></td><td>Situation</td><td>Beam base is cracked and dropped</td></tr>
<tr><td>Cause</td><td>Fatigue due to wind vibration.</td></tr>
<tr><td>Countermeasure</td><td>Renew.</td></tr>
<tr><td>Note</td><td></td></tr>
<tr><td rowspan="4">II</td><td rowspan="4" colspan="2"></td><td>Situation</td><td></td></tr>
<tr><td>Cause</td><td></td></tr>
<tr><td>Countermeasure</td><td></td></tr>
<tr><td>Note</td><td></td></tr>
<tr><td rowspan="4">I</td><td rowspan="4" colspan="2"></td><td>Situation</td><td>Good.</td></tr>
<tr><td>Cause</td><td></td></tr>
<tr><td>Countermeasure</td><td></td></tr>
<tr><td>Note</td><td></td></tr>
</table>

(5) Pylon joint (Rapture, broken)

	Rapture, broken	Portion	Pylon joint	
III			Situation	Pylon is fallen due to welding connection by corrosion.
			Cause	Corrosion
			Countermeasure	Remove quickly and renew.
			Note	
II			Situation	
			Cause	
			Countermeasure	
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(6) Pylon joint (Rapture)

	Rapture	Portion	Pylon joint (Bolt connection)	
III			Situation	Bolt connection failed.
			Cause	Road traffic vibration.
			Countermeasure	Renew bolt or pylon change is needed.
			Note	
II			Situation	
			Cause	
			Countermeasure	
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(7) Hatch (Corrosion)

	Corrosion	Portion	Hatch	
III			Situation	Corrosion with lack of cross section
			Cause	Aging and stagnant water
			Countermeasure	Change pylon.
			Note	
II			Situation	Hatch corrosion but not deep.
			Cause	Aging.
			Countermeasure	Repaint or change hatch.
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(8) Pylon base plate (Crack)

	Crack	Portion	Pylon base plate	
III			Situation	Crack on rib plate for fear of falling.
			Cause	Road traffic vibration.
			Countermeasure	Need repair or change the pylon.
			Note	
II			Situation	
			Cause	
			Countermeasure	
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(9) Pylon base (Corrosion)

	Corrosion	Portion	Pylon base	
III			Situation	Breakage of pylon when digged or scoured at road surface.
			Cause	Stagnant water at the gap between pylon and road and corroded.
			Countermeasure	Changing quickly of pylon is needed.
			Note	
II			Situation	Corrosion occurred at the bearing pylon and road and corroded.
			Cause	Stagnant water at the gap between pylon and road and corroded.
			Countermeasure	Repaint or repair and adding concrete for drain tangent.
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(10) Base plate (Corrosion)

<table>
<tr><th></th><th>Corrosion</th><th>Portion</th><th colspan="2">Base plate</th></tr>
<tr><td rowspan="4">III</td><td colspan="2" rowspan="4"></td><td>Situation</td><td>Hole by corrosion can be seen</td></tr>
<tr><td>Cause</td><td>The lack of thickness of paint film at welding point and edge</td></tr>
<tr><td>Countermeasure</td><td>Quick renewal is needed.</td></tr>
<tr><td>Note</td><td></td></tr>
<tr><td rowspan="4">II</td><td colspan="2" rowspan="4"></td><td>Situation</td><td>Whole part is corroded but not so deep.</td></tr>
<tr><td>Cause</td><td>Aging and lack of thickness at welding point.</td></tr>
<tr><td>Countermeasure</td><td>Repaint is needed.</td></tr>
<tr><td>Note</td><td></td></tr>
<tr><td rowspan="4">I</td><td colspan="2" rowspan="4"></td><td>Situation</td><td>Good.</td></tr>
<tr><td>Cause</td><td></td></tr>
<tr><td>Countermeasure</td><td></td></tr>
<tr><td>Note</td><td></td></tr>
</table>

