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 ORIENTAL CONSULTANTS** EI **CENTRAL NIPPON EXPRESSWAY CO. LTD.** JR

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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 <u>Capacity</u> <u>Enhancement in Road Maintenance in Vietnam</u>. 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**.

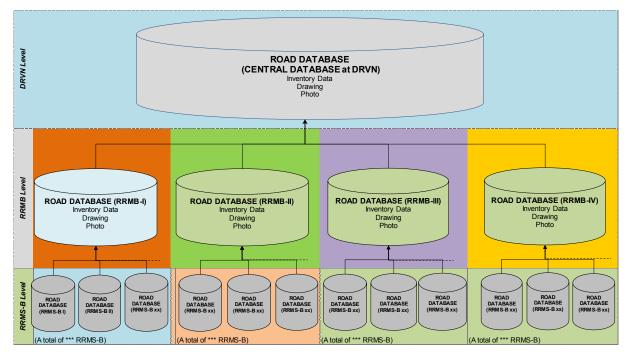
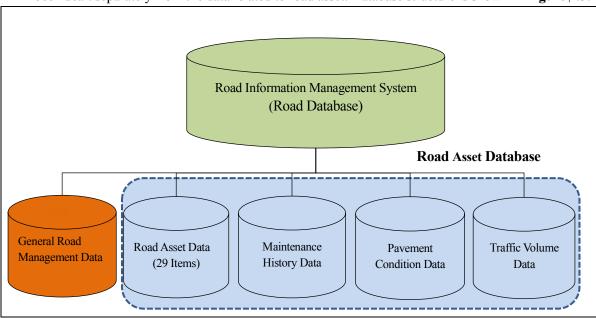


Figure 1.3.1 Database Hierarchy

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.

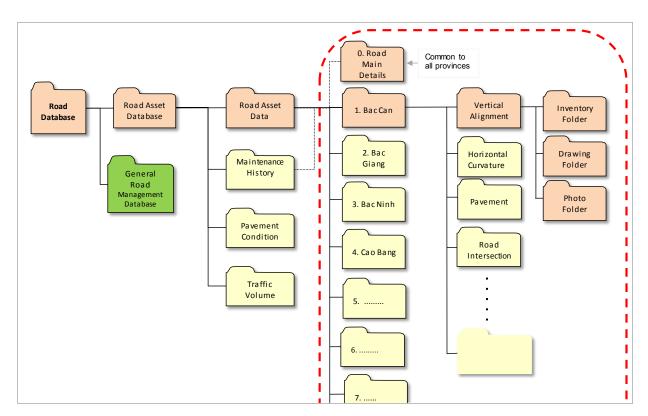


Figure 1.3.3 Database Folder Structure (for RRMB-I Jurisdiction)

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 "Cannot find Pivot Table file" as shown below. This error occurs because a particular path has been specified in VBA code.

CERM 2012	×
Can not find P	vivot table file!
	ОК

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.

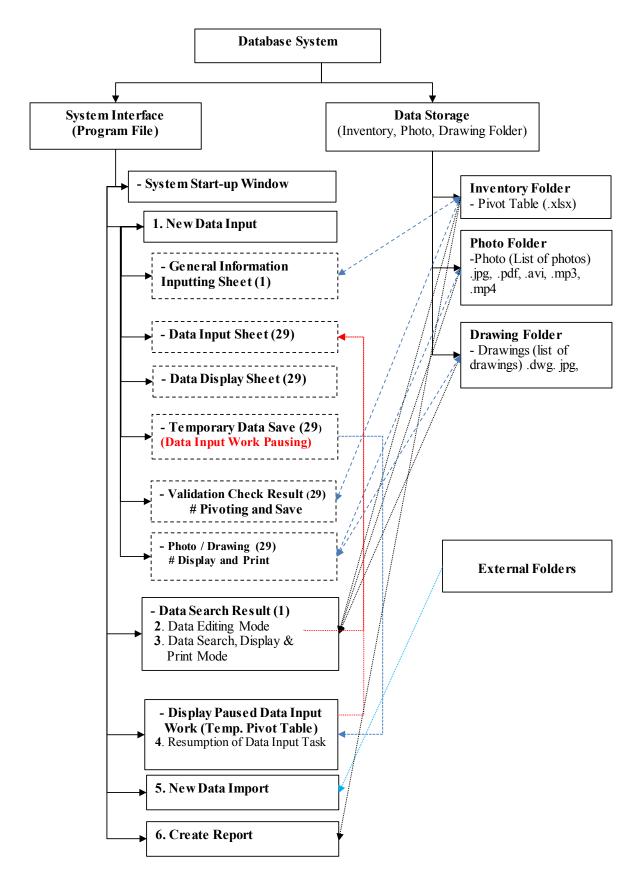


Figure 1.4.1 System Interface and Data Storage Relationship

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.

CDI			Exp	ected U	ilization	S		
SN	Data Items	PMS	PMoS	AI	AM	RTOM	SD	Other
1	Road Main Details	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
2	Pavement	\checkmark	\checkmark					
3	Overlap Section				\checkmark			
4	Bridge (VBMS Inventory Module)						1	
5	Road Intersection				\checkmark			
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					V		
17	Horizontal Curvature					√		
18	Slope							
19	Pedestrian Crossing Bridge			√	√	√		
20	Retaining Wall			v v	√	,		
20	Road Lighting			√	√			
22	Roadside Plantation			√	√	,		
22	Guard Fence			√	√			,
				√	v √	√		
24 25	Disaster Response Storage Warehouse Median Strip			N V	N √	N √		
25	Road Sign			√	 √	√		
20	Kilo Post			V	V	V	-	
28	Noise Barrier			V		V.		1
29	Shade Fence							

Table 1.5.1 Road Asset Data Items and Expected Utilization

1.5.2 File Naming

1) Inventory Data

Database		Data		Data		Stage of		Asset		RRMB		Province		Data	.xlsx
		Туре		Source		Data		Name		Number		Name		Version	
								AssetN				Province			
DB	-	RA	-	DRVN	-	OR	-	ame	-	RRMB-X	-	Name	-	Year	.xlsx
Example (A	Example (Asset Data): DB_RA_DRVN_OR_Pavement_RRMB-I_Hanoi_2013.xlsx														
DB		MH		DRVN		OR				RRMBX		Province		Year	.xlsx
DB	-	МН	-	DRVN	-	ŰŔ	-			KKMBA	-	Name	-	Year	.XISX
Example (M	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
1	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	Ι	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. <u>It is recommended to allocate at least 1GB free space for the Road Database at the time of the Road Database system installation.</u>

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.

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	The system development is carried out in close collaboration with DRVN and JICA Project
DRVN during System	Team by taking account of effective technology transfer (capacity enhancement in database
Development	development and management), system sustainability, etc.

Table 2.1.1 Road Database System Requirements

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 <u>it is strongly recommended to install / copy the Road Database</u> <u>system in internal hard disk.</u> 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.

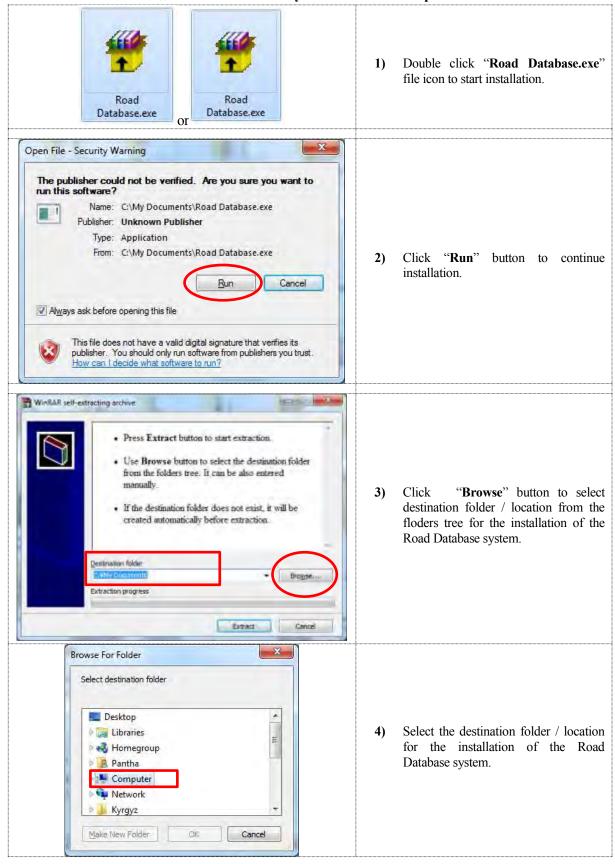
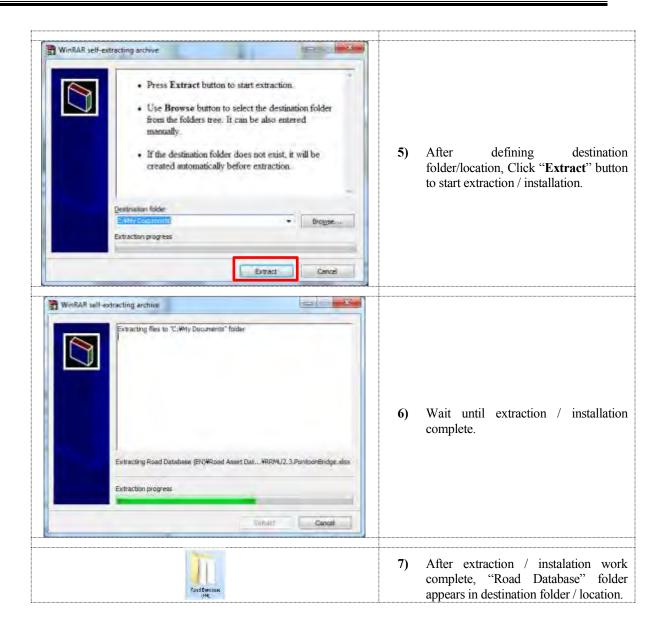


 Table 2.2.1 Road Database System Installation Steps



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**.

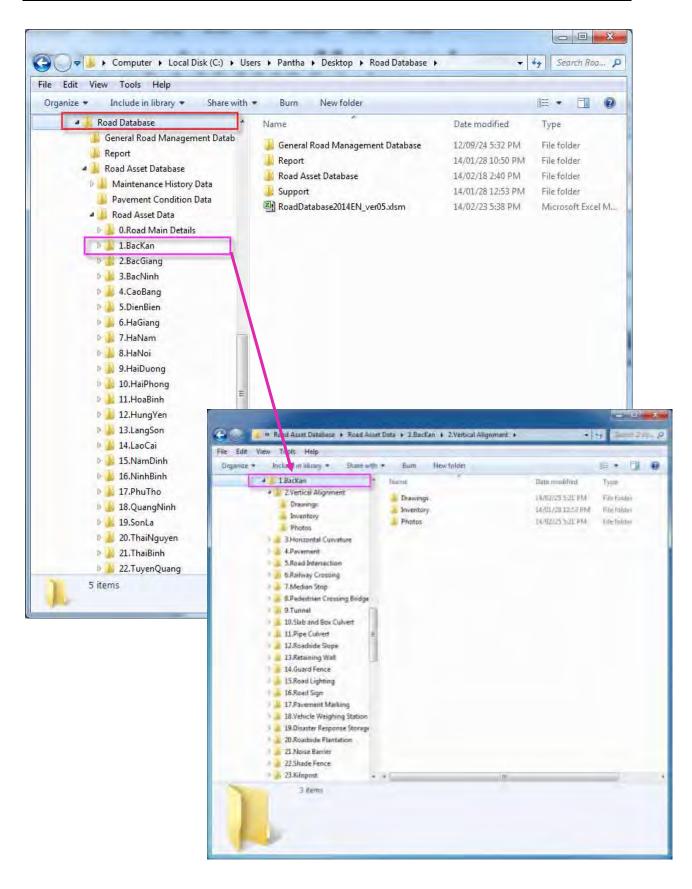


Figure 2.2.1 Folder Tree in Road Database Folder

2.3 PROGRAMMING LANGUAGE / VERSION OF MS-EXCEL

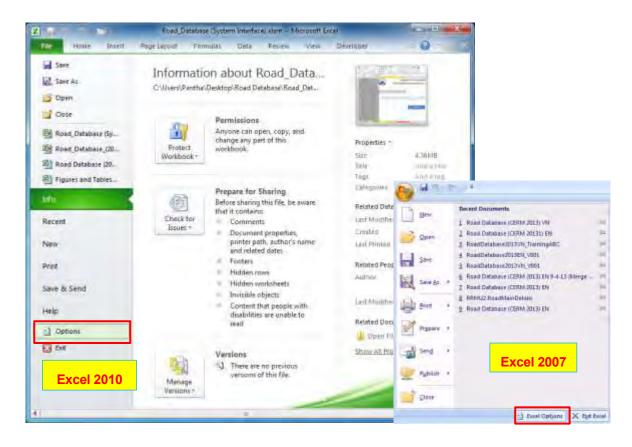
Database system has been developed in MS-Excel platform using Excel Visual Basic Application (hereinafter referred to as "Excel VBA"). Only Excel VBA programming language has been used while inserting various functions. Also, some built-in tools / functions of MS-Excel are used. Therefore, it is necessary 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

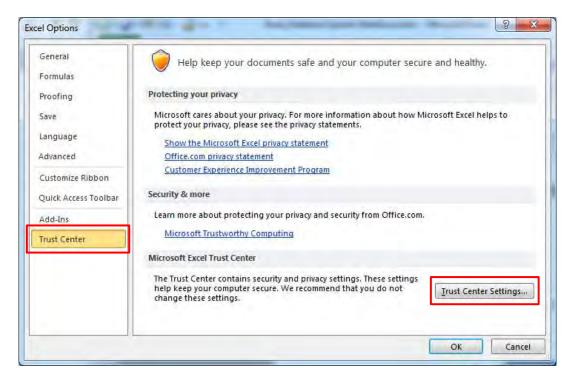
In Microsoft Excel 2007 and 2010, macro can be enabled by two ways;

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

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

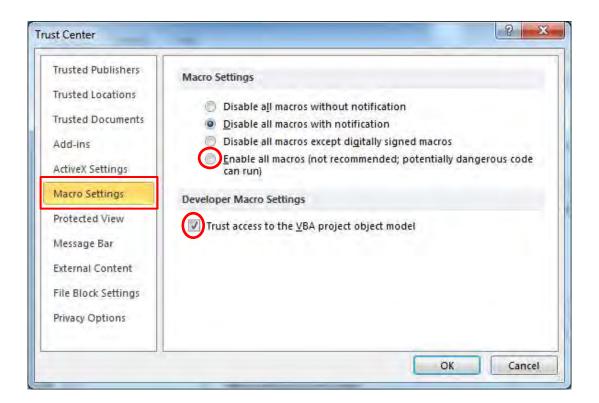


(2) Click Trust Center and Click Trust Center Settings.



(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.



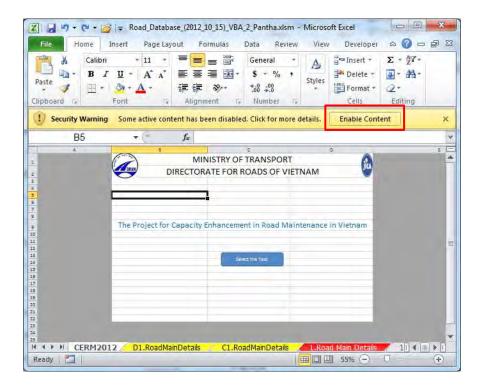
(2) Following "Security Warning" Alerts

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

	* 11 * <u>U</u> * A A <u>3</u> * <u>A</u> * Font	律律 📎	General → \$ → % → *:0 ÷:0 Number 5	A Styles	B ← Insert + Delete + Format + Cells	Σ * 27* • 2* Editing
Security Warning	Some active cor	ntent has been disable	d. Click for more d	letails.	Enable Cont	ent
B5		fx				
1		DIRECTORATE FOR	KUADS OF VIETI	NAM		
	The Project for	r Capacity Enhancem	ent in Road Maini	tenance i	n Vietnam	
					-	

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.

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U Security V	Warning S	ome active	content h	as been d	lisabled	. Click for	more d	etails.	Enable Cont	ent	×
B	5	(°	f_x								Y
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(3) Click Enable Content and then click Advanced Options.

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2 Cons 例 Road, Database (), . 程 Road, Sababase (), . 初 Road Ortabase (),	Enders Carliert	Tennoity Wanning Aston contact resplit particle recome and other security narrows. The following context has been detailed:	Prepietberg v Anne Trans Trans Trans Transporter
1 Paparen and Tateren	Allerant	All Content stable bits mousteed's entry content re a Trusted Discoverin	Patient Dates
Mant	belief in	end Queliness electrony of the constraint division of the strategiest diserve with the strain the trees sections control sciences of	Staff Mitighteer Staffeer Land Filling
tigai	- 4-		Rabeled Perspire

(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.

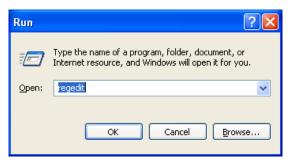
To resolve this problem, following two methods can be applied as described below.

- 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 <u>http://www.microsoft.com/en-us/download/details.aspx?id=5</u>
 - ✓ 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

it New Paylader test				
+ Offer + 11.5 + 12.0 + Acres + Common + Common + Common		New Colar) Accession Colarison	Type REG_SZ REG_DWORD REG_DWORD	Data Uniter net set1 ph00000000 (1) tix00000000 (1)
File M		Keer Strong Value Dinary Value		
Registra Like Sit B Wod B Acres	Equit Permanent	Nub-Dong-Veilar Expendebia Song		
÷ ⊇ Connet + ⊇ Connet ÷ ⊇ Ward + ⊇ Cuttot Espress	Cupy My filene			

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

Nerne (Default) MArcessvBOM MVBAWarnings MARCESSVBOM	Type REG_SZ PEG_DWORD REG_DWORD REG_DWORD	Data (value not set) oxid0000001(1) 0xi00000001(2) 0xi00000000(0)	
	C 12. DExcel Security	e 112. DiExcellSecurity	e 112. Tij Sucel Security

✓ Replace New Value #1 by ExcelBypassEncryptedMacroScan in file name

<u>File E</u> dit <u>V</u> iew F <u>a</u> vorites <u>H</u> elp			
Office I1.0 I2.0 Access Common Excel File MRU Options Security StatusBar Groove OneNote	<	Name	Type REG_52 REG_DWORD REG_DWORD REG_DWORD

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

Edit DWORD Value	? 🔀
Value <u>n</u> ame:	
ExcelBypassEncryptedMa	croScan
⊻alue data:	Base
0	⊙ <u>H</u> exadecimal
	O <u>D</u> ecimal
	OK Cancel

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.

Select Task	Select Task
Road Asset Data	• New Data Input
C Pavement Condition	C Data Editing
	C Data Search, Display, Delete & Print
C Maintenance History	C New Data Import (Data Assembling)
C Traffic Volume	C Resumption of Data Input Task
C VBMS Interface	C Create Report
C System Back-up	Select data type:
Home Cancel OK	

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.

Image: New Data Input 1. Bac Can Image: Data Editing Select data type: Image: Data Search, Display, Delete & Print 1. Road Main Details Image: Data Input Task Select data format: Image: Data Report Image: Data Search Select data type: Image: Data Input Task Image: Data Report Image: Data Input Task Image: Data Input Task Imag	Select Task	Select province:
C Data Search, Display, Delete & Print Select data type: C New Data Import (Data Assembling) 1. Road Main Details C Resumption of Data Input Task Select data format: C Create Report Inventory Select data type: Drawings	C New Data Input	1. Bac Can
C Resumption of Data Input Task Select data format: C Create Report I Select data type: Inventory Drawings	C Data Search, Display, Delete & Print	
Select data type: Drawings	C Resumption of Data Input Task	Select data format:
	Select data type:	

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.