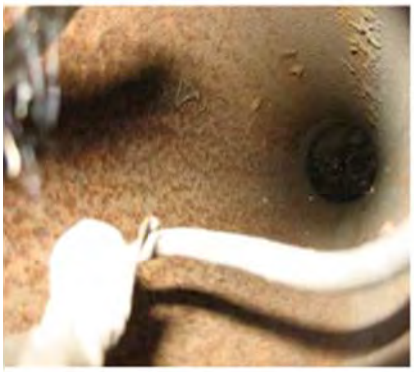
(11) Pylon base (Anchor bolt nut) (Corrosion)

	Corrosion	Portion	Pylon base (Anchor bolt nut)	
III			Situation	Whole corroded and cross section reduced.
			Cause	Aging and rain water.
			Countermeasure	Renewal is needed.
			Note	
II			Situation	Corroded but cross section reduction is not seen.
			Cause	Aging.
			Countermeasure	Repaint is needed and anti-corrosion cap is effective.
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(12) Pylon base (Anchor bolt nut) (Rapture)

	Rapture	Portion	Pylon base (Anchor bolt nut)	
III			Situation	Rapture at anchor bolt due to corrosion.
			Cause	Stagnant water at plate and corroded.
			Countermeasure	Renewal is needed.
			Note	
II			Situation	
			Cause	
			Countermeasure	
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(13) Hatch at pylon (Others stagnant water)

	Others stagnant water	Portion	Hatch at pylon	
III			Situation	Stagnant water in the pylon.
			Cause	Water Penetration from hatch.
			Countermeasure	Drain water from pylon clean and repaint.
			Note	
II			Situation	Footprint of stagnant water.
			Cause	Penetration from hatch.
			Countermeasure	Clean inside and repaint.
			Note	
I			Situation	Good.
			Cause	
			Countermeasure	
			Note	