- Select Task	Select province:
C New Data Input	Bac Kan 👻
Data Search, Display, Delete & Print	Select data type:
C New Data Import (Data Assembling)	1, Road Main Details 👻
C Resumption of Data Input Task	Select data format:
Select data type:	1
	Inventory Drawings Photos
	Inventory Drawings

Note: For data search, aspiny, delete and printing maintenance history data, user shall enter inrough ma 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.

Select Task	Select province:	
C New Data Input	1. Bac Can	-
C Data Editing	Select data type:	-
New Data Import (Data Assembling)	1. Road Main Details	-
C Resumption of Data Input Task	Select data format:	
C Create Report		•
lect data type:	Drawings Photos	
Back Cancel OK		

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.

Data Editing Data Search, Display, Delete & Print New Data Import (Data Assembling) Resumption of Data Input Task Create Report data type:	1. Bac Can Select data type: 1. Road Main Details 2. Vertical Alignment 3. Horizontal Curvature 4. Pavement	

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.

C New Data Input	Select report type
C Data Editing	C Dynamic Report C Data Export
C Data Search, Display, Delete & Print	Back Cancel OK
🗘 New Data Import (Data Assembling)	
C Resumption of Data Input Task	<u> </u>
Create Report	
ct data type:	

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.

			Ν	/INISTRY OF	TRA	NSPORT					
		[DIRECT	ORATE FOR		DS OF VIE	TNAM				
				DATAINP	UT S	HEET					
Data Type : Road Main Details											
GENERAL INFORMATION											
Road ID : Null	Location Ref							01		Jurisdiction	Date
Road Name : QL.1A	-	Km +		Latitude	Lo	ngitude	Province	City		RRMU No.:	KM Post Adju
Route Name : Lạng Sơn '⊣ Bắc Giang		0	0				Lạng Sơn	-		RRMU2	2014/1/25
Route Branch N : 0	To :	1	0				Lạng Sơn	-		F.O Name	Data Entry
Road Class : I	Length :	1,000.0	m	1						VPHT II.05	2014/1/25
MAIN DETAILS											
Construction Year :		CROSS	SECTION	SCALE							
Year of Service Operation Open :		Directio	n Type	:		Shou	<u>llder</u>		Fo	otpath, Ditch	
Terrain Type :		Motoriz	ed Lane			Treat	ed Shoulder W:		m Fo	otpath Width (inclu	ıding : n
Temperature :	°C	No. of La	ane	:		Treat	ed Shoulder S :		Fo	otpath Structure	· :
Annual Preciptation :	mm	Lane Wi	dth (one l	a : 🛛	m	Non-	Freated Shoulc :		m Dit	ch Width	: n
Road Bed Type :		Pavemer	nt Type	:					Dit	ch Structure	:
Actual Length :	m	Non-Mo	torized L	ane (NMT)		Medi	an Strip		Cro	oss Section Detai	ls
Right of Way :	m	No. of La	ane	:		Width	ו :		m Ca	rriageway Width	: 0 n
Design Speed : #N/A	km/h	Lane Wi	dth (one l	a : 🛛	m	Max.	Difference in E :		m Pa	vement Width	:0 n
0.		Pavemer	nt Type	:		Media	an Structure :		Ro	ad Bed Width	: 0 n
ROAD STRUCTURES (if any)						Rem	arks				
Structure Type	<u>Q</u> ı	antity	<u>Remark</u>	s							
Bridge	:										
Road Intersection	:										
Railway Crossing	:										
Box Culvert	:										
Slab Culvert	:										
Pipe Culvert	:										
Flyover Bridge	:										
Others	:										
							Back to			Edit	Display
							Back to MainWindow			Edit	Display



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.

		DA	TE FOR ROADS OF VIETN/ TA CONFIRMATION			
sN		Road Main Details	Cub Hom	Linit	Volue	Demark
	ltem General		Sub-Item	Unit	Value	Remarks
1.1	Information		Road ID			
			Road Name		QL.1A	
			Route Name Route Branch No.		Hàr Nộir -r Hàr Nam	
			Road Class		0 	
		Jurisdisction	RRMU No.		RRMU-2	
			RRMC No.		RRMC234	•••••••
		KM Post	From	km	3	
				m	100	
			То	km	4	
				m	100	
		From	Latitude		200000	
	1	То	Longitude Latitude		1000000 200000	
			Longitude		100000	
	1	From	Province		Bac Can	
			City		X	
	İ	То	Province		Bac Giang	
			City		X	
		Date	Kilopost Update	YY	4/2/2013	
			Data Entry	YY	4/2/2013	
		Length		m	1000	
4.0	Main Datalla	Actual Length	Oranda atian Oranalatian Viran	km	1000	
1.2	Main Details		Construction Completion Year Year of Service Operation	YY	11/11/1990	
			Open	YY	12/12/1990	
			Terrain Type		1	
			Temperature	°C	25	
			Annual Preciptation	mm	80	
			Road Bed Type	km/h	1 60	
		Roadway Lane Details	Design Speed	KIII/II	Down	
		Troadway Lanc Details	Right of Way	m	15	
			Carriageway Width	m	7	
	1		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	
	1		Width of Lane Pavement Type	m	2 1	
S	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	
	1	Right Side	Width	m	1	
	Road Structures	Structures (I)	Type (Pavement)		4 1	
	Nodu Structures	Structures (I)	Structure Type Start Point	km	50000	
				m		
	1		End Point	km		
				m	50200	
			Center Point	km		
				m	50100	
	ļ		Location Name		HN	
1.3	Remarks					
			k to Select			

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 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.

C Pavement Condition	sent in an insecure manner (basic authentication without a secure connection).
	User name Password
VBMS Interface	Remember my credentials OK Cance
C System Back-up	

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.

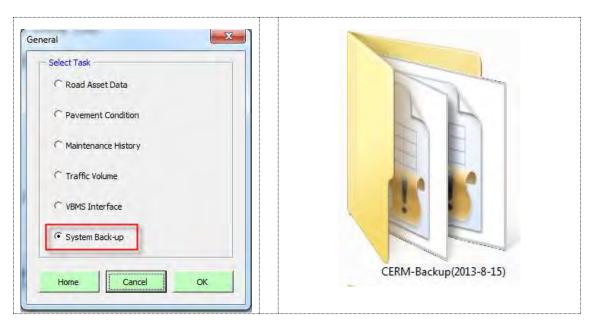


Figure 3.3.2 Data Back-up System

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.

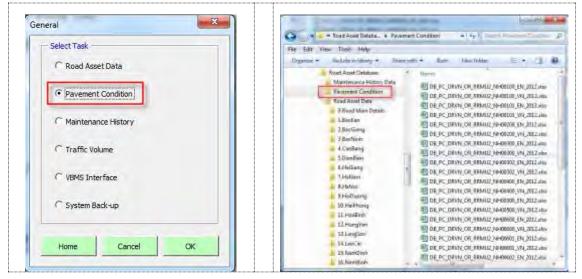


Figure **B.3.3** Pavement Condition Data

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.

- Select Task	
C Road Asset Data	Digariat * Include include in three with * Bant * E * 1
C Pavement Condition	Road Asset Database Nerris Maintenance History Data 10 DB, TV, DRVN, OR, RRMU2, 2013.set
C Maintenance History	Road Asset Data
C Traffic Volume	Traffic Volume
C VBMS Interface	

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.

Road Asset Data	C New Data Input
C Pavement Condition	C Data Search, Display & Print
C Maintenance History	C New Data Import
C Traffic Volume	C Resumption of Data Input Task
C VBMS Interface	Select data type:
C System Back-up	Back Cancel OK
Home Cancel OK	

(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

								MINIST			PORT OF VIETNAM							
							INPUI					A						
								INTOL	ATA INF	UT SF	1EE I		Export		Data	Day	ck to MainW	indow
		Pavement											Input	She	eet	Dat		nuow
	nputing General Information																	
Road		:	Location											-	Jurisdiction		Date	
	Name	:			Km	+ m		Latitude	Longiti	ıde	Province	City	y		RRMU No.	_	Kilopost Upo	
Route	e Name	:]	From	:		+										L	(dd/mm/yyy	()
Route	e Branch No	:	То	:		+									RRMC No.	ļ	Data Entry	
Road	Class	:	Length	:	0.0		m										(dd/mm/yyy	6/3/2013
Infor	mation ab	out Road N	lame, Pr	rovi	nce an	d Roa	d Mar	nagement.	urisdic	ion								
SN	RRMU	NH	Branch N	lo.	From		÷	То			Province				City			RRMC
-	Ŧ	-	-		-	-	* *	Ŧ	×	-	-	¥	-	¥	-	¥	Ŧ	* *
1	RRMU 2	QL.1A	(0	KM0	+ 0	÷	KM94	+ 70		Lang Son	÷ Lar	ng Son		-	÷	-	236
2	RRMU 2	QL.1A	(0	KM94	+ 70	÷	KM132	+ 245		Bac Giang	÷ Ba	c Giang		-	÷	-	236
3	RRMU 2	QL.1A	(0	KM132	+ 245	÷	KM152	+ 234		Bac Ninh	÷ Ba	c Ninh		-	÷	-	236
4	RRMU 2	QL.1A	(0	KM152	+ 234	÷	KM160	+ 77		Ha Noi	+ Ha	Noi		-	÷	-	236
								100.007.0	. 704		Ha Noi	· He	Moi		1	÷ .		248
5	RRMU 2	QL.1A	(0	KM160	+ 77	÷	KM174	+ 784			÷ ⊓a	INUI			· * .	-	248

- (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.

						DIRE		OF TRANS		1				
					I	NPUT	TING GENER	RAL INFOR	MATION DAT	A				
					-		INTO DAT	A INPUT SH	HEET					
Data	Type :	Pavement								Export 1 Input S			Back to Mai	nWindow
		ral Informat								input	sneet			
Road			Location Re	eferencina						1	Juri	sdiction	Date	
Road	Name :	QL.1A		Km	+ m		Latitude L	Longitude	Province	City	RR	MU No.	Kilopost	Update
Route	Name :	QL.1A	From :		+	_			Bac Giang	-		RRMU 2	(dd/mm/	yyy <mark>y</mark>)
Route	Branch No:		To :		+				Bac Giang	-	RR	MC No.	Data Ent	ry
Road	Class :		Length :	0.0		m			-			236	(dd/mm/	yyy 6/3/2013
	mation ab		ame, Prov Branch No.	From	d Road	d Man ÷	iagement Jur i To	isdiction	Province			City		RRMC
		NH	r ć	From			To	isdiction		-			×	RRMC
SN	RRMU	NH	Branch No.	From	Ŧ	÷	To	T .	-	• • • • • • • • • • • • • • • • • • •	v . v	*	¥ + -	* 1
SN	RRMU	NH	Branch No.	From	+ 0	÷ T T	To	70	Lang Son		· •	Ŧ		23
SN 7	RRMU RRMU 2	NH QL.1A	βranch No.	From KM0	+ 0 + 70	÷ * *	To KM94 + 7	70 245	Lang Son Bac Giang	+ Lang Son	v T	-	÷ -	23
SN 7 1 2	RRMU RRMU 2 RRMU 2	QL.1A QL.1A	Branch No.	From KM0 KM94	+ 0 + 70 + 245	÷ * * ÷	To KM94 + 7 KM132 + 2	70 245 234	Lang Son Bac Giang Bac Ninh	÷ Lang Son ÷ Bac Giang	* *	-	÷ - ÷ -	23 23 23 23
SN 1 2 3	RRMU RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A	Branch No.	From KM0 KM94 KM132	+ 0 + 70 + 245 + 234	÷ • ÷	To KM94 + 7 KM132 + 2 KM152 + 2	70 245 234 77	Lang Son Bac Giang Bac Ninh Ha Noi	÷ Lang Son ÷ Bac Giang ÷ Bac Ninh		-	÷ - ÷ - ÷ -	230 230 230 230 230 230 240
SN 1 2 3 4	RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A QL.1A QL.1A	βranch No. • • • 0 0 0 0 0	From KM0 KM94 KM132 KM152	+ 0 + 70 + 245 + 234 + 77	+ * + + +	To KM94 + 7 KM132 + 2 KM152 + 2 KM160 + 7	70 245 234 77 784	Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi	 Lang Son Bac Giang Bac Ninh Ha Noi 	* *	-	+ - + - + - + -	230 230 230 230 230 240
SN 1 2 3 4 5	RRMU RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A QL.1A QL.1A QL.1A	Branch No.	From KM0 KM94 KM132 KM152 KM160	+ 0 + 70 + 245 + 234 + 77 + 784	÷ * * * *	To KM94 + 7 KM132 + 2 KM152 + 2 KM152 + 7 KM174 + 7	70 245 234 77 784 570	Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi Ha Noi	 Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi 		-	* - * - * - * - * -	230 230 230 230 244 230
SN 1 2 3 4 5 6	RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A QL.1A QL.1A QL.1A	Branch No.	From KM0 KM94 KM132 KM152 KM160 KM174	+ 0 + 70 + 245 + 234 + 77 + 784 + 570	+ + + + + + +	To KM94 + 7 KM132 + 2 KM152 + 2 KM160 + 7 KM174 + 7 KM181 + 5	70 245 234 77 784 570 608	Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi Ha Noi Ha Noi	 Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi Ha Noi 			+ - + - + - + - + - + -	

(8) Upon completion of filling up yellow-colored cells, click required 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.

						סוח			SPORT S OF VIETNAI	4				
						NPUI				A				
							INTO DA	ATA INPUT S	HEEI	Export t	o Da	ta	ack to MainV	the dame.
		Pavement								Input S	heet		ack to mainv	lindow
	<u> </u>	ral Informat	tion											
Road	ID	:	Location Re	eferencing				00000			Juri	sdiction	Date	
Road	Name	QL.1A		Km	+ m		Latitude	Longitude	Province	City	RR	MU No.	Kilopost Up	date
Route	e Name	QL.1A	From :		+				Bac Giang	-		RRMU 2	(dd/mm/yy	r <mark>y)</mark>
Route	Branch No	:	To :		+				Bac Giang	-	RR	MC No.	Data Entry	
I	Class		Length :	0.0		lm						236	(dd/mm/yy	6/3/2013
		out Road N			d Roa		nagement Ju	urisdiction				200	(-2	0.0.201
					d Roa		nagement Ju	urisdiction	Province			City	(22	RRMC
Infor	mation ab	NH	ame, Prov	From	_	d Mar	nagement Ju To			-		1		RRMC
Infor SN	mation ab	NH	ame, Prov Branch No.	From	Ŧ	d Mar	nagement Ju To	-	× 7	Lang Son	-	City		RRMC
Infor SN	mation ab	NH 🖛	ame, Prov Branch No.	From	- + 0	d Mar ÷	To To KM94 4	+ 70	Lang Son		7	City		RRMC
Infor SN	RRMU	NH QL.1A	ame, Prov Branch No.	From KM0	+ 0 + 70	d Mar ÷ •	To To KM94 + KM132 +	+ 70 + 245	Lang Son Bac Giang	+ Lang Son	v T	City		RRMC 230 231
Infor SN T 1 2	RRMU RRMU RRMU 2 RRMU 2	QL.1A QL.1A	ame, Prov Branch No.	From KM0 KM94	+ 0 + 70 + 245	d Mar + + + +	To To KM94 + KM132 + KM152 +	+ 70 + 245 + 234	Lang Son Bac Giang Bac Ninh	+ Lang Son + Bac Giang		City		RRMC 231 231 231
Infor SN 1 2 3	RRMU RRMU RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A	ame, Prov Branch No.	From From KM0 KM94 KM132	 + 0 + 70 + 245 + 234 	d Mar + + + + +	To To KM94 + KM132 + KM152 + KM150 +	• 70 • 245 • 234 • 77	Lang Son Bac Giang Bac Ninh Ha Noi	+ Lang Son+ Bac Giang+ Bac Ninh		City		RRMC 236 236 236 236
Infor SN 1 2 3 4	RRMU RRMU RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A QL.1A QL.1A QL.1A	ame, Prov Branch No.	From KM0 KM94 KM132 KM152	+ 0 + 70 + 245 + 234 + 77	d Mar + + + + + +	To To KM94 + KM132 + KM152 + KM150 + KM160 + KM174 +	• 70 • 245 • 234 • 77 • 784	Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi	 + Lang Son + Bac Giang + Bac Ninh + Ha Noi 	* *	City	-	RRMC 236 236 236 236 236 248 236
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Infor SN 1 2 3 4 5 6	RRMU RRMU RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2 RRMU 2	NH QL.1A QL.1A QL.1A QL.1A QL.1A QL.1A	ame, Prov Branch No. 0 0 0 0 0 0	From KM0 KM94 KM132 KM152 KM160 KM174	 + 0 + 70 + 245 + 234 + 77 + 784 + 570 	d Mar + + + + + + + + +	To To KM94 + KM132 + KM152 + KM160 + KM174 + KM174 + KM181 + KM181 +	 70 245 234 77 784 570 608 	Lang Son Bac Giang Bac Ninh Ha Noi Ha Noi Ha Noi Ha Noi	 + Lang Son + Bac Giang + Bac Ninh + Ha Noi + Ha Noi + Ha Noi + Ha Noi 		City -+ -+ -+ -+ -+	· · · · · · · · · · · · · · · · · · ·	RRMC 23 23 23 23 23 23 24 24 23

(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.

					MINISTRY TORATE F	an 105	DS OF VI					
	9 Road thain De	taila-										
GENERAL INFOR Road ID Road Name Route Name Route Branch N Road Cales	QL 14 Lang Sim - Bắc G J	-	Location Refer From To Length		Latitude	Lin	gitude	Province Lang Son Lang Son	Cey -	Junediction RAMB No. RRMB 1 RRMS-8 Name Chricole QLOB 15	Date KII Post / 2014/ Data Entr 2014/	2/5 Y
MANH DETAIL S Construction View View of Service I Temperature Annue Procipital Road Sed Type Actual Length Road Safety Con Design Speed	Operation Op <mark>e</mark> r of	#UA	12 Jam m (up) m (down) kmit	CROSS SECTION S Direction Type Motorized Lane No. of Lane Lane Wath (one to Pavement Type Lane Wath (one to Pavement Type			Treat Treat NDD- Macd Widt Max.	uider ted Shoulder V ted Shoulder S Tripated Shoul ten Strip h Difference in I an Structure	m	Footnath, Ditch Footpath With (Rouding cur Footpath Shuchare Otch Widt) Dich Bhuchare Cross Section Details Carrageway Width Pavement Width Road Bac Width	ă ă	an an an an an an an an an an
ROAD STRUCTU Structure Ty Bridge Road Intersec Railway Cros Box Culvert Siab Culvert Pipe Culvert Flyover Bridge Others	105 Sion Bing		9	aantiity Remarks	-		Berri	urks				
								Bata to De		(Edit)	Disp	AT F

(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.

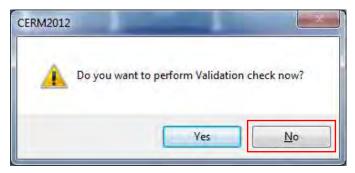
	DIRECTORATE FOR	F TRANSPORT R ROADS OF VIETNAM PUT SHEET			
Data Type : Road Main Details					
GENERAL INFORMATION Road ID : : Road Name : QL.1A Route Name : Lạng Son - Bắc Giang Route Branch N : 0 Road Class : I	Km m Latitude From 0 0 To 1 0 Length 1,000.0 m	Longitude Province Lang Son Lang Son	City - -	Jurisdiction RRMB No.: RRMS-B Name Chi cục QLĐB I.5	Date KM Post Adjustmen 2014/2/5 Data Entry 2014/2/5
MAIN DETAILS Construction Year Year of Service Operation Oper Terrain Type Temperature Annual Preciptation Road Bed Type Actual Length Road Safety Corridor Design Speed #N/A	CROSS SECTION SCALE Direction Type : Motorized Lane No. of Lane : Lane Width (one la : Mon-Motorized Lare (NMT) Mon-Motorized Lare (NMT) m (up) m (down) Lane Width (one la : Mon-Motorized Lare (NMT) m (down) Lane Width (one la : Mon-Motorized Lare (NMT) No. of Lane : Mon-Motorized Lare (NMT) Mon	<u>Median Strip</u> Width	m Footp Footp Ditch Ditch Carris M Carris Road	path, Ditch ath Width (including curb ath Structure Width Structure <u>is Section Details</u> ageway Width ment Width Bed Width Land Width) m m : 0 m : 0 m : m
ROAD STRUCTURES (if any) Structure Type Bridge Road Intersection Railway Crossing Box Culvert Slab Culvert Pipe Culvert Flyover Bridge Others	Quantity Remarks	Remarks			
			Select	Edit	Display

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.

			TE FOR ROADS OF VIETN	AM		
Data Type		Road Main Details				
SN	Item		Sub-Item	Unit	Value	Remarks
1.1	General Information		Road ID		QLLLLLLLLLT	
	Information		Road Name		QL-1	
			Route No.		QL-26	
			Route Branch No.		10	
		Jurisdisction	Road Class RRMU No.		III RRMU-2	
		Junsuischon	RRMC No.		RRMC234	
		KM Post	From	km, m	350000	
			То	km,m	450000	
		From	Latitude		200000 1000000	
		То	Longitude Latitude		200000	
			Longitude		1000000	
		From	Province		Bac Can	
			City		X	
		То	Province City		Bac Giang x	
	t	Date	Kilopost Update	YY	× 12/5/2012	
			Data Entry	YY	12/21/2012	
	ļ	Length		m	100000	
1 0	Main Details	Actual Length	Construction Completion Year	km YY	1000 11/11/1990	
1.2	main Delâns		Year of Service Operation			
			Open	YY	12/12/1990	
			Terrain Type		1	
			Temperature	°C	25	
			Annual Preciptation	mm	80	
			Road Bed Type Design Speed	km/h	1 60	
		Roadway Lane Details		Kiivii	Down	
			Right of Way	m	15	
			Carriageway Width	m	7	
		Motorized Lane	Pavement Width No. of Lane	m	9 2	
			Width of Lane	m	3	
			Pavement Type		3	
		Non-Motorized Lane	No. of Lane		1	
			Width of Lane Pavement Type	m	2 1	
	Shoulder	Left Side	Width	m		
			Type (Pavement)		6	
		Right Side	Width	m	1	
	Footpath	Left-side	Type (Pavement) Width	m	5 1	
			Type (Pavement)		5	
		Right Side	Width	m	1	
			Type (Pavement)		4	
	Road Structures	Structures (I)	Structure Type Start Point		1 50000	
			End Point		50200	
			Center Point		50100	
	l		Location Name		x	
1.3	Remarks					
		Ba	nck to Select Data Print	E	dit Che	ck Validity
	on to return Window.	Click this button Printing the data			ta procee	his butto ed ation Ch o

(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?"



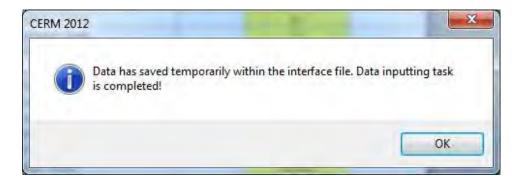
(13) Click "**No**" button to terminate / exit from data inputting work and save inputted data temporarily within the system interface file.

ERM 2012	-	
Do you want t	to save inputed data t	temporality?
	Yes	No

(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".



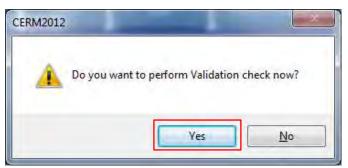
Since inputted data will be saved temporarily within the system interface file, the interface file should be saved WITHOUT changing interface file name. Click save icon to save interface file.

(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.

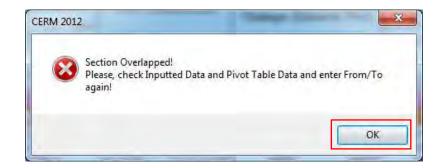


4.1.3 Validation Check

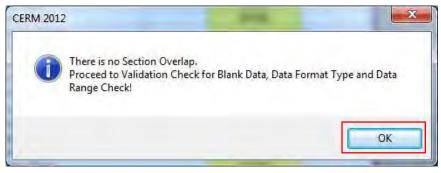
(17) Click "Yes" button to proceed to Data Validation Check.



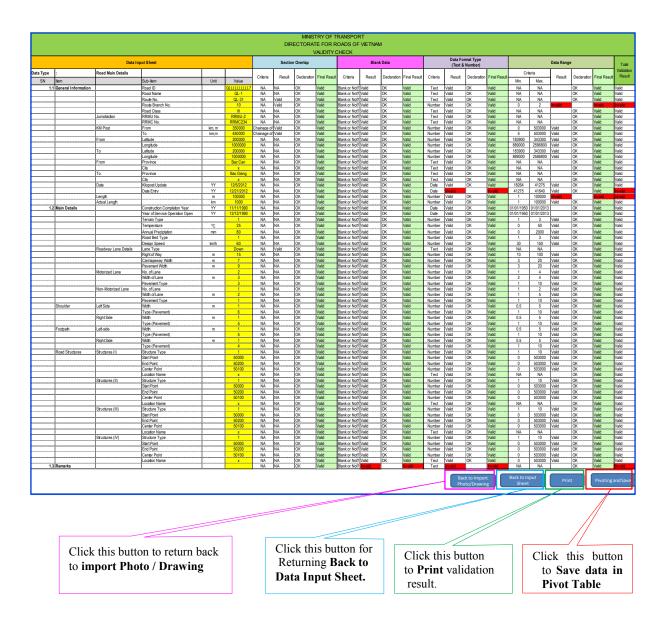
- (18) Validation Check process carry-out validation check process starting from Section Overlap Check.
 - ✓ If the system identifies Section Overlap, the following window is appeared with the massage indicated in the window. Click "OK" button to correct the inputted data. When "OK" button is clicked, 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".



(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.

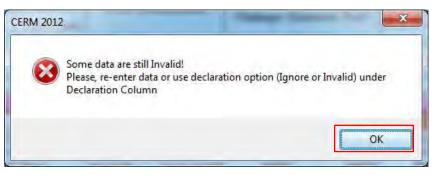
Printer	
Name: ApeosPort-IV C6680A	▼ Properties
Status: Idle	Find Printer
Type: FX ApeosPort-IV C6680 Where: 192,52,150,230	Fuig Frances
Comment:	Print to file
Print range	Copies
● <u>A</u> I	Number of copies:
Page(s) Erom: Io:	
Print what	
🔘 Selection 👘 Entire workbo	ook 12 ³ 12 ³ Collate
Active sheet(s) Table	
Ignore print areas	

(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.

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4.1.4 Pivoting and Saving

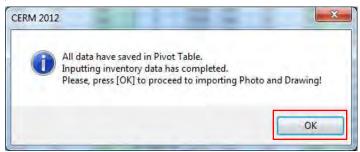
(22) Click "**Pivoting and Save**" button to save data in pivot table. If "**Pivoting and Save**" button is pressed without declaring the invalid data, error message is appeared as shown below.



- (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.

RM 2012		
🛕 Do you hav	ve Photo of this Road Sec	tion/Facility?
	Yes	No

(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

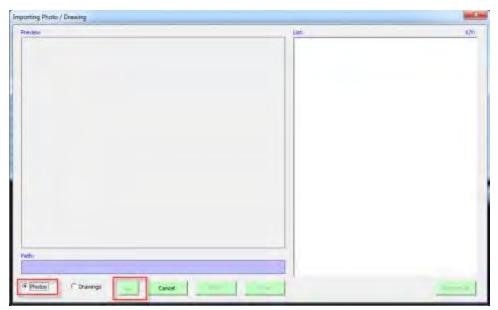
(28) Click "Yes" button, if photo or Video of this Road Section / Facility is available.



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

Importing Photo / Drawing		
Prezien	Lat	- x/tz
Petr		
C Photos C Drawings Cancel		

(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).

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Desktop Downineds Recent Places Photo Stream	IMG_0085.PG	IMG_0066.J#G	IM6_0088.JPG	IMG_0069.JPG	IMG_0030.JPG
Documents Music	IMG_0091_IFG	TMG_0092.JPG	IM6_0093_P/G	BM5,0094JP5	IMG,0025.JPG
Videos	-	- North	100	-	

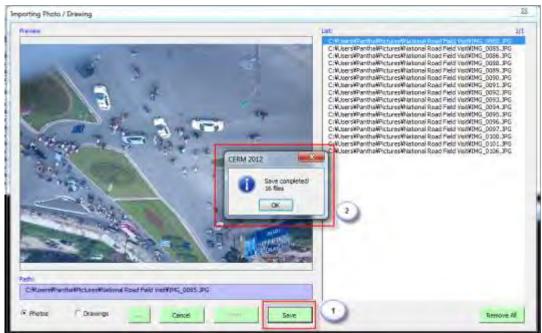
(31) Single or multiple photos can be selected and uploaded at once. Upon selection of the photo(s), detailed path of selected files is also appeared in right side of the photo importing window. Selected photos can be previewed in the left side of the same window.

Image: State of the state	President	Lat	5
adhi C. N.SersWPantheRPicturesNNetional Road Field VisitHIME_0085.PFG		C: KuperskiPanthakiPictureskiKational Road Reid VisitkiPi45_003 C: KuserskiPanthakiPictureskiNational Road Reid VisitkiPi45_003 C: KuserskiPanthakiPictureskiNational Road Reid VisitkiPi45_003 C: KuserskiPanthakiPictureskiNational Road Reid VisitkiPi45_003	88.3PG 91.3PG 92.3PG

(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.

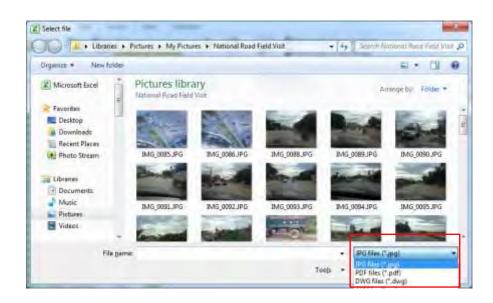
(36) Upon importing all photos and videos, click "OK" button to proceed to importing drawings of the same location. Photo and Drawing importing window is still active. Alternatively, Click "Cancel" button on active Photo and Drawing Importing Window. Window shown in Step 19 is appeared. Click "Import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

4.1.7 Importing Drawings

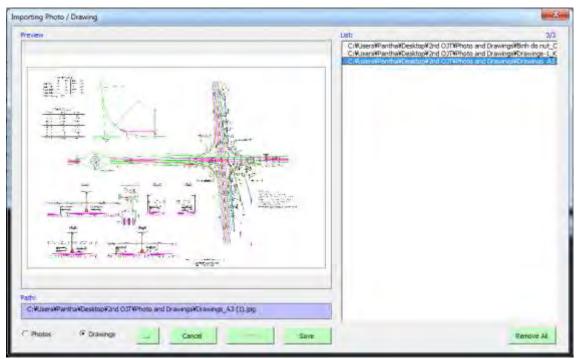
(37) Click "Drawings" button and click "Browse" button.

Importing Photo / Drawing		100 A
Preview	Lep	4 <u>76</u>
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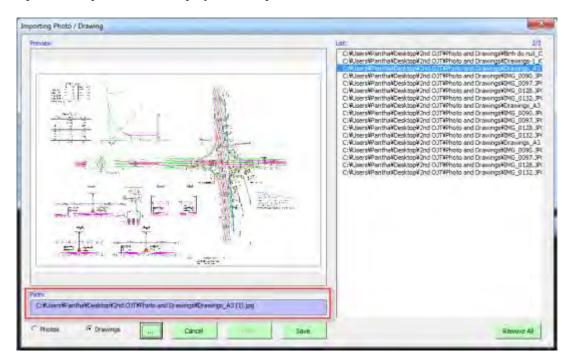
(38) Browse drawings by selecting appropriate drawing file format (*.DWG, PDF, JPG) using "Select file" window.



(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.

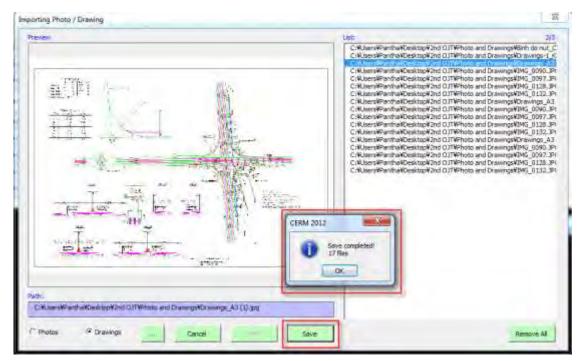


(40) If wrong photos are uploaded mistakenly, photos can be removed from the list by clicking "Remove All" button. Additional photos can also be uploaded however the maximum size (total size of uploaded photos) should be within 100MB. The file path of previewed photo is also displayed in the path box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

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(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.

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NO-WICH	_	Bat Can		NA .	00	Nete	think or Not		DR.	Net	764	Vete		Valid	164	- 154		OF.	Vend	Valid
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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.

Select Task	Select Task
Road Asset Data	C New Data Input
C Pavement Condition	Data Editing
	C Data Search, Display, Delete & Print
C Maintenance History	C New Data Import (Data Assembling)
C Traffic Volume	C Resumption of Data Input Task
C VBMS Interface	C Create Report
C System Back-up	Select data type:
Home Cancel OK	
Home Cancer OK	Back Cancel OK

- (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".

Select province	ŧ	
Bac Can		•
Select data typ	e:	
1. Road Main) Details	•
Select data for	mat:	
Inventory		-
Back	Cancel	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.

				DISPLAY DA	and the second second	S OF VIETNAM	Delete	Back		Export Data
SN	RRMU	Road Main Road Name	Route Name	Route Branch No.	Chamage (bom)	Chainage (to)	Direction Type	Province (fram)	FOName	Date of Update
	Khu QLĐB II	QL4E	Láo Ca:	0	Km0 + 0	Km1 + 1	Ngurore	Lão Cai	VPHT II.03	13/07/03
;	Khu QLOB II	GL 4E	Lão Cai	0	Km0 + 0	Km1 + 1	Xuði	Lão Cai	VPHT II.03	13/07/03
3	Khu QLEB II	QL.6	Hoa Binh - Son La	0	Km38 + 0	Km39 + 0	Xuði	Hea Binn	VPHT II.01	13/08/28
	Khu QLEB II	QL.6	Hóa Binh - Sơn La	0	Km39 + 0	Kim40 + 0	Xuði	Hòa Binh	VPHT IL01	13/08/28
	Khu QLEB I	QL 15	Hỏa Định	0	Km0 + 0	Km4 + 0	Xuôi	Hòa Binh	VPHT II.01	13/09/07
(Khu QLĐB 8	QL. 15	Hóa Binh	0	Km4 + 0	Km6 + 0	Хибі	Hòa Binh	VPHT II.01	13/09/07
1	Khu QLDB I	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Хибі	Hóa Đình	VPHT IL01	13/09/07
1	Khu QLEB II	QL 15	Hóa Binh	0	Km6 + 500	Km8 + 0	Хибі	Hóa Bình	VPHT II.01	13/09/07
1	Khu QLEB II	QL. 15	Hóa Binh	0	Km8 + 0	Km19 + 0	Хибі	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLEE II	QL 15	Hóa Binh	0	Km19 + 0	Km20 + 0	Хибі	Hóa Binh	VPHT II.01	13/09/07
1	Khu QLEE II	QL.6	Hóa Binh - Sơn La	0	Km40 + 0	Km43 = 0	Xuði	Hóa Bình	VPHT 11.01	13/09/07
15	Khu QLEB II	QL.6	Hòa Binh - Son La	0	Km43 + 0.	Km44 + 0	Хибі	Hủa Đinh	VPHT II.01	13/09/07
i ta	Khu QLEB I	QL6	Hóa Binh - Son La	0	Km44 + 0	Km45 + 0	Хибі	Hóa Bình	VPHT II.01	13/09/07
14	Khu QLĐĐ II	QL6	Hòa Binh - Sơn La	0	Km45 + 0	Km50 + 0	Xuði	Hòa Binh	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.

ata Type		Road Main		DISPLAY DA		DATABASE	Delete	Back		Export Data
SN	RRMU	Road Name		Route Branch No.	Chamage (bom)	Chainage (to)	Direction Type	Province (fram)	FOName	Date of Update
3	Khu QLEB II	QL4E	Láo Cai	0	Km0 + 0	Km1 + 1	Ngurore	Lão Cai	EO.II THAY	13/07/03
2	Khu QLOB II	QL.4E	Lão Cai	0	Km0 + 0	Km1 + 1	Xuði	Lão Cai	VPHT II.03	13/07/03
3	Khu QLEB il	QL.6	Hoa Binh - Son La	0	Km38 + 0	Km39 + 0	Xuði	Hèa Binh	VPHT II.01	13/08/28
4	Khu QLEB II	QL 6	Hòa Binh - Sơn Lạ:	0	Km39 + 0	Km40 + 0	Χυδί	Hòa Binh	VPHT II.01	13/08/28
5	Khu QLEB II	QL 15	Hòa Binh	0	Km0 + 0	Km4 + 0	Xuði	Hòa Bình	VPHT II.01	13/09/07
6	Khu QLĐB II	QL 15	Hóa Bình	0	Km4 + 0	Km6 + 0	Xuði	Hòa Bình	VPHT IL.01	13/09/07
7	Khu QLDB II	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Xuði	Hóa Binh	VPHT IL.01	13/09/07
8	Khu QLEB it	QL 15	Hoa Binh	0	Km5 + 500	Km8 + 0	Xuði	Hóa Elinh	VPHT II.01	13/09/07
9	Khu QLEB II	QL. 15	Hòa Binh	0	Km8 + 0	Km19 + 0	Хибі	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLEB I	QL 15	Hóa Binh	0	Km19 + 0	Km20 + 0	Хибі	Hóa Binh	VPHT II.01	13/09/07
11	Khu QLEE II	QL.6	Hóa Binh - Sơn La	0	Km40 + 0	Km43 + 0	Xuði	Hóa Binh	VPHT 11.01	13/09/07
12	Khu QLEB II	QL.6	Hòa Binh - Son La	0	Km43 + 0	Km44 + 0	Xuði	Hòa Đình	VPHT II.01	13/09/07
12	Khu QLEB II	QL6	Hóa Binh - Son La	0	Km44 + 0	Km45 + 0.	Хибі	Hèa Bình	VPHT II.01	13/09/07
14	Khu QLĐB II	QL6	Hòa Binh - Sơn La	0	Km45 + 0	Km50 + 0	Xuði	Hòa Binh	VPHT ILOI	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 C	DF TI	RANSPO	RT							
				DIRECT	FORATE FO	RR	OADS O	F VIE	TNAM						
					DATA IN	PUT	SHEET								
					DAI AI		011221								
Data Type : Road Main De	tails														
GENERAL INFORMATION															
Road ID :		Location Re	eferencing	J								Jurisdiction	Date		
Road Name : QL.6			Km +	+ m	Latitude	_	Longitude	е	Province	City		RRMU No.:			djustme
Route Name : HòarBìnhr⊓Sorn		From :	39	0					Hòa Bình	-		Khu'QLĐBj'll		905/06	/29
Route Branch N : 0		To :	40	0					Hòa Bình	-		F.O Name	Data	a Entry	
Road Class : Cấp III		Length :	1,000.0) r	m							VPHT II.01	1	13/08/28	3
MAIN DETAILS Construction Year	1905/0	06/03	CPOSS	SECTIO	N SCALE										
Year of Service Operation Open :	1905/0			on Type	: Xuôi			Shou	ldor		I.	Footpath, Ditch			
Terrain Type :	Đồng		-	zed Lane					ed Shoulder W			Footpath Width (inclu	udina		m
Temperature :	Dong	°C	No. of L		: <mark>1</mark>				ed Shoulder S			Footpath Structure	uunig	1	
Annual Preciptation :		mm		idth (one		m			Freated Should			Ditch Width		1	m
Road Bed Type :	2			ent Type	: AC			NOTI-1	ineated onould	. 2.0		Ditch Structure		1	
Actual Length :	1000	m			Lane (NMT)			Modi	an Strip			Cross Section Deta	ile	<u>. </u>	_
Right of Way :	1000	m	No. of L					Width				Carriageway Width	113	3.5	m
Design Speed :	#N/A	km/h		idth (one	In .	m			Difference in F	1		Pavement Width		: 3.5	m
Design Speed .		KIII/II		ent Type	10.				an Structure			Road Bed Width		: 6	m
			, atome	Sint Type	•			mound		•					
								-							
ROAD STRUCTURES (if any)								Rema	arks						
Structure Type		Q	<u>uantity</u>	<u>Remar</u>											
Bridge		:	1	<mark>Cầư K</mark> é	L=28,2m										
Road Intersection		:													
Railway Crossing		:													
Box Culvert		:													
Slab Culvert		:													
Pipe Culvert		:													
Flyover Bridge		:													
Others		:													
								1							
									Back to			E .111		0	
									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.