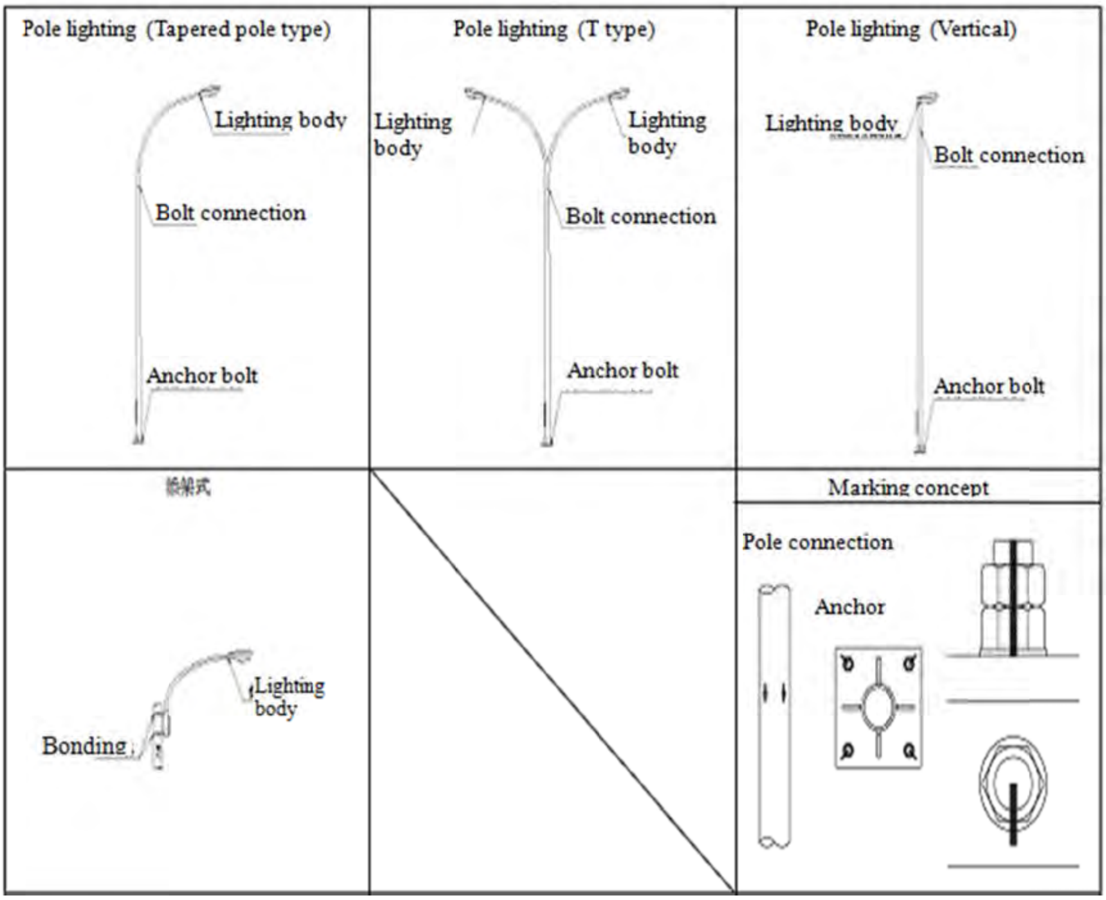
REFERENCE 3: CONFORMATION MAKING INSPECTION

(1) Conformation making inspection (Lightening)

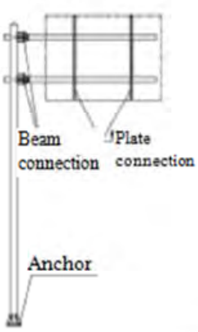
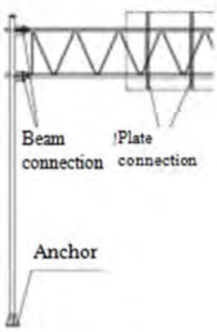
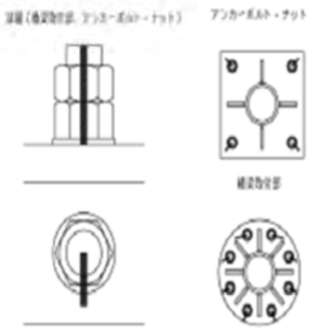
The bolts loosening confirmation marking are widely used for inspection. When there is no marking, the inspectors should mark after checking the bolt situation. The most suitable method for checking the bolt loosening by visual inspection is marking.

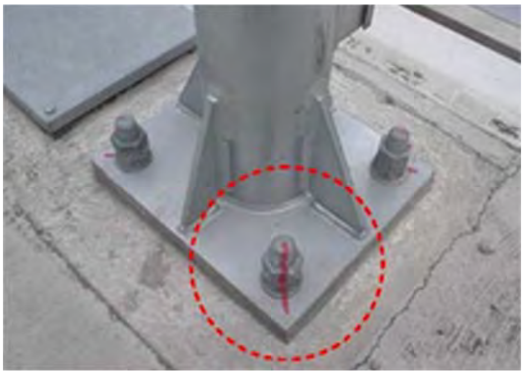
Marking implement concept show the next pages.

(2) Lighting pole



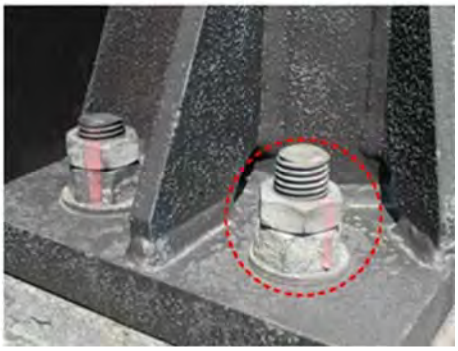
(3) Road sign

Overhang	Rigid frame overhead type	
		
Concept of checkpoint		
		



(a) Good

It is easy to see and marking has enough length good from bolt to plate



(b) Not good

It is hard to see and marking is only on the not