Select Task	Select Task
Road Asset Data	C New Data Input
C Pavement Condition	C Data Editing
	Oata Search, Display, Delete & Print
C Maintenance History	C New Data Import (Data Assembling)
C Traffic Volume	C Resumption of Data Input Task
C VBMS Interface	Create Report
C System Back-up	Select data type:
Home Cancel OK	Back Cancel OK

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".

Data Search	x
Select province:	_
Bac Can	•
Select data type:	
1. Road Main Details	•
Select data format:	
Inventory	
Back Cancel	ок

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

ata Type		Road Main	Dotails		Back to MainWindow					
SN	RRMU	Road Name	Route Name	Route Branch No.	Chamage (bom)	Chainage (to)	Direction Type	Province (fram)	FOName	Date of Update
1.13	Khu QLEB II	QL4E	Láo Ca	0	Km0 + 0	Km1 + 1	Ngurore	Lão Cai	VPHT II.03	13/07/03
:	Khu QLOB II	GL 4E	Lão Cai	0	Km0 + 0	Km1 + 1	Xuði	Lão Cai	VPHT II.03	13/07/03
3	Khu QLEB II	QL.6	Hoa Binh - Son La	0	Km38 + 0	Km39 + 0	Xuði	Hea Binh	VPHT II.01	13/08/28
	Khu QLEB II	QL.6	Hóa Binh - Sơn La	0	Km39 + 0	Km40 + 0	Хибі	Hòa Bình	VPHT II.01	13/08/28
1	Khu QLEB I	QL 15	Hóa Binh	0	Km0 + 0	Km4 + 0	Xuôi	Hòa Binh	VPHT II.01	13/09/07
6	Khu QLĐB II	CL 15	Hóa Bình	0	Km4 + 0	Km6 + 0	Xuði	Hòa Bình	VPHT II.01	13/09/07
1	Khu QLĐB II	QL 15	Hòa Bình	0	Km6 + 0	Km6 + 500	Xuði	Hóa Binh	VPHT IL01	13/09/07
1	Khu QLEB it	QL 15	Hóa Binh	0	Km6 + 500	Km8 + 0	Xuði	Hòa Bình	VPHT II.01	13/09/07
(Khu QLĐB II	QL. 15	Hóa Binh	0	Km8 + 0	Km19 ± 0	Хиві	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLEB II	QL 15	Hóa Binh	0	Km19 + 0	Km20 + 0	Хибі	Hóa Binh	VPHT II.01	13/09/07
1	Khu QLEE II	QL.6	Hóa Binh - Sơn La	0	Km40 + 0	Km43 = 0	Xuði	Hóa Binh	VPHT II.01	13/09/07
12	Khu QLEB II	QL.6	Hòa Binh - Son La	o	Km43 + 0.	Km44 + 0	Xuði	Hòa Đình	VPHT II.01	13/09/07
t:	Khu QLEB I	QL6	Hóa Binh - Son La	0	Km44 + 0	Km45 + 0.	Хибі	Hóa Bình	VPHT II.01	13/09/07
14	Khu QLĐB II	QL6	Hòa Binh - Sơn La	0.	Km45 + 0	Km50 + 0	Xuði	Hòa Binh	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.

ata Type		Road Main		DISPLAY DA		DATABASE	Delete	Back		Export Data
SN	RRMU	Road Name	Roste Name	Route Branch No.	Chamage (bom)	Chainage (to)	Direction Type	Province (fram)	F O-Name	Date of Update
3	Khu QLEB II	QL4E	Láo Cai	0	Km0 + 0	Km1 + 1	Ngược	Lão Cai	EO.II THAY	13/07/03
2	Khu QLOB II	QL.4E	Lão Cai	0	Km0 + 0	Km1 + 1	Xuði	Lão Cai	VPHT II.03	13/07/03
3	Khu QLĐĐ II	QL.6	Hoa Binh - Son La	0	Km38 + 0	Km39 + 0	Xuði	Hea Binn	VPHT II.01	13/08/28
-4	Khu QLEB II	QL 6	Hoa Binh - Son La	0	Km39 + 0	Km40 + 0	Χυδί	Hèa Binh	VPHT II.01	13/08/28
5	Khu QLEB II	QL 15	Hòa Binh	0	Km0 + 0	Km4 + 0	Xuði	Hòa Bình	VPHT II.01	13/09/07
6	Khu QLĐB II	QL 15	Hóa Bình	0	Km4 + 0	Km6 + 0	Xuði	Hòa Bình	VPHT IL.01	13/09/07
7	Khu QLDB II	QL 15	Hòa Bình	0	Km6 + 0	Kim6 + 500	Xuði	Hòa Đình	VPHT II.01	13/09/07
8	Khu QLEB it	QL 15	Hoa Binh	0	Km6 + 500	Km8 + 0	Xuði	Hóa Binh	VPHT II.01	13/09/07
9	Khu QLEB II	QL. 15	Hóa Binh	0	Km8 + 0	Km19 + 0	Хибі	Hòa Bình	VPHT II.01	13/09/07
10	Khu QLEB II	QL 15	Hóa Binh	0	Km19 + 0	Km20 + 0	Хибі	Hóa Binh	VPHT II.01	13/09/07
11	Khu QLEE II	QL.6	Hóa Binh - Sơn La	0	Km40 + 0	Km43 = 0	Xuði	Hóa Bình	VPHT 11.01	13/09/07
12	Khu QLEB II	QL.6	Hòa Binh - Son La	0	Km43 + 0	Km44 + 0	Хибі	Hòa Đình	VPHT II.01	13/09/07
13	Khu QLEB II	QL6	Hóa Binh - Son La	Ó	Km44 + 0	Km45 + 0.	Xuði	Héa Đình	VPHT II.01	13/09/07
14	Khu QLDB II	QL6	Hòa Binh - Sơn La	0	Km45 + 0	Km50 + 0	Xuði	Hòa Binh	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.

		DIRECTOR	ISTRY OF TRANSPORT ATE FOR ROADS OF VIETNA	М		
ta Type	:	Road Main Details	ATA CONFIRMATION			
SN	ltem		Sub-Item	Unit	Value	Remark
1.1	General Information		Road ID			
	l		Road Name		QL.6	
			Route Name		Hòa Bình - Sơn La	
			Route Branch No.		-	
	•		Road Class		0 Cấp III	
	•	Jurisdisction	RRMU No.:		Khu QLĐB I	
	•		F.O Name		VPHT II.01	
		KM Post	From	km	38	
				m	0	
			То	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		1	
			Remarks			
		8. Others	Quantity			
			Remarks			
1.3	Remarks					
		Back to Select Data	Print	Ed	it 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.

Road Asset Data	C New Data Input
Pavement Condition	C Data Editing
Pavement Condition	C Data Search, Display, Delete & Print
Maintenance History	New Data Import (Data Assembling)
Traffic Volume	C Resumption of Data Input Task
VBMS Interface	C Create Report
System Back-up	Select data type:
System buck up.	
	Back Cancel OK
VBMS Interface System Back-up	

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.

Thwentery C Photos IF Drawings	Browse	Finantary C Hutan	C Draverga Brav
Province manel Data type:		Provence name: Data type:	
Finners		Fleright	
TR NAME.			
Ful path		Ful paths	
Old: on the ten to show details:		Click an the item to drow details: -	

(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.

Comput	ter 🖡 Local Disk (C:) 🖡 Users 🖡 Pantha 🖡 Desktop 🖡 🔹	Search Desktop	¢.
Organize 🔹 New fold	Jer	BEE	• 🔳 🔞
*	Name	Date modified	Туре
💦 Libraries	Road Database (EN2013)	13/08/15 1:59 PM	File folder
Documents	📕 Road Database (EN2013) - New	13/08/20 12:23 PM	File folder
J Music	👍 Template(DataType)	13/08/09 3:50 PM	File folder
E Pictures	📙 TopographicMap(2500)	13/05/10 2:54 PM	File folder
Videos	U Training Materials	13/06/22 4:32 PM	File folder
	VBA	13/07/25 4:14 PM	File folder
🖏 Homegroup	🕌 Vietnam	13/08/20 11:39 AM	File folder
	B_MH_DRVN_OR_MaintenanceHistory_RRMU2_BacKan_2013.xlsx	13/08/16 1:16 PM	Microsoft Excel
🖳 Computer	DB_RA_DRVN_OR_Pavement_RRMU2_BacKan_2013.xlsx	13/08/16 1:14 PM	Microsoft Excel
🚢 Local Disk (C:)	B_RA_TCDuongBoVN_OR_CacTTChinhVeDuong_KhuQLDB2_2013.xlsx	13/07/29 3:49 PM	Microsoft Excel
RECOVERY (D: -	·		٠
File	name: DB_MH_DRVN_OR_MaintenanceHistory_RRMU2_BacKan_2013.xlsx	Pivot file (Excel file	e *.xlsx) (*.xlsx 🔻

(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.

New Data Import	CERM 2012
Senici data format type: F Inventory Photos Drawings Bravise Sic Kan	Inport conglete! CRisers/Panthol/Destap/UDB_RA_DRIVE_CR_CoxTTChrohiteDuong_KhuQLOB2_2011.x8x
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DB_RA_DRW_OR_Peverient_RRM12_Backan_2013 view	
Trui genti	
Becker_2013.vice Cick on the tien to show details:	
CrikUsers/Pantha/Desktop#DE_MH_DRVN_OR_MaintenanceHistory_##	
C:#Users#Fanths#Deskto/NOB_RA_TCDuorg8o/M_OR_CarTTCb=#wei	
Remove M Back Cancel Import	

(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.

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on the ten to show details:		Club on the fam to	show dehalar	

(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.

Organiae • New Ioldis	(#I+) 🛄 O
Libraries KhuQLB8-0 Discurrents KhuQLB8-0 Music KhuQLB8-0 Pictures KhuQLB8-0 Videos E KhuQLB8-0	QL1A_LangSon_CacTTChinNVeDuong_Km2+0_LamNguoc_2013(1).IPG QL1A_LangSon_CacTTChinNVeDuong_Km2+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(1).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(2).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(3).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(7).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG QL1A_LangSon_CacTTChinNVeDuong_Km20+0-km21+0_LamNguoc_2013(8).IPG

(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.

ew Data Import		CERM 20	
L. Select data form	et type: Photos C Drawings Brow		Inport condetel CRISerri#PanhalDedrap008_AL pRive CR_CocTCOvervieDucro_xvu0c0822011.v
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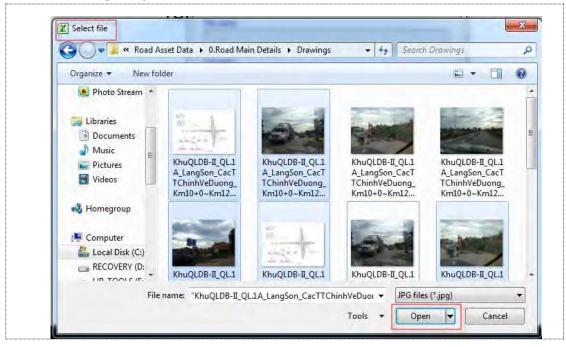
(11) Upon successful importing of data into the photos folder, user can import additional photos / videos (if any) also following the same steps as described above. However, if attempt is made to import same data / file multiple times, the system prompts the message that "Data of this location has already 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.

L Select data format tiges: C Swentery C Photos IF Drawings	Browse	1. Select data format type: C Inventory C Photos 4	Drawings Browse
Province name: Date type:		Province name: Cwta type:	1
file name:		Tie name:	
Full paths		ful path.	
Olds on the terr to show details:		Chills on the stars to alway details:	

(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.

Province memel Data type: Lang Spin Calc being in children & datang Fle name: IthuQLOB-II: QL: JA. LangSon, CalCTTONINISTION, Kini H0: Tartiguize: 2015/2): PC PC Fold path: Cit. Users/Partitis/Workstop/Minad Database (RIQUI3) - New/Minad Asse Cit. Users/Partitis/Distributions_CalcTTONINISTIONS_Kini H0: LangSon, CalcTTONINISTIONS_Kini H0: Link path: Cit. Users/Partitis/Distributions_CalcTTONINISTIONS_Kini H0: Link path: Link path: Cit. Users/Partitis/Distributions_CalcTTONINIVULing_(Int) + 0 Link path: Cit. Users/Partitis/Distributions_CalcTTONINIVULing_(Int) + 0 Link path: Cit. Users/Partitis/Distributions_CalcTTONINIVULing_(Int) + 0 Cit. Users/Partitis/Distributions_CalcTTONINIVULing_(Int) + 0 Link path: Cit. Users/Partitis/Distributions_CalcTTONINIVULing_(Int) + 0 Link path: Cit. Users/Partitis/Distributions_CalcTTONINIVULing_(Int) + 0 Link path: Cit. Users/Partitis/Distributions_CalcTTONINIVULING Link Path: Cit. Users/Partitis/Distributions_CalcTTONINIVULING Link Path: Cit. Users/Partitis/Distributions_CalcTTONINIVULING Link Path: Cit. Users/Partitis/Distributions_CalcTTONINIVULING Link Path: Cit. Users/Partitis/DistonViced Dat	Select data formati Inventory	Photos C Drawings	Browse	0	Import completel Cillusere/Pontholl	A. BOWGENBED	DRWLOR_CA	cTTChehineDu	ong_khuQLOB.	2_2011.88
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MuQUDE-II: QL: 1A Langton_CaCTTChrintWeblang_Kin1+0 Lindigue: 2013(2):3FG Cill Derbit Cill MarchWeblackpolikand Detabase (RI2013) - Herwikkand Asset DatabaseKend Asset DataWeblackpolikang_Kin1+0 Lindigue: 2013(2):3FG Cill Conft Her Ban to show detailst Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset Cill Conft Her Ban detailstow (EVD13) - New WRoad Asset	ang Son	Các trông trị chính về đường								
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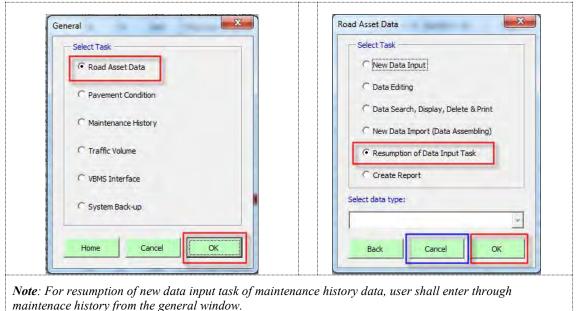
(15) Upon successful importing of data into the drawing folder, user can import additional drawings (if any) also following the same steps as described above. However, if attempt is made to import same data/ file multiple times, the system prompts the message that "Data of this location has already imported".

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.



- (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".

Resumption o	f Data Input (D	ata Search	n) <u> </u>	5
Bắc Kạn]
Select data	ype:			
1. Các thể	ing tin chính về c	đường	<u>–</u>	
Back	Cance	e [ОК	1

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

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Export to Input	Experts Input DIRECTORATE FOR ROADS OF VIETNAM																																
Sheet																																	
	GENERAL INFORMATION																																
						Location	n Referencing	1	Geographi	cal Location						1																	
n 110	Road ID Road Name Route No. Route Branch No.	Route No. Route Branch No. Road Cla	D . N	Danta Ma		n . v	Danta Ma	Route No.	Dania Ma	D N	Dania Ma	Route No.	Route No	- No. Doute Drough No.	D 101	Road Adn	ninistration	Chainage (Kilometer Post)	Coc	rdinates in U	TM (WGS 1	1984)	A	dministra	ative Locat	tion	Kilopost	Date of	Length	Actual	Construction Completion	Year of Service
Koad ID			Route Branch No.	Route Branch No.	Road Class			-		Fn	om	1	Го	Fro	m		То	Adjustment Date	Update	(as per Kilopost)	Length		Vear										
																		Name of RRMU	Name of RRMC	From	То	Latitude	Longitude	Latitude	Longitude	Province	City	Province	City			Kilópösty	
							(m)	(m)	(m)	(m)	(m)	(m)								(m)													
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-	-	-	-		-			-		-	-	•					-																
QLULULUU17	QL-1	QL-2	10	u .	RRMU-2	RRMC234	350000	450000	200000	1000000	200000	1000000	Bac Can	х	Bac Giang	x	12/5/2012	12/21/2012	100000	1000	11/11/1990	12/12/1990											
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(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.

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							MIN	VISTRY OF	TRANS	PORT														
Export to Input						DIR	ECTOR	ATE FOR F	ROADS (OF VIET	ΓNAM													
Sheet	Back to MainWindow							ROAD MAII	N DETA	ILS														
<u> </u>							GE	NERAL INFO	RMATION															
							Locatio	n Referencing		Geograph	ical Location													Clin
Road ID	Road Name	Route No.	Route Branch No.	Road Class	Road Adr	ninistration	Chainage	(Kilometer Post)	Cox	ordinates in I	UTM (WGS	1984)	А	.dministra	tive Locati	m	Kilopost	Date of	Length (as per	Actual	Construction Completion	Year of Service	Terrain	Temperatur
Kond IIJ	Koad Name	Route No.	Koule Branch No.	Road Cass					Fr	om		Го	Fro	m	Т	ò	Adjustment Date	Update	(as per Kilopost)	Length	Year	Operation	Type	e
					Name of RRMU	Name of RRMC	From	То	Latitude	Longitude	Latitude	Longitude	Province	City	Province	City			(clopcot)		. cui	Open		, i
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(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.

				Ν	MINISTRY (OF TF	RANSPO	RT							
			DI	RECT	ORATE FC	R R	DADS O	F VIET	NAM						
					DATAIN	IPUT	SHEET								
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Data Type : Road Main De	atails														
GENERAL INFORMATION Road ID :		Location R	oforoncing									Jurisdiction	Date		
Road Name : QL.6		LUCATION N	Km + m	1	Latitude		Longitude		Province	City		RRMU No.:			ljustme
Route Name : Hòa Bình d'Sơn	ntla	From	: 39 0		Lutitude		Longitude		Hòa Bình	-		Khu QLĐB II		905/06	
Route Branch N : 0	, Lu		: 40 0						Hòa Bình	-		F.O Name		Entry	20
Road Class : Cấp III			: 1.000.0	m								VPHT II.01		3/08/28	
Road Class . Cap III		Lengin	. 1,000.0		1							VI III II.01		5/00/20	
MAIN DETAILS															
	1905/	06/03	CROSS SE	CTIO	N SCALE										
Year of Service Operation Open :	1905/	06/03	Direction	Туре	: Xuôi			Shou	der		Foo	otpath, Ditch			
Terrain Type :	Đồng	bằng	Motorized	Lane				Treate	d Shoulder W :	m	Foo	otpath Width (inclu	ding		m
Temperature :		°C	No. of Lane)	: 1			Treate	d Shoulder S :		Foo	otpath Structure	Ŭ		
Annual Preciptation :		mm	Lane Width	i (one l	a : 3.5	m		Non-T	reated Shoulc :	2.5 m	Dite	ch Width			m
Road Bed Type :	2		Pavement		: AC						Dite	ch Structure			
Actual Length :	1000	m	Non-Motor	ized L	ane (NMT)			Media	an Strip		Cro	oss Section Detail	s		
Right of Way :		m	No. of Lane	9	:			Width	:	m	Car	rriageway Width		3.5	m
Design Speed :	#N/A	km/h	Lane Width	n (one l	la :	m		Max. I	Difference in E :	m	Pav	vement Width		3.5	m
		-	Pavement	Туре	:			Media	n Structure :		Roa	ad Bed Width		6	m
ROAD STRUCTURES (if any)								Rema	140						
. ,,								Reilla	IKS						
Structure Type		<u>c</u>		emark											
Bridge			: 1 C	<mark>âu K</mark> é	L=28,2m										
Road Intersection			:												
Railway Crossing			:												
Box Culvert			:												
Slab Culvert			:												
Pipe Culvert			:												
Flyover Bridge			:												
Others			:												
<u> </u>															
									Back to			Edit	ſ	Display	
									MainWindow						

(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.

Select Task	Select Task
🕫 Road Asset Data	C New Data Input
C Pavement Condition	C Data Editing
	C Data Search, Display, Delete & Print
C Maintenance History	C New Data Import (Data Assembling)
C Traffic Volume	C Resumption of Data Input Task
C VBMS Interface	Create Report
C System Back-up	Select data type:
Home Cancel OK	Back Cancel OK

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.

elect report ty	pe	
C Dynamic		ata Export
Back	Cancel	OK.

4.6.1 Create Dynamic Report

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

lect report t	/pe	
Dynamic	Report C	Data Export
		and a second second
1		Lauraninin

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

				OF TRANSPORT		
Seler SN	RRMB No.:	National Highway	Province/City	RRMS-B Name	Chainage: from + to	Select
-	+	+				_
1	RRMB /	QL1A	Long Sơn	Chi cuc OL0815	KM0 + 0 - KM94 + 70	Ves
2	RRMB /	QL 1A	Bắc Giang	Chi sue QLDB15	KM04 + 70 = KM132 + 345	Yes
3	ERMB 1	QLIA	Bắc Ninh	Chi cục GLOB I.S	KM132 + 245 + KM152 + 234	Yes
4	RRMB (QL1A	Hà Nội	Chi cuc QLDB 1.6	KM181 + 570 + KM213 + 608	No
5	RAMB I	QLIA	Hà Nội	Chi que QUDB 1.6	KM215 + 608 + KM215 + 775	No
6	RRMB I	QL1A	HaNam	Chi cuc DLDB 1.6	KM215 + 775 # KM251 + 50	Np
7	RRMB (GL1A	Ninh Binh	Chi cuc GLEB LS	KM251 + 50 + KM285 + 400	Yes
1	RRMB I	CL3	Winh Phúc	Chi cục QLĐB I.S	KM30 + 600 + KM50 + 650	No
2	RRMB1	QL2	Phu Tho	Chicks QL0618	KM50 + 650 + KM109 + 0	No
3	RRMB /	0.1	Phu Thọ	Chi cục QuĐ8 I S	KM109 + 0 + KM115 + 0	No
4	RRMB (QL2	Tuyén Quang	Chi cục QLDB I.S	KM115 + 0 + KM205 + 0	Yes
5	RRMB I	QL.2	Hà Giang	Chi rue QLDB I S	KM205 + 0 = KM312 + 500	No
1	RRMB 1	Q6.3	Thái Nguyên	Chi cục QLĐ6 I.S	KM33 + 300 ± KMI13 + 815	No
2	BRMB /	01.8	Sắc Kạn	Chi cyc QLB81.4	KM113 + 816 = KM239 + 414	No
3	RRMB I	QL3	Cao Bằng	Chi cục QLĐB I 4	KM239 + 414 + KM344 + 436	No
1	BRMB (QL38	Bác Keri	Chi que QuDB i 4	KM0 + 0 = KM66 + 600	No
2	RRMB I	QL.38	Lang Sovi	Chi cục QLĐB 14	KM66 + 600 + KM129 + 0	Ves
1	RRMB I	OL.4E	Liab Cai	Chi cục GLĐB I.S.	KM0 + 0 + KM44 + 200	Ves
2	RAMB (QLS	Hurng Yen	Chi cuc QL0B16	KM11 + 155 # KM33 + 720	Ves

(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".

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			Route Name			Yes
			Route Branch No.			Yes
			Road Class			Yes
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			RRMS-5 Name		~	Yes
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		Actual Length		m		Yes

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

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	1 Road Main (Details		Get Field	Is Create Report	Back to MainWindow
1.2. Se	lect fields:					
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			Road Name			Yes
			Route Name			Yes
-			Route Branch No			Ves
			Road Class		/	Yes
-		Jurisdisction	RRMB No.			Yes
			RRMS-8 Name			Yes
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			To	kom)		Yes
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(5) Open the Report from the "**Report**" folder in the database system

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🚽 Report		Report_BaoCa	ao_21446_2812014.xlsx	14/01/28 2:37 AM	Microsoft Excel W	171 KE

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.

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4.6.2 Data Export

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

Select report type Image: Static Report C Static Report Image: Static Report Static Report Image: Static Report Static Report Image: Static Report Select data type: Image: Static Report Back Cancel OK Image: Static Report	eate Report	Deta Sport Issuer NW arbeits' annung	+0
	Select report type C Static Report Static Report Select data type:		Seture dans hywart (C) (20045 Sefer tr C)

(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.

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(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.

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

volvig (as.it)	Select data format:
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(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".

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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 **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.

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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.

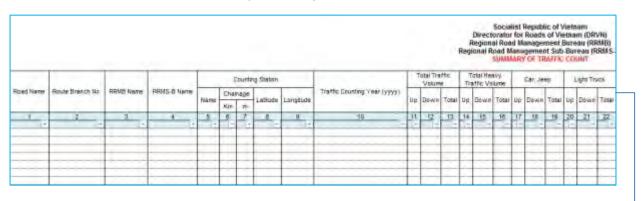
C VBMS Interface	elect Task C Road Asset Data Pavement Condition Maintenance History Traffic Volume	Select Task C Create Main Details C Access to Pavement Condition Folder Back Cancel OK
C System Back-up		

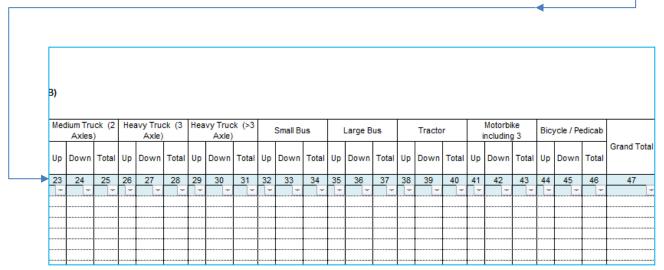
(3) Select "Create Main Details" and Click "OK". To exit from Main Window, click "Cancel". Upon selecting "Create Main Details" and clicking "OK", the system automatically combine all individual files of pavement condition data into one.

E	Select Task —		_	
	Create Mai	n Details		
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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.





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 <u>www.vbms.vn</u> 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".

⊂ Road Asset Data	The server vbms.vn at Thong tin dang nhap requires a username and password.
C Pavement Condition	Warning: This server is requesting that your username and password be sent in an insecure manner (basic authentication without a secure
Maintenance History	connection).
C Traffic Volume	User name
VBMS Interface	Password
C System Back-up	Remember my credentials
	OK Cancel

(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.

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/08/13	Download				

(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.

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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 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.

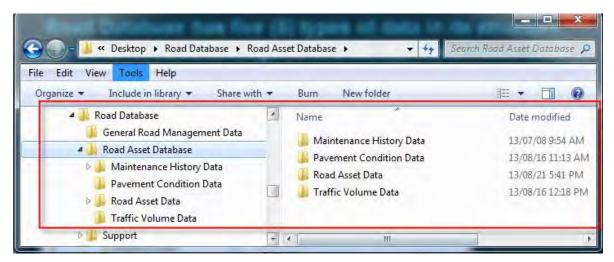
CHAPTER 7 DATABASE SYSTEM UPDATING AND EDITING

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

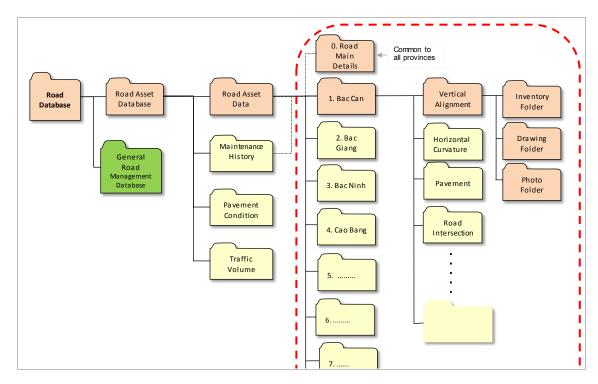
Road database has five (5) types of data in its structure; (1) General Road Management Data(2) Road Asset Data, (3) Maintenance History Data, (4) Pavement Condition Data, and (5)Traffic Volume Data. Road database structure is shown below.



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. <u>Therefore, before changing any folder name</u> or relocating sub-folder, it is necessary to check path details and revised them accordingly <u>if modification is utmost necessary</u>. 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. <u>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</u>



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.

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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.

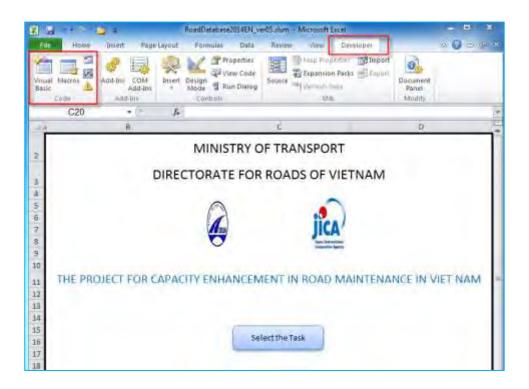
(1) Double click "**Road Database**" system interface file and enter password to open the system interface. Main System Window is appeared as shown.



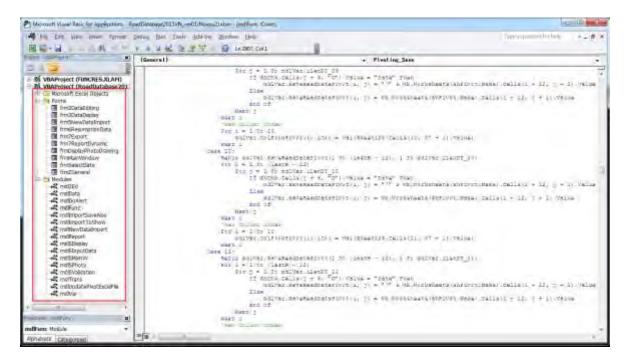
(2) Enable "Developer" ribbon of MS-Excel by entering check mark (√) from MS-Excel options if developer ribbon is not appeared in the MS-Excel standard toolbar.

el Options		(a)
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(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

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
1	Road Main	1.1	General Information	Road ID		Character	Road ID According to DRVN Reference System	
	Details			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	
				То	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	3
				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	Down : Both :	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.		
				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 Mountainou	: Flat : 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 Embankmen Both Mostly_Cut Mostly_Emb	: Both : Mostly Cutting
				Road Safety Corridor	m	Numeric	Land allocated in each side of road corridor for safety purpose and future expansion of the road		Corridor (Up) 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: Asphalt ConcreteAM: Asphalt MacadamBP: Bituminous Pavement(Bituminous surface treatmentBitumen penetration)CC: Cement ConcreteMP: Macadam PavementAP: Aggregate PavementEP: Earth PavementOthers: Others	and
			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: Asphalt ConcreteAM: Asphalt MacadamBP: Bituminous Pavement(Bituminous surface treatmentBitumen penetration)	and

SN	T 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 Alignm	2.1	General Information	Road ID					
	ent			Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	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.		. Single Lane used for both directions
				Gradient	%	Numeric	Value of longitudinal gradient/slope		
				Gradient Type	(+/-)	Symbol	Ascending (+) and Descending (-)	Zero Ascending Descendin	
		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	Horizon	3.1	General	Road ID					
	tal Curvatu		Information	Road Name					
	re			Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	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	4.1	General	Road ID					
	nt		Information	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				
				То	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.		<u> </u>
				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		

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	Width	m	Numeric	Width of Carriageway		
		(Motorized	Area	m2	Numeric	Area of Carriageway (Length X Width)		
		Lane)	Pavement Structure Type		Character	Pavement structure of carriageway portion	Flexible Rigid Composite Others	: Flexible Pavement : Rigid Pavement : Composite Pavement : 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	Мра	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	Мра	Numeric	Loading capacity of subgrade layer measured by FWD		
				%	Numeric	layer measured by CBR Test		
	4.3.3	Subgrade	Thickness	cm	Numeric	Thickness of subgrade course		
		Course	Pavement Type		Character	Type of material applied in subgrade course	AM : BP : (Asphalt Concrete Asphalt Macadam Bituminous Pavement Bituminous surface treatment and Bitumen penetration) Cement Concrete
		Type 4.3 4.3.1	TypeItemTypeImage: Constraint of the second seco	TypeItemSub-ItemImage: TypeImage: Addition of the second sec	TypeItemSub-ItemUnitTypeItemPavement Aream24.3Roadway Carriageway (Motorized Lane)Widthm4.3Roadway Carriageway (Motorized Lane)Widthm4.3.1Pavement Loading CapacityBenkelman Beam DeflectiondaN/cm24.3.1Pavement Loading CapacityBenkelman Beam DeflectiondaN/cm24.3.2Subgrade Loading CapacityLoading PlatedaN/cm2FWDMpaFWDMpa4.3.3Subgrade CourseThicknesscm	TypeItemSub-ItemUnitFormatTypeImage: Sub-ItemPavement Aream2NumericImage: Algorithm of the second sec	TypeItemSub-ItemUnitFormatDefinitionTypeImage: Sub-ItemPavement Aream2NumericArea covered by Pavement Surface (length X avg. width)Image: Area of Carriageway (Motorized Lane)WidthmNumericTotal Thickness of Pavement StructureImage: Area of Carriageway (Motorized Lane)WidthmNumericArea of Carriageway (Motorized Lane)Image: Area of Carriageway (Motorized Lane)Pavement Structure TypeCharacterPavement structure of carriageway portionImage: Area of Carriageway (Motorized Lane)Benkelman Beam DeflectiondaN/cm2NumericPavement Loading Capacity measured by Benkelman Beam on the finished surfaceImage: Area of Carriageway (CapacityBenkelman Beam DeflectiondaN/cm2NumericPavement Loading Capacity measured by Loading Plate on the finished surfaceImage: Area of Carriageway (CapacityLoading PlatedaN/cm2NumericPavement Loading Capacity measured by FWD on the finished surfaceImage: Area of Carriageway (CapacityLoading PlatedaN/cm2NumericPavement Loading Capacity measured by FWD on the finished surfaceImage: Area of Carriageway (CapacityCBR%NumericLoading capacity of subgrade layer measured by CBR TestImage: Area of CourseThicknesscmNumericThickness of subgrade courseImage: Area of CourseThicknesscmNumericLoading capacity of subgrade layer measured by CBR Test </td <td>Type Item Sub-Item Unit Format Definition 4.3 Roadway Carriageway (Motorized Lane) Pavement Area m2 Numeric Surface (length X avg.width) </td>	Type Item Sub-Item Unit Format Definition 4.3 Roadway Carriageway (Motorized Lane) Pavement Area m2 Numeric Surface (length X avg.width)

SN	SN Data Type		Item	Sub-Item	Unit	Data Format	Definition		CODE
								AP EP Others	: Aggregate Pavement : Earth Pavement : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of subgrade course		
				Binder Type		Character	Type of binder used in subgrade course	Cement Lime Emulsion Bitumen Flyash Chemical Mixed Others	: Bitumen : Fly Ash
				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 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 sub- base course		
				Binder Type		Character	Type of binder used in sub-base course	Cement Lime Emulsion Bitumen	: Cement : Lime : Emulsion : 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	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 : 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	AM BP	: Asphalt Concrete : Asphalt Macadam : Bituminous Pavement (Bituminous surface treatment and

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE	
								CC MP AP EP Others	Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of binder course		
				Binder Type		Character	Type of binder used in binder 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 binder course		
		4.3.7	Wearing	Thickness	cm	Numeric	Thickness of wearing course		
			Course	Pavement Type		Character	Type of material applied 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
				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-	Width	m	Numeric	Width of shoulder		
			Motorized Traffic Lane	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	Мра	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	Мра	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 ConcreteAM: Asphalt MacadamBP: Bituminous Pavement (Bituminous surface treatment and Bitumen penetration)CC: Cement ConcreteMP: Macadam Pavement AP : Aggregate PavementEP: 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: CementLime: LimeEmulsion: EmulsionBitumen: BitumenFlyash: Fly AshChemical: Chemical AgentsMixed: CombinedOthers: 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 ConcreteAM: Asphalt MacadamBP: Bituminous Pavement (Bituminous surface treatment and Bitumen penetration)CC: Cement ConcreteMP: Macadam Pavement

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition		CODE
								AP EP Others	: Aggregate Pavement : Earth Pavement : 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 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 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 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	: Cement : Lime : Emulsion : 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 base course		
		4.4.6	Binder Course	Thickness	cm	Numeric	Thickness of binder course		
				Pavement Type		Character	Type of material applied in binder course	BP CC MP AP	 : 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 binder course		
				Binder Type		Character	Type of binder used in binder 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 binder course		Δ
		4.4.7	Wearing	Thickness	cm	Numeric	Thickness of wearing course		
			Course	Pavement Type		Character	Type of material applied in wearing 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
								CC MP AP EP Others	Bitumen penetration) : Cement Concrete : Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of wearing course		
				Binder Type		Character	Type of binder material used in wearing 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/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 PCC	: RCC Surface : 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	5.1	General Information	Road ID					
	Intersec tion		Information	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	Down : Both :	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 : Intersect	ion with National Road(s) ion 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 Non-Signaliz	
				Intersection Type (by configuration)		Character	Number of intersection legs/branches that are meeting at the intersection	3-Leg 4-Leg 5-Leg Roundabout Flyover Viaduct Others	: 3-Legs Intersection : 4-Legs Intersection : 5-Legs Intersection : Roundabout : Flyover : Viaduct : 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	Branch / Leg No.	No.	Numeric	Number of branches or legs that belongs to sub-main road	
			(Crossing 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	Мра	Numeric	Loading capacity of subgrade layer measured by FWD	
				CBR	%	Numeric	Loading capacity of subgrade layer measured by CBR Test	
		5.4.3	Subgrade	Thickness	cm	Numeric	Thickness of subgrade course	
			Course	Pavement Type		Character	Type of material applied in subgrade course	AC: Asphalt ConcreteAM: Asphalt MacadamBP: Bituminous Pavement (Bituminous surface treatment and Bitumen penetration)CC: Cement ConcreteMP: Macadam PavementAP: Aggregate PavementEP: 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 Lime Emulsion Bitumen Flyash Chemical Mixed Others	: Cement : Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents : Combined : 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 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 sub- base course		
				Binder Type		Character	Type of binder used in sub-base course	Cement Lime Emulsion Bitumen Flyash Chemical	: Cement : Lime : Emulsion : Bitumen : Fly Ash : Chemical Agents

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition		CODE	
								Mixed Others	: Combined : 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 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	: Bitumen : Fly Ash	
				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 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 AP EP Others	: Macadam Pavement : Aggregate Pavement : Earth Pavement : Others
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of binder course		
				Binder Type		Character	Type of binder used in binder 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 binder course		
		5.4.7	Wearing	Thickness	cm	Numeric	Thickness of wearing course		
			Course	Pavement Type		Character	Type of material applied 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
				Actual Compaction Coefficient / Loading Capacity	%	Numeric	Compaction coefficient of wearing course		
				Binder Type		Character	Type of binder material used in wearing course	Cement Lime Emulsion	: Cement : Lime : Emulsion

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition		CODE
								Bitumen Flyash Chemical Mixed Others	: Bitumen : Fly Ash : Chemical Agents : Combined : Others
				Max. Aggr. Size (mm)	mm	Numeric	Max. size of aggregate/chips used in wearing course		.4
		5.5	Asset Value	Construction/Inst allation Completion Year (Traffic Lights, Road Lighting and Other Structures)	YY/MM	Date	Construction / installation year of each facility		
				Construction/Inst allation 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	Railwa y Crossin	6.1	General Information	Road ID Road Name					
	g			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 : Y No : N	/es 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 ConcreteMP: Macadam PavementAP: Aggregate PavementEP: Earth PavementOthers: 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	7.1	General	Road ID				
	Strip		Information	Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				From (Kilopost)	km, m			
				То	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 StartDown: Down: Start to EndBoth: Both DirectionSingle: 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 RailingOthers: 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 MeshWelded_Wire: Welded Wire MeshOthers: Others

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Shade Fence (Yes / No)		Character	Existence of Shade Fence (Plantation Zone)	Yes : Yes No : No
				Type of Fence (Material)		Character	Type of Shade Fence (Plantation Zone) by construction material type	RCC_Block: RCC BlockCC_Block: CC BlockPolymer_Block: Polymer BlockComposite_Block: Composite BlockOthers: 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	Pedestri an	8.1	General Information	Road ID Road Name				
	Crossin		mormation	Route Name				
	g (Overhe			Route Branch No.				
	ad							
	Bridge /			Road Class				
	Underp ass)			Jurisdiction				
	u 55)			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: Down Both Single	 : End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Pedestrian Crossing Type		Character	Structural type of pedestrian crossing	Overhe Underpa	
				Length	m	Numeric	Length of pedestrian crossing		
				Width	m	Numeric	Width of pedestrian crossing		
				Facility to Pass Bicycle		Character	Provision for Bicyclist		: Yes : No
				Structure Type (Steel or RCC)		Character	Type of pedestrian crossing by material used	RCC Steel Compo Others	: RCC : Steel : Composite 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	1 1	: Yes : No
				Hand Rail Type		Character	Type of Hand Rail	Steel RCC	: Steel Railing : RCC Railing
				Height	m	Numeric	Height of Hand Rail		
				Pavement Type		Character	Pavement type on pedestrian crossing	AC RCC CC Others	: Asphalt Concrete : Reinforced Cement Concrete (RCC) : Cement Concrete (CC) : 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	Road ID					
			Information	Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	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	Down Both	: 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.		
				Tunnel Section		Character	Section for which tunnel is provided	Carriagewa Footpath	ay : Road Carriageway : Footpath
				Toll Free or Not		Character	Utilization fee of tunnel	Free Non-Free	: Toll 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 Water Subway Others	 : Tunnel Built to pass Mountain : Tunnel Built to cross Water Bodies : Tunnel Built in City Area (subway) : 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&Cove Drill&Blas Boring_TE	t : Drill and Blast
				Tunnel Cross- Section Type		Character	Cross-section of tunnel in terms of single or double	Single : Pair :	Single Double (Pair) 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	Arc Combined	: 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	Туре		Character	Pavement type on road surface	AM : Asp BP : Bitu surfa penet	halt Concrete halt Macadam iminous Pavement (Bituminous ce treatment and Bitumen tration) nent Concrete

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
								MP: Macadam PavementAP: Aggregate PavementEP: Earth PavementOthers: 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: NaturalArtificial: ArtificialBoth: BothOthers: Others
				Number	No.	Numeric	Number of ventilation facility in tunnel section	
		9.14	Tunnel	Alarming		Character	Provision of alarming	Yes : Yes
			Emergency Facility	Equipment Number		Numeric	equipment Number of alarming equipment	No : No
			raciiity	INUIIIUEI		INUITICITC	runner of alarming equipment	

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE		
				Emergency		Character	Provision of emergency	Yes	: Yes	
				Telephone (SOS) Number		Numeric	telephone Number of installed emergency telephone	No	: No	
				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	Alarming Board		Character	Provision of Alarming board during emergency	Yes No	: Yes : No	
			System	Number		Numeric	Number of alarming board		-	
			Facility	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	Guidance Board		Character	Provision of guidance board for emergency evacuation	Yes No	: Yes : No	
			System	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
	v *			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	Installed Year	YY/MM	Date	Installation year of the facility		
			each facility	Installation Cost	VND	Numeric	Installation cost of the facility		
				Service Life	Year	Numeric	Service life of the facility		
10	Culvert	10.1	General	Road ID					
	[Box and		Information	Road Name					
	Slab			Route Name					
	Culvert (L<6m)			Route Branch No.					
	(L<011)			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_Culv Box_Culv	
				Precast or Cast- insitu or other places		Character	Method of construction	Precast Cast-insitu Combined Others	
				Structure Type (RCC, Steel,)		Character	Type of structure by material used	RCC Steel Others	: RCC : Steel : Others
				Culvert X-Section Type		Character	Type of culvert cross section	Single Double	: Single (Common for both lanes) : 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 : Y No : N	/ es No
				Guardrail Type		Character	Type of guardrail by construction material type	RCC : Others :	Steel Railing RCC Railing Others
		10.3	Structure in the Stream	Upstream Structure		Character	Type of upstream structure in case of slab culvert	Apron_Concre Apron_Stone Stone_Soling Aproan_Brick Others	te : Apron with Cement Concrete : Apron with Stone Riprap with C/S Mortar : Stone Soling : Brick with Cement Sand Mortar : Others
			(Slab Culvert)	Down Stream Structure		Character	Type of downstream structure in case of slab culvert	Apron_Concre Apron_Stone Stone_Soling Aproan_Brick Others	te : Apron with Cement Concrete : Apron with Stone Riprap with C/S Mortar : Stone Soling : Brick with Cement Sand Mortar : 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 StreamNon-Perennial: Non-Perennial StreamGully: GullyOthers: Others
		10.4	Abutment and Wing Wall	Abutment Foundation Type		Character	Foundation type of abutment wall	Raft: Raft FoundationIsolated: Isolated FootingSpread: Spread FootingPile: Pile FoundationOthers: Others
				Abutment Wall Type	m	Numeric	Type of abutment wall by construction material	RCC: Reinforced Cement ConcreteStone_Masonry: Stone MasonryBrick_Masonry: Brick Masonry: Others
				Wing Wall Foundation Type		Character	Foundation type of wing wall	Raft: Raft FoundationIsolated: Isolated FootingSpread: Spread FootingPile: Pile FoundationOthers: Others
				Wing Wall Type		Character	Type of wing wall by construction material	RCC: Reinforced Cement ConcreteStone_Masonry: Stone MasonryBrick_Masonry: Brick MasonryOthers: Others
		10.5	Overburden	Thickness	m	Numeric	Average thickness of overburden above the slab	
		10.6	Pavement	Туре		Character	Type of pavement material above culvert slab	AC: Asphalt ConcreteAM: Asphalt MacadamBP: Bituminous Pavement (Bituminous surface treatment and Bitumen penetration)CC: Cement ConcreteMP: Macadam PavementAP: Aggregate PavementEP: Earth PavementOthers: 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 ConcreteEarthen: EarthenRiprap: Stone Riprap with C/S MortarOthers: 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	11.1	General	Road ID				
	Culvert		Information	Road Name				
				Route Name				
				Route Branch No.				
				Road Class				
				Jurisdiction				
				Chainage at Center From (Kilopost) Latitude	km, m			
				Longitude				
				Kilopost	YY			
[Adjustment Date	II			

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 StartDown: Down: Start to EndBoth: Both DirectionSingle: Single Lane used for both directions
				Usage Type (Sewer pipe, road water)		Character	Type of pipe culvert by usage	Road: Road DrainageSewer: Sewer PipeIrrigation: Irrigation ChannelOthers: 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 PipePVC: PVC PipeOthers: 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	Road ID				
			Information	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				
				То	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	Down : Dow Both : Both	to Start m: Start to End Direction e Lane used for both directions
				Actual Length	m	Numeric	Actual Length of the section in the field.	<u> </u>	
				Slope Classification		Character	Slope classification by construction type		ng (Hill Side) Inkment (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 Noticeable None	: V : D	lighly Wet (Seepage Appear) Vet but no Seepage Appear Dry
				Source of Dampness (Surface / Spring Water)		Character	The dominant source of dampness	S_Water G_Water Both N/A	: C : B	urface water Ground Water Both I/A
		12.3	Countermeasu res	Countermeasure Type		Character	Type of counter measure in terms of purpose	Cut&Fill Bio-Eng. Water_Mgt Slope_Streng Protection_ Others	gthening	: Protection Work : Others
				Structure Type		Character	Type of counter measure in terms of structure type	CC_Wall Anchoring Rock_Boltin Shotcreating S&C_Stabili Plantation Ret_Wall Drainage Wire_Net Geosynthesi Others	zing	 Cement Concrete Wall Anchoring Rock Bolting Shotcreting Soil Cement Stabilizing Vegetation / Plantation Retaining Wall Surface & Sub-surface Drainage Wire Netting Application of Geosynthetic 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	Rectangula Trapezoida Semicircula Triangular Others	1 : ar : :	Rectangular Trapezoidal Semi-Circular Triangular Others
				Drainage		Character	Drainage structure type by	Open	: Oper	1

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 Riprap Earthen Others	: Cement Concrete : Stone Riprap with C/S Mortar : Earthen : 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	Rectangula Trapezoida Semicircul Others	al : Trapezoidal
				Structure Type		Character	Drainage structure type by construction material	PVC_Pipe Concrete_1 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	Rectangula Trapezoida Semicircul Triangular Others	al : Trapezoidal ar : Semi-Circular
				Drainage Structure Type		Character	Drainage structure type by coverage (Open or close)	Open Covered	: Open : Covered
				Structure Type		Character	Drainage structure type by construction material	Concrete Riprap	: Cement Concrete : Stone Riprap with C/S Morta

SN	Data Type		Item	Sub-ItemUnitData FormatDefinition					CODE
								1 1	: Earthen
				Length	m	Numeric	Length of drainage structure	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		
		12.7	Slope Monitoring	Slope Monitoring Equipment		Character	Provision of Slope monitoring equipment	Yes : Yes No : No	
			Equipment	Туре		Character	Type of monitoring equipment by purpose	GW_Table Slope_Move GW&Slope Others	: Increase in Ground Water Table : Slope Movement (Slow & Fast) : Both of Above : 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	Installed Year	YY/MM	Date	Year of equipment installation		
			each facility installed	Installation Cost	VND	Numeric	Installation cost of the equipment		
				Service Life	Year	Numeric	Service life of installed equipment		
13	Retaini	13.1	General	Road ID					
	ng Wall		Information	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
	**			То	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 StartDown: Down: Start to EndBoth: Both DirectionSingle: 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 SideToe: 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 WallSemi-Gravity: Semi-GravityCantilever: Cantilever WallCounterfort: Counterfort WallAnchored: Anchored WallCrib: Crib Retaining WallOthers: Others
				Material Type		Character	Type of retaining wall by material type	RCC: Reinforced Cement ConcreteCC: Cement ConcreteStone: Stone MasonryBrick: Brick MasonryDry_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	Road ID					
	Fence		Information	Road Name					
				Route Name	•				
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km,m				
				То	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: 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.		
				Installed Location (Road side or median strip)		Character	Location of Guard Fence installation	Roadside Medianstr Both	1
				Guard Fence Type		Character	Type of guard fence in terms of structure	Guard_Ra Guard Fe	
				Material		Character	Manufacturing material of guard fence	Steel_Pipe GalvShee RCC Steel_Pipe& Welded_M Wire_Net Others	et : Galvanized Sheet : Reinforced Cement Concrete : Steel Pipe and Concrete
				Surface Coating Material (galvanized type, painting, others)		Character	Surface coating material of guard fence (Galvanized, painting, etc.)	Ordinary Zinc Anti-corrosic Others	: Ordinary Painting : Zinc Coating : Anti-Corrosion Painting other than Zinc : 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 Bridge Culvert Tunnel Others	: Road Section : Bridge : Culvert : Tunnel : Others
				Installed Objective		Character	Primary Objective of installation of guard fence	TDS MT&NMT_L NMT&MS All Others	: Traffic Direction Separation (Up & Down) : Separation of Traffic Lane & Footpath : Traffic Lane and Median Strip : All Above : 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	15.1	General	Road ID					
	Lightin g		Information	Road Name					
	0			Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	km, m				
					, í				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
				City					
		15.2	.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_Med 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)	Ordinary	: 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	Туре		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	Contract Type		Character	Power supply arrangement		
			Agreement	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	Installed Year	YY/MM	Date	Installation year of road light		
			for each facility	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 StartDown: Down: Start to EndBoth: Both DirectionSingle: Single Lane used for both directions
				Installation type of Poles		Character	Installation/ fixation type of road sign pole	Bolting: Bolting with Metal PlateOrdinary: Ordinary FoundationOthers: Others
				Pole (Strut) Type		Character	Type of pole in terms of shape	Steel_Pipe: Steel Circular PipeSteel_Strut: Steel Rectangular StrutConcrete: Concrete PoleWooden: Wooden PoleOthers: 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 PaintingZinc: Zinc CoatingAnti-Corrosion: Anti-Corrosion Painting other than ZincNone: NothingOthers: Others
		16.3	Sign Board	Sign Type		Character	Type of signed written	Route_Info: Route InformationSafety_Info: Traffic Safety InformationStructure_Info: Road Structure InformationOthers: 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 / SteelMixed: Galvanized Iron Sheet with Wooden framePolymer: Polymer / PlasticOthers: Others
				Fixing Type of Board		Character	Fixing type of board (by bolting, welding,)	Welding: WeldingBolting: BoltingHanging: HangingOthers: 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	17.1	General	Road ID					
	nt Markin		Information	Road Name					
	g			Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	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: 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.		
				Marking Line Type		Character	Line type or pavement marking	Solid Dotted Both	: Continuous : Dotted Line : Both

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition	CODE
				Marking Location (Left, Right, Center)		Character	Location of pavement marking	Center: Center LineLane_Separate: Lane SeparationBoth: 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: Paint (Enamel)Thermoplastic: ThermoplasticCold_Plastic: Cold PlasticPolymer_Tape: Polymer TapeRetro_Reflector: Retro-ReflectorOthers: 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 Weighi ng /	18.1	General Information	Road ID				
	Measuri			Road Name				
	ng Facility			Route Name				
	ruenny			Route Branch No.				
				Road Class				
				Jurisdiction				
				Chainage of Station From (Kilopost) Latitude	km, m			
				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: Down Both Single	: End to Start : Down: Start to End : Both Direction : 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 No	: Yes : 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 No	: Yes : 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 No	: Yes : 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	19.1	General	Road ID					
	Respon se		Information	Road Name					
	Storage			Route Name					
	Wareho			Route Branch No.					
	use			Road Class					
				Jurisdiction					
				Chainage of Storage Warehouse From (Kilopost) Latitude	km, m				
				Longitude	YY				
				Kilopost Adjustment Date					
				Date of Update	m				
				Province					
		10.0		City		ai		115	
		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 Single	: Both Direction : Single Lane used for both directions
				Location Name		Character	Name of location where the warehouse installed	Single	
				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	9	
				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	Plantati on	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				
				То	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: 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.		
				Area	m2	Numeric	Area of plantation zone		
			Tall Tree	Number Tall Tree		Character	Approx. No. of tall tree (H>m)		
				Туре		Character	Type of dominant tree		
			Medium Height Tree	Number Medium Height Tree		Character	No. of medium height tree (H>m)		
				Туре		Character	Type of dominant tree		
			Shrub	Area Shrub		Character	Approx. area covered by shrub		
				Туре		Character	Type of dominant shrub type		
			Turf	Area Turf		Character	Approx. area covered by turf		
				Туре		Character	Type of dominant turf type		
21	Noise	21.1	General	Road ID					
	barrier		Information	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				
				То	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	Down : Both :	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.		<u> </u>
				Type (Material)		Character	Type of noise barrier by material type	Earthen Concrete Stone_Masc Brick_Masc Metal Alloy Polymer Others	onry : Brick Masonry : Metal : Alloy : Polymer : Others
				Type (Shape)		Character	Type by shape of Noise Barrier	Vertical Vertical&A 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					
	Fence		Information	Road Name					
				Route Name					
				Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	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) Actual Length	m	Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane Actual Length of the section in	UP:: End to StartDown: Down: Start to EndBoth: Both DirectionSingle: Single Lane used for both directions
				Type (Material)		Character	the field. Type shade fence by material	RCC_Block: RCC BlockCC_Block: CC BlockPolymer_Block: Polymer BlockComposite_Block: Composite BlockOthers: Others
				Type (Shape)		Character	Type by shape of shade fence	Vertical: VerticalVertical&Arc: Vertical and ArcArc: ArcVertical6Slant: Vertical and SlantOthers: 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	Kilomet er 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				
				То	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: Down Both Single	: End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Total length of section under consideration		
				Туре		Character	Type of kilometer post by material type	RCC CC SMCSP BMCSP SB Others	 Reinforced Cement Concrete Cement Concrete Stone Masonry with Plastering Brick Masonry with Plastering Stone Block only 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		Character	Installation side of kilometer	Left	: Left
				(Left / Right)			post (with reference to	Right	: Right
				Tetel New less	NI-	Numeral	increasing chainage)	Center	: 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	24.1	General Information	Road ID					
	Damag e		mormation	Road Name					
	Invento			Route Name					
	ry			Route Branch No.					
				Road Class					
				Jurisdiction					
				From (Kilopost)	km, m				
				То	km, m				
				Latitude					
				Longitude					
				Length	m				
				Kilopost Adjustment Date	YY				
				Date of Update	m				
				Province					
			<u> </u>	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: Down Both Single	: Dov : Bot	l to Start wn: Start to End h Direction gle 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 Landslic Earthqua Thunder Typhoon Others	le ake rstorm	: Flooding : Landslide : Earthquake : Thunderstorm : Typhoon : 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 Right Both	: Left : Right : Both	
				Traffic Disruption (Yes / No)		Character	Status of traffic movement because of damage	Yes No	: Yes : 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	25.1	General Information	Road ID				
	Routes			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	Road Name		Character		
			Overlapping Road -1	Route Name		Character		
			Roud I	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	Road Name		Character		0		
			Overlapping Road-2	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 IDRoad NameRoute NameRoute Branch No.Road ClassJurisdictionChainage at Center From (Kilopost)Latitude	km, m					

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) Name of Facility		Character Character	Up-bound and down-bound (Start Point to End Point {Down}, End Point to Start Point {Up}) Lane Name of facility	UP:: End to StartDown: Down: Start to EndBoth: Both DirectionSingle: Single Lane used for both directionsCauseway: CausewaySyphon: SyphonSpillway: SpillwayOthers: 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	27.1	General	Road ID					
	Crossin g		Information	Road Name					
	g Facility			Route Name					
	(Ferry,			Route Branch No.					
	etc.)			Road Class					
				Jurisdiction					
				Chainage at Center From (Kilopost) Latitude	km, m				
				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 FerryManual DrivenOthers
				Ferry Size Capacity of ferry	mXm	Numeric	Max. allowable weight which can be transported via ferry	ļ	
				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 Wooden RCC Concrete Others	: Metal Type : Wooden : RCC : Concrete : 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/aux iliary 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	28.1	General	Road ID					
	n Bridge		Information	Road Name					
	211484			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: Down Both Single	 : End to Start : Down: Start to End : Both Direction : 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 SurfaceWooden&Metal: Wooden and Thin Metal SheetOthers: Other Light Density MaterialMixed: 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	Mainte nance	29.1	General Information	Road ID		Character	Road ID According to DRVN Reference System	
	History			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	
				То	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
	· · · ·				Ī		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: Down Both Single	 : End to Start : Down: Start to End : Both Direction : Single Lane used for both directions
				Actual Length	m	Numeric	Length of Repair Section as in the field	<u> </u>	
				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	75 50	: Full : ¾ of Cross-Section : ½ of Cross-Section : 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	Sut	-Item	Unit	Data Format	Definition	CODE
								Work	
				Total Pa Repair C		Mil VND	Numeric	Total Cost Required for Pavement Repair Work Only	
				Budget S	Source		Character	Budget Source of Repair Work	
		29.3	Existing Pavement Condition before Repair	Pav Structure	ement e Type		Character	Type of Pavement Structure (Rigid, Flexible, Composite or Other	Flexible: Flexible PavementRigid: Rigid PavementComposite: Composite PavementOthers: Others
			Project	Pavemen Loading By Benk Beam	Capacity	daN/cm2	Numeric	Loading Capacity of Pavement measured by Benkelmen Beam	
					nt Capacity ling Plate	daN/cm2	Numeric	Loading Capacity of Pavement Measured by Loading Plate	
				Pavemer Loading (Mr) by	Capacity	Мра	Numeric	Loading Capacity (in terms of resilient modulus) of Pavement Measured by FWD	
				I	D0	μm	Numeric	Deflection at a distance of 0 cm from the center of load	
				FWD Test	D20	μm	Numeric	Deflection at a distance of 20 cm from the center of load	
				Data	D150	μm	Numeric	Deflection at a distance of 150 cm from the center of load	
				-	de Capacity ing Plate	daN/cm2	Numeric	Loading Capacity of Pavement Measured by Loading Plate	
				Sub-Gra Loading (Mr) by	Capacity	Мра	Numeric	Loading Capacity (in terms of resilient modulus) of Pavement Measured by FWD	
			FWD	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	Reason to Repair		Character	Main Reason of Repair.	
			Method	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 TreatmentDBST: DBST-Double Bituminous Surface TreatmentTBST: TBST-Triple Bituminous Surface TreatmentBPM: BPM-Bituminous Penetrated MacadamASOL: ASOL- Asphalt Concrete OverlaySOL: Rep- Structural Overlay (Replacement)CS: Crack SealGPR: GPR- Gravelling Pavement RepairPR: PR- Patching Repair TypeEBR: EBR-Edge Break Repair TypeOthers: Others
				Pavement Type (Rigid / Flexible /		Character	Pavement Type by Structure Type	Flexible: Flexible PavementRigid: Rigid Pavement

SN	Data Type	Item	Sub-Item	Unit	Data Format	Definition		CODE
			Composite)				Composite Others	e : Composite Pavement : Others
			Pavement Type (by Material		Character	Pavement Type by Material Type Used in Repair Work	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
			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 AM APM CC MP AP EP Others	 Asphalt Concrete Asphalt Macadam Asphalt Penetration Macadam 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 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 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 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 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 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	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 ConcreteMP: Macadam PavementAP: Aggregate PavementEP: Earth PavementOthers: Others
				Binder Type (if any)		Character	Type of Binder If Used	Cement: CementLime: LimeEmulsion: EmulsionBitumen: BitumenFlyash: Fly AshChemical: Chemical AgentsMixed: CombinedOthers: 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	Мра	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	30.1	General	Road ID				
	Condition		Information	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				
				То	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	Both : Both	o Start n: Start to End Direction 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 Road_Intersection Railway_Crossing Slab_Culvert Box_Culvert Pipe_Culvert Shade_Fence Tunnel Others	: Bridge : Road Intersection : Railway Crossing : Slab Culvert : Box Culvert : Pipe Culvert : Shade Fence : Tunnel : Others
				Road Crossing Type			Location of road crossings	Non-Signalized :	Signalized Intersection Non-Signalized Intersection 3-Leg Intersection

SN	Data Type		Item	Sub-Item	Unit	Data Format	Definition		CODE
								4-Leg 5-Leg Roundabout Flyover Viadust Others	: 4-Leg Intersection : 5-Leg Intersection : Roundabout : Flyover : Viaduct : 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	AM APM CC MP AP EP	 Asphalt Concrete Asphalt Macadam Asphalt Penetration Macadam Cement Concrete Macadam Pavement Aggregate Pavement Earth Pavement Others
				Cracking Ratio (for AC) Total	%	Numeric	A total area of cracking/patching expressed in percentage of total pavement area for Asphalt Concrete	<u>,</u>	
				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 Res	istance		Numeric	Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface	
				Loading (Resilien Modulus By FWD	t (Mr))	Мра	Numeric	Loading Capacity in terms of resilient modulus of Pavement Measured by FWD after Repair Work Completion	
				FWD Te	st Date	YY/MM	Date	Year and Month of the FWD test conducted.	
				FWD Te	st Data			Loading Capacity of Pavement Measured by FWD after Repair Work Completion.	
				D0 D20 D15		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	31.1	General	Road Na	me				
	Volume		Information	Route Br	anch No.				
				Jurisdicti	on				
					Name			Name of counting station	
					Km			Chainage of counting station	
				Counting	М			km+m	
				Station	Latitude				
					Longitu de				

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	Car				
			Traffic	Light Truck				
			Category (Annual	Medium Truck (2 Axles 6 Wheels)				
			Average)	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	nd 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		

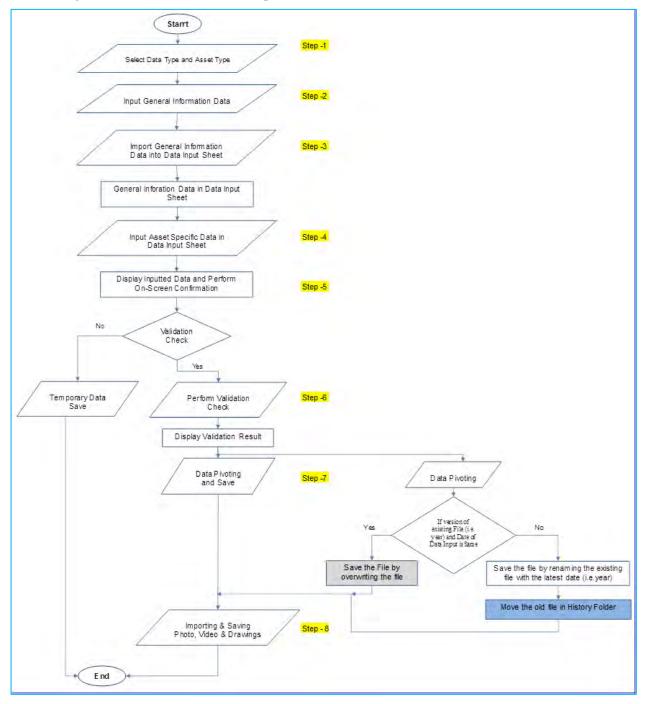
(8) Data on Repair, Enhancement and Replacement

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

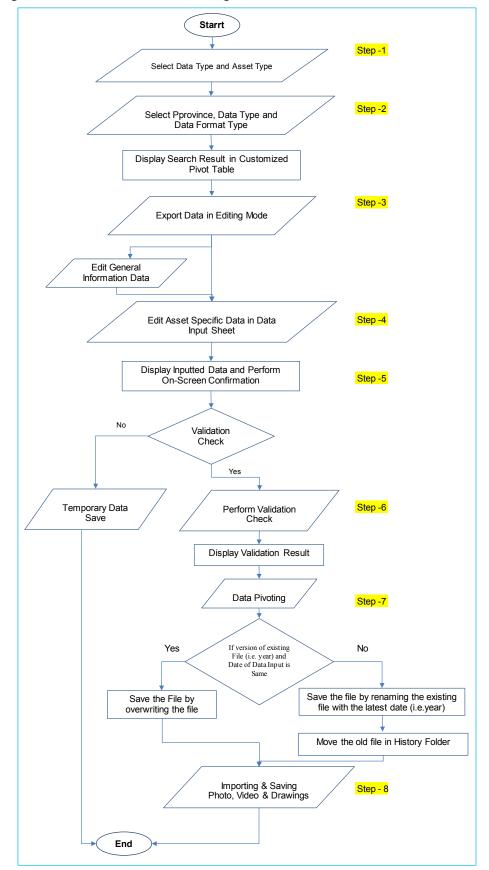
APPENDIX - 3 FLOW CHART OF BASIC FUNCTIONS

A3.1 NEW DATA INPUT

The general flowchart of new data input is shown below.



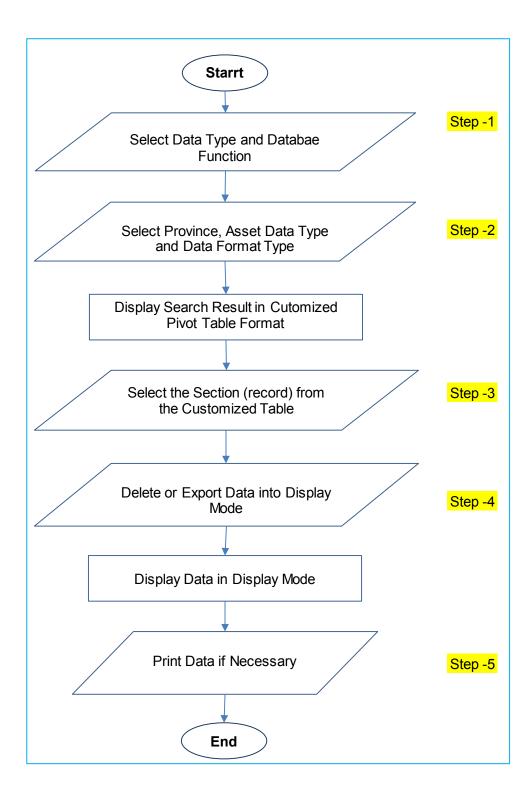
A3.2 DATAEDITING



The general flowchart of new data editing is shown below.

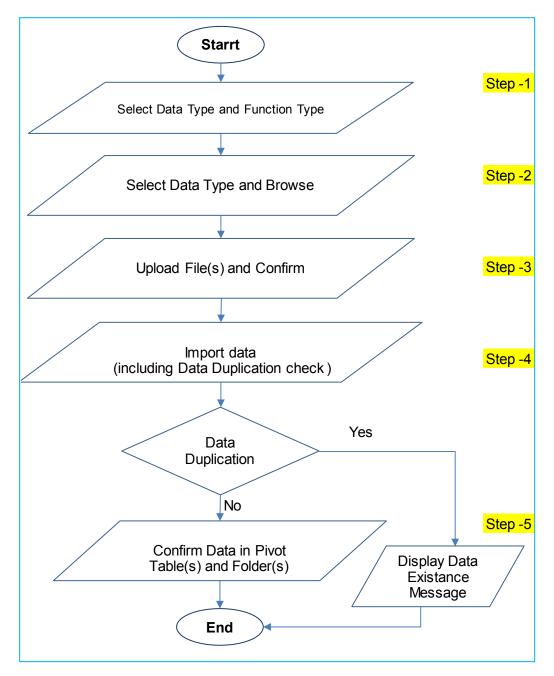
A3.3 DATA SEARCH, DISPLAY, DELETE & PRINT

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

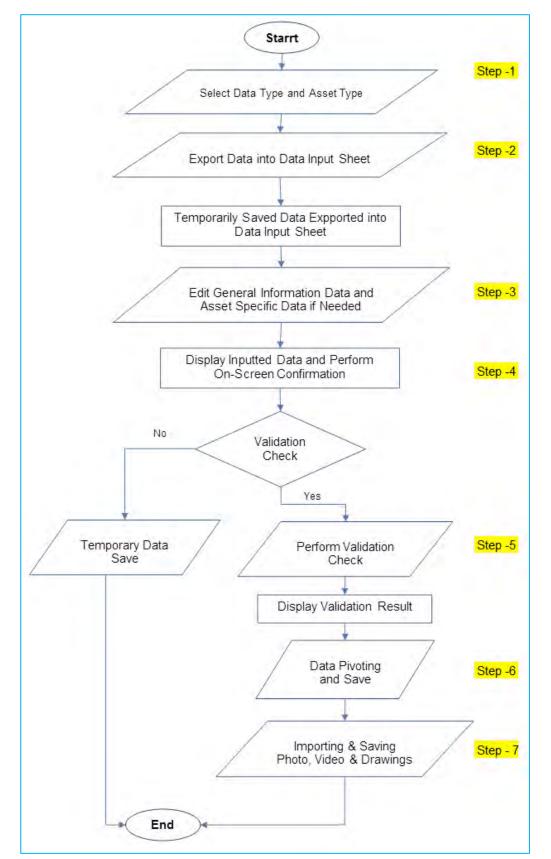


A3.4 NEW DATA IMPORT (DATA ASSEMBLING)

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



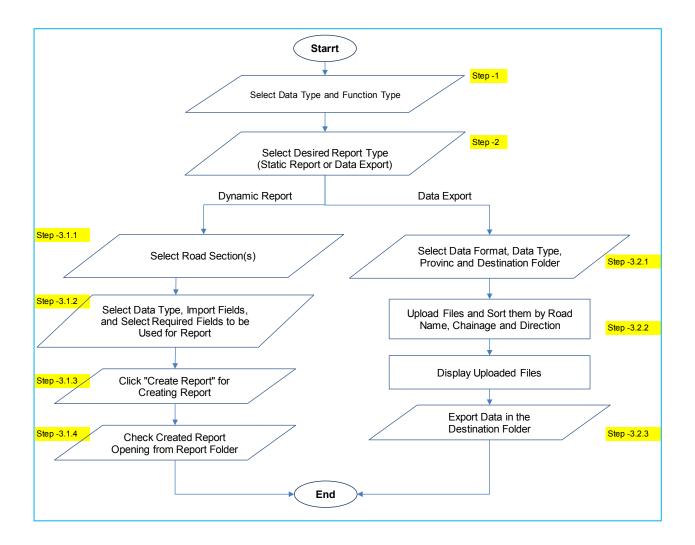
A3.5 RESUMPTION OF DATA INPUT TASK



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

ſ	Gene	ral Information		MIN DIRECTOR		OF TRAN		NAM				
		Road Main Details		I	DATA	INPUT SHI	ET			Back to MainWindow		xport to Input Sheet
Roa	d ID :		Location Referencing						,	Jurisdiction	Date	
Roa	d Name :	QL.1A		Km + m		Latitude l	ongitude	Province	City	RRMB No.:	KM Post Ad	justment Date
Tên	Tuyến :	Lạng Sơn - Bắc Giang	From :	+				Lạng Sơn	-	RRMB I	(yyyy/mm/d	d)
Rout	te Branch No. :		To :	+				Lạng Sơn	-	RRMS-B Name	Data Entry	
Roa	d Class :		Length :	0.0	m					Chi cục QLĐB I.5	(yyyy/mm/d	2014/1/30
			Within Section :	KM0+0 -:- KM9	4+70							
Sele	ect National H	ighway										
SN	RRMB No.:	National Highway	Route Name	Chainage: from	÷ to			Province: from	m ÷ to	District: from +	⊦ to	RRMS-B Name
-	* •	-	* *	v v	• •	* -	.	.	.	•		
1	RRMB I	QL.1A	Lạng Sơn - Bắc Giang	KM0 + 0	÷	KM94 + 3	70	Lạng Sơn ÷	· Lạng Sơn	- ÷	-	Chi cục QLĐB I.5
2	RRMB I	QL.1A	Bắc Giang - Bắc Ninh	KM94 + 70	÷	KM132 + 2	245	Bắc Giang ÷	- Bắc Giang	- ÷	-	Chi cục QLĐB I.5
3	RRMB I	QL.1A	Bắc Ninh - Hà Nội	KM132 + 245	÷	KM152 + 2	234	Bắc Ninh ÷	Bắc Ninh	- ÷	-	Chi cục QLĐB I.5
4	RRMB I	QL.1A	Pháp Vân - Cầu Giẽ	KM181 + 570	÷	KM213 + 6	508	Hà Nội ÷	Hà Nội	- ÷	-	Chi cục QLĐB I.6
5	RRMB I	QL.1A	Hà Nội - Hà Nam	KM213 + 608	÷	KM215 + 2	775	Hà Nội ÷	Hà Nội	- ÷	-	Chi cục QLĐB I.6
6	RRMB I	QL.1A	Hà Nam - Ninh Bình	KM215 + 775	÷	KM251 + 5	50	Hà Nam ÷	Hà Nam	- ÷	-	Chi cục QLĐB I.6
7	RRMB I	QL.1A	Ninh Bình - Thanh Hóa	KM251 + 50	÷	KM285 + 4	100	Ninh Bình ÷	Ninh Bình	- ÷	-	Chi cục QLĐB I.6
1	RRMB I	QL.2	Vĩnh Phúc - Phú Thọ	KM30 + 600	÷	KM50 + 6	50	Vĩnh Phúc ÷	Vĩnh Phúc	- ÷	-	Chi cục QLĐB I.8
2	RRMB I	QL.2	Phú Thọ - Tuyên Quang	KM50 + 650	÷	KM109 + ()	Phú Thọ ÷	Phú Thọ	- ÷	-	Chi cục QLĐB I.8
3	RRMB I	QL.2	Phú Thọ - Tuyên Quang	KM109 + 0	÷	KM115 + ()	Phú Thọ ÷	Phú Thọ	- ÷	-	Chi cục QLĐB I.8
4	RRMB I	QL.2	Tuyên Quang - Hà Giang	KM115 + 0	÷	KM205 + (ר (Tuyên Quang ÷	Tuyên Quang	- ÷	-	Chi cục QLĐB I.8
5	RRMB I	QL.2	Hà Giang	KM205 + 0	÷	KM312 + 5	500	Hà Giang ÷	Hà Giang	- ÷	-	Chi cục QLĐB I.8
1	RRMB I	QL.3	Thái Nguyên - Bắc Kạn	KM33 + 300	÷	KM113 + 8	316	Thái Nguyên ÷	Thái Nguyên	- ÷	-	Chi cục QLĐB I.8
2	RRMB I	QL.3	Bắc Kạn - Cao Bằng	KM113 + 816	÷	KM239 + 4	414	Bắc Kạn ÷	- Bắc Kạn	- ÷	-	Chi cục QLĐB I.4
3	RRMB I	QL.3	Cao Bằng	KM239 + 414	÷	KM344 + 4	136	Cao Bằng ÷	Cao Bằng	- ÷	-	Chi cục QLĐB I.4

				ANSPORT					
		DIRECTOR	RATE FOR RO	ADS OF VIE	TNAM				
			DATA INPUT	SHEET					
ata Type : Road Main Details									
ENERAL INFORMATION	eneral Infor	mation							
oad ID :	Location Refere	encing					Jurisdiction	Date	
oad Name : QL.1A		Km + m Latitu	ide Lo	ngitude	Province	City	RRMB No.:	KM Post Ad	ljustme
oute Name 🛛 : Lạng Sơn - Bắc Gian	g From :	0 0			Lang Sơn	-	RRMB I	2014/1/	30
oute Branch N : 0	To :	1 0			Lang Sơn	-	RRMS-B Name	Data Entry	
oad Class : I	Length :	1,000.0 m					Chi cục QLĐB I.5	2014/1/	
IAIN DETAILS Asset	Sepecific D	ata	·						
onstruction Year :		CROSS SECTION SCAL	.E						
ear of Service Operation Oper :		Direction Type :		Shou			Footpath, Ditch		
errain Type :		Motorized Lane		Treate	ed Shoulder W :	m	Footpath Width (including curt	o) :	m
emperature :	°C	No.ofLane :		Treate	ed Shoulder S :		Footpath Structure	:	
nnual Preciptation :	mm	Lane Width (one la :	m	Non-T	reated Shouk :	m	Ditch Width	:	m
oad Bed Type :		Pavement Type :					Ditch Structure	:	
ctual Length :	m	Non-Motorized Lane (NMT)	Media	an Strip		Cross Section Details		
oad Safety Corridor :	m (up)	No.ofLane :		Width		m	Carriageway Width	: 0	m
:	m (down)	Lane Width (one la :	m	Max. D	Difference in E:		Pavement Width	: 0	m
esign Speed : #N/A	A km/h	Pavement Type :		Media	n Structure :		Road Bed Width	:	m
							Road Land Width	:	m
				_			1		
OAD STRUCTURES (if any) Structure Type	0	antity Remarks		Rema	irks				
Bridge	<u>.</u>	Iditity Kondrka							
Road Intersection									
Railway Crossing									
Box Culvert									
Slab Culvert	:								
Pipe Culvert	:								
Flyover Bridge	:								
Others	:								
				I					
					Back to		Edit	Displa	v
					Da	*-		Dispid	

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.
- \checkmark 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-bysection, 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	$\rightarrow B_s $	\rightarrow C _s	D (Up, Down, Both) _S	Invalid
			D(Up, Down) _D with Both	Invalid
			D(Up, Down) _D without Both	Valid
/			D (Up, Down, Both) _S	Valid
	\mathbf{X}		D(Up, Down) _D with Both	Valid
			D(Up, Down) _D without Both	Valid
			D (Up, Down, Both) _S	Valid
			D(Up, Down) _D with Both	Valid
			D(Up, Down) _D without Both	valid
			D (Up, Down, Both) _S	Valid
		\rightarrow	D(Up, Down) _D with Both	Valid
			D(Up, Down) _D without Both	Valid

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
ľ		► 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.

	Validati	ion Check Results		Total Validation
Section Overlap	Blank Data	Data Format Type	Data Range	Check Results
Valid 🖯	→ Valid <u></u>	→ Valid	→ Valid	Valid
			Invalid	Invalid
	\mathbf{X}	Invalid	→ Valid	Invalid
			Invalid	Invalid
	Invalid	→ Valid	→ Valid	Invalid
			Invalid	Invalid
		Invalid	→ Valid	Invalid
			Invalid	Invalid
Invalid 🖯	→ Valid <u></u>	→ Valid →	→ Valid	Invalid
			Invalid	Invalid
	\	Invalid	→ Valid	Invalid
			Invalid	Invalid
	Invalid	→ Valid	→ Valid	Invalid
			Invalid	Invalid
		Invalid	→ Valid	Invalid
			Invalid	Invalid

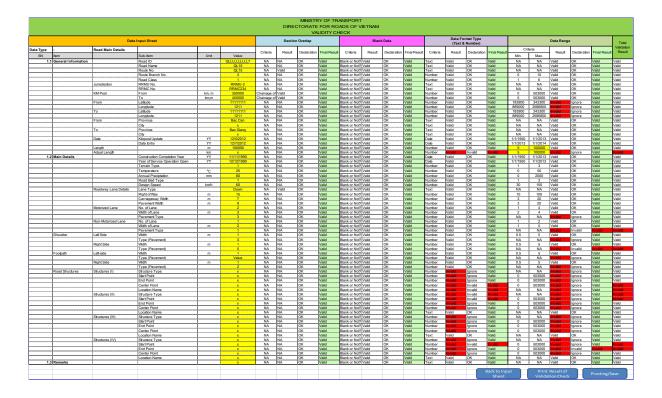


Figure 1 1-1 Display of Results of Data Validation Check

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 Resu	lts		Total Validation
Section Overlap	Blank Data	Data Format Type	Data Range	Check Results
Valid	Invalid			
	Invalid Ignore			
	To be declared by declaration button)			
\backslash	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 <u>Capacity Enhancement in Road Maintenance in Vietnam</u>. 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 "PMS"). 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..

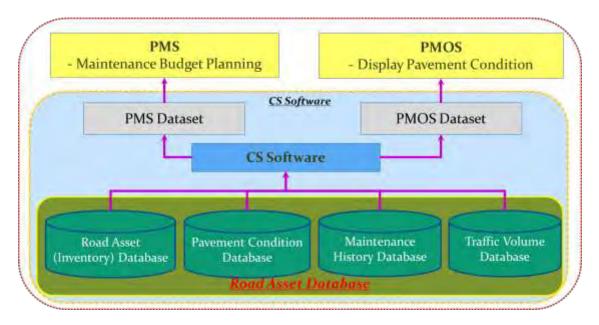


Figure 1.3.1 Road Database, Conversion Software and PMS & PMOS

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.

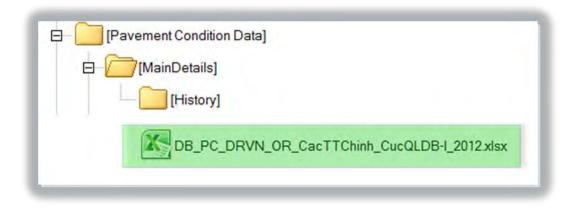


Figure 1.3.2 Main Details Folder and Pivot Table

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"



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

Table 2.1.1 System Requirements for Conversion Software

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

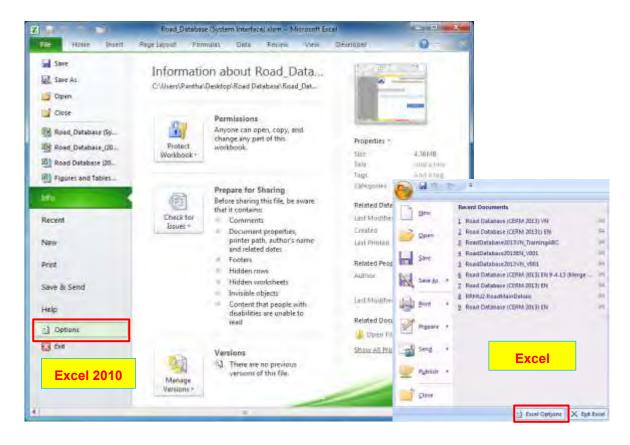
The Conversion Software has been developed in MS-Excel platform using Excel Visual Basic Application (hereinafter referred to as "Excel VBA"). Only Excel VBA programming language has been used while inserting various functions and modules. Also, some built-in tools / functions of MS-Excel are used. Therefore, it 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

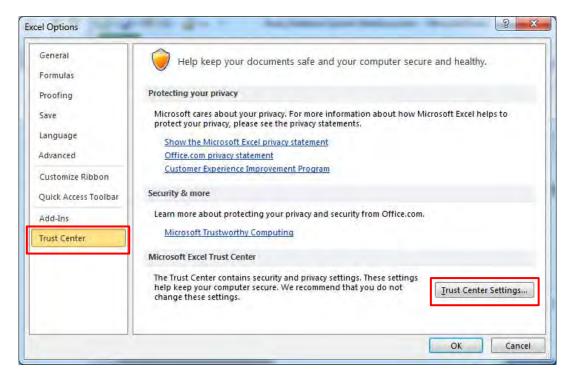
In Microsoft Excel 2007 and 2010, macro can be enabled by two ways;

(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.

Trusted Publishers	Macro Settings
Frusted Locations	Disable all macros without notification
Trusted Documents	Disable all macros with notification
Add-ins	Disable all macros except digitally signed macros
ActiveX Settings	Enable all macros (not recommended; potentially dangerous code can run)
Macro Settings	Developer Macro Settings
Protected View	Trust access to the VBA project object model
Message Bar	
External Content	
File Block Settings	
Privacy Options	

(2) Following "Security Warning" Alerts

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

*	Calibri	* 11 *		General +	B** Insert *	$\Sigma * \frac{A}{Z} T *$
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- 1		· <u>A</u> ·		€.0 .00 →.0	Format *	Q*

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

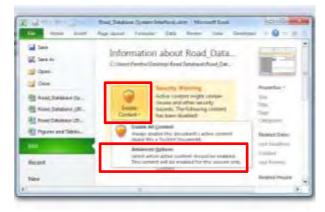
(1) Click **Enable Content** appeared at the warning message bar.

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

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(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 B.6.1.**

and Database Folder C#My Documents#Vietnam#P-610#Activity -2#C5 201	LA.03.05VCS SAMPLE DB1_large Load data
Road Asset dataset files Latent updated Road Main datais . Alfined Asset Databasel/Ruad Asset DataVII. Ruad Main Details/Roventary/V 	Maintenance History detaset files Latest updated Maintenance History Writing Asset Distoleses Maintenance History DataWhanDetailsk Distort Distoleses Maintenance History DataWhanDetailsk Distort Distort Research and Provide Research
Prevezaly updated Road Ham distain "Whood Asset Database#Road Asset Data#0.Road Main Details#Inventory#Hatory#	Prévoualy updated Maintenance History "Wood Asset DatabasekMaintenance History DataWhanDetailsHistory#
Pavement Condition dataset files	Traffic Volume dataset files
Latest updated Pavement Condition . WRoad Asset Database/Paversent Condition Data/Man/Details/	Latest updated Traffic Volume WRoad Amet Detabase#Traffic Volume Data#
Carlor Carlor Carlor Carlor Carlor	Ref. 10 (10) (et al. (et al
Previously updated Pavement Conditor . Wand Amet DatabaseWinterard Contition DataWinterCodeMinister VV	Previously updated Traffic Volume Vitoed Amet Catabinet Traffic Volume CataWrintory
PMS and PMsS dataset are based on	
Latest Pavement Condition dataset	

Figure **3.6.1** System Window

CHAPTER 4 OPERATION OF CONVERSION SOFTWARE

4.1 STEP – 1: LAUNCH THE APPLICATION

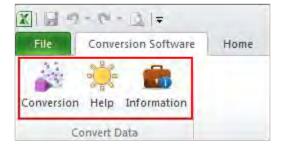
(1) Click on Conversation Software program file (CS2014.xlam) to run the program.



(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:

Information of CS Input	datasets	×
Road Database Folder	C:\C5 SAMPLE DB	Connect DB
Road Asset dataset files	·	Maintenance History dataset files
Latest updated Road Ma \Road Asset Database	ain details \Road Asset Data\0.Road Main Details\Inventory∖	Latest updated Maintenance History \Road Asset Database\Maintenance History Data\MainDetails\
Previously updated Road	d Main details \Road Asset Data\0.Road Main Details\Inventory\History\	Previously updated Maintenance History \Road Asset Database\Maintenance History Data\MainDetails\History\
Pavement Condition dat		Traffic Volume dataset files
Latest updated Pavemer		Latest updated Traffic Volume \Road Asset Database\Traffic Volume Data\
Previously updated Pave	ement Conditon Pavement Condition Data MainDetails History \	Previously updated Traffic Volume \Road Asset Database\Traffic Volume Data\History\
PMS and PMoS dataset a	are based on	
Latest Pavement Con Division of Latest Roa	dition dataset ad Main Details dataset with unit length 100 (m)	Convert data

(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.

lame 🔭 Road Asset Database	Date modified 14/03/10 12:15 PM	Type File folde
Road Asset Database	14/03/10 12:15 PM	File folde
	ш	11

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

Road Database Folder C:\CS SAMPLE DB ... Connect DB

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.

C:\CS SAMPLE DB	 Connect DB

(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.

– Pavement Condition dataset files	
Latest updated Pavement Condition	
\Road Asset Database\Pavement Condition Data\MainDetails\ DB_PC_DRVN_OR_CacTTChinh_CucQLDB-I_2012.xlsx	→ Data of latest year
Previously updated Pavement Conditon \Road Asset Database\Pavement Condition Data\MainDetails\History\	
DB_PC_DRVN_OR_CacTTChinh_CucQLDB-I_2009.xlsx DB_PC_DRVN_OR_CacTTChinh_CucQLDB-I_2010.xlsx	→ Data of previous years in History folder
DB_PC_DRVN_OR_CacTTChinh_CucQLDB-I_2010.xlsx DB_PC_DRVN_OR_CacTTChinh_CucQLDB-I_2011.xlsx	

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 ($\sqrt{}$).

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.

test up Fined 4	he data conversion has been finished	- Hittery DataWhanDetails¥
	PROCESSING REPORT	TOTAL AND A CONTRACT OF CONTRACT
Road A	Reading Pavement Condition datasetOK Reading Road Asset datasetOK Distribute RA data into PMS and PMoSOK Reading Maintenance History datasetOK Distribute MH data into PMSOK Reading Traffic Volume dataset 1OK Distribute TV1 data into PMSOK There's no 2nd Latest Traffic Volume dataset	Retory DataWienOctais#Hestory#
nemeni test up	- Calculate MCI valuesOK	
Road	THE PROCESS HAS BEEN FINISHED !	Detail
		ag net jack
er roush Marei i		DataWeteroryW
		6(3)(b)1_3)(1 ale
	THE PROCESS HAS BEEN FINISHED !	

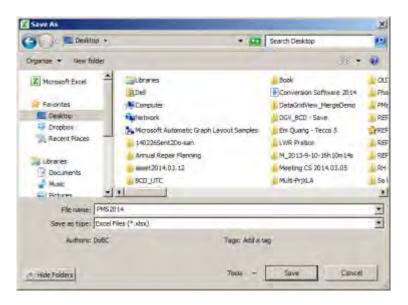
4.6 STEP 6 – EXPORT THE RESULT TO FILES

(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:

Setting informati	on for exporting PMoS dataset	X
- Select section in	n exported dataset	
Route Name	QL.1	•
Branch number	0 Direction D Lane	1 💌
From location	To location	(In kilometer)
Latest year for M	aintenance History data 2013	Export PMoS

- 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.

Organize + New fold	ler.		39	- 4
Recent Places	A Hana -		Curve modified	Tism .
The Libraries	140.2265ent2Do-san		26/02/2014 2:47 PM	File folder
Documenter	Annual Repair Planning		04/03/2014 1:48 PM	File folder
A Music	L Amer 12014,03.12		12/05/2014 10:15 AM	File folder
E Pictures	BCD_UTC		12/03/2014 8: 14 AM	File folder
Vickeon	. Book		21/02/2014 3:12 PM	The folde
	Conversion Software 2034	e	04/03/2014 7:10 PM	File folde
SYSTEM (C)	DataGndView_MergeDemo		20/01/2014 3:09 PM	File foldes
and allocated lied-	-11			
Plename:	PMOS_NH1_01_D1_2013.03.12			
Save as type: 1	Sxcel Files (*.xlsx)			
Autors: D	ai.	Tabli Add a tap		

(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.

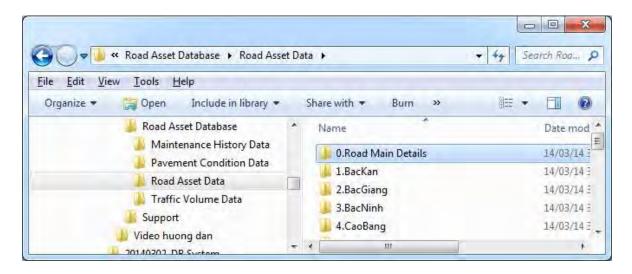
APPENDIX - 1 MAIN DETAILS FOR PMS AND PMOS DATASET DEVELOPMENT

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 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.

nze • Include in litnary • Share w	th - Dum Nexfolder		12		ET I	14
 Include in Interry * Other with the interval of t	Har Dee New Tolke Name History DB_MH_DBWN_DR_CacTTCHINA_CacQLDB-L2014.ata	Date modified 14/02/25 6-60 PM 14/02/21 8:51 PM		Sire	124	

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.

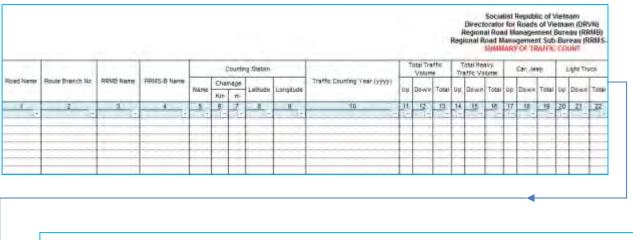
Pavement Condition Maintenance History Traffic Volume VBMS Interface	C Create Main Details C Access to Pavement Condition Folder Back Cancel OK
C System Back-up	

(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.

Sel	ect Task —			
6	Create Main	Details		
0	Access to Pa	vement Conc	dition Folder	

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.



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Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Up	Down	Total	Grand
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
-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	
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APPENDIX - 2 PMOS AND PMOS DATASET

A2.1 PMS DATASET

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

			Road Ass	t Data									Paven	ent Conditi	on Data					
			Road Ass	t Data								Latest Conc	lition Surve	y				2nd Lat	est Conditio	n Survey
Pavement	Pavement	t	Climate	Ten Ty		toad		Year/mont	Lane	Pavement		Cracl	k Rate		Rut	Depth		Year/	Lane	Paveme
Width (m)	Thickness (m)	s Annua Precip tation	i- atur	er- g/M	oun- C	lass <>>	ummy>	h of survey	position surveyed	type	Cracking %	Patching %	Pothole unrepaired %	Total %	Maximum (mm)	Average (mm)	IRI (mm/m)	month of survey	position surveyed	type
21	22	23	24	2		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
			Road Asso	t Data									Pavem	ent Conditi	on Data					
			100011255									Latest Cond	lition Survey	r				2nd Late	st Conditio	n Survey
Pavement	Pavement	nt Climate Terrain Type p. Year/mont Lane p.					Pavement		Crack	c Rate		Rut I	Depth		Year/	Lane	Pavem			
Width (m)	Thickness (m)	Annua Precipi tation	- atun	er-	lat/Rollin z/Moun-		ummy>		position surveyed	type	Cracking %	Patching %	Pothole unrepaired %	Total %	Maximum (mm)	A verage (mm)	IRI (mm/m)	month of survey	position surveyed	type
21	22	23	24	25		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
		_	_																	
		-	_																	
			Pavem	ent Conditio	on Data						Maintena	nce History					Traffic Vol	ume Data		
		2nd Late	st Condition	Survey						Late	st Repair				Latest S	Survey	2nd Late	st Survey		
	Crack F	Rate		Rut I	Depth		мсі	<dummy></dummy>	Year/				<dummy></dummy>	<dummy></dummy>	Total traffic volume	Heavy traffic volume	Total traffic volume	Heavy traffi volume	c <dummy></dummy>	<dumm< td=""></dumm<>
racking %		Pothole inrepaired %	Total %	Maximum (mm)	Average (mm)	IRI (mm/m)			Month of the latest repair	Repaired Lane	Repair Method	Repair Classification			AADT (24 hour data)	AADT (24 hour data)	AADT (24 hour data)	AADT (24 hour data)		
	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
41	42																			
41	42								-											

Table A2.1 PMS Dataset

A2.2 PMOS DATASET

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

Table A2.2 PMoS Dataset

						Road Asse	et Data									Paveme	ent Conditi	on Data	
									Loca	ation						Ro	ad condition	on	
	Road Nam		Route No	Route Branch		Lane	Date of	from	n	to		Pavement	Structure	Crossing			Crack F	Rate (%)	
Road ID	Road Nam	ie i	KOUTE NO	No.	Direction	Position	update	Km	m	Km	m	type	type	type	Year/month of survey	Cracking	Patching	Pothole unrepaired	Total
1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Pav	rement C	Condition [Data								Maintenan	ice History	Data					
	Pav		Condition I	Data			2013		20)12			ice History	Data	201	10		2009	
Rut Dep	Pav			Data FWD (mm	<u>1)</u>	:	2013		20)12			-	Data	201	10		2009	
Rut Dep Average				FWD (mm	1) D _{150max}	Repair Method	2013 Repair Classificatior		pair	012 Repai Classifica	ir		-	r F	Repair	I0 Repair Classificatic	Rep Meth	air	Repair
	oth (mm)	Road o	condition Year/mon	FWD (mm		Repair	Repair	n Met	pair	Repai	ir	2 Repair	011 Repa	r F	Repair	Repair		air hod Cla	Repair
Average	oth (mm) Maximum	Road of IRI (mm)	Year/mon of survey	FWD (mm	D _{150max}	Repair Method	Repair Classification	n Met	pair thod	Repai Classifica	ir	2 Repair Method	Repair Classifica	r F	Repair Iethod (Repair Classificatio	on Meth	air hod Cla	Repair assificatio
Average	oth (mm) Maximum	Road of IRI (mm)	Year/mon of survey	FWD (mm	D _{150max}	Repair Method	Repair Classification	n Met	pair thod	Repai Classifica	ir	2 Repair Method	Repair Classifica	r F	Repair Iethod (Repair Classificatio	on Meth	air hod Cla	Repair assificatio

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

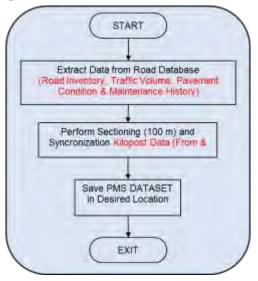
1.1 GENERAL

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 <u>Capacity Enhancement in Road Maintenance in Vietnam</u>. 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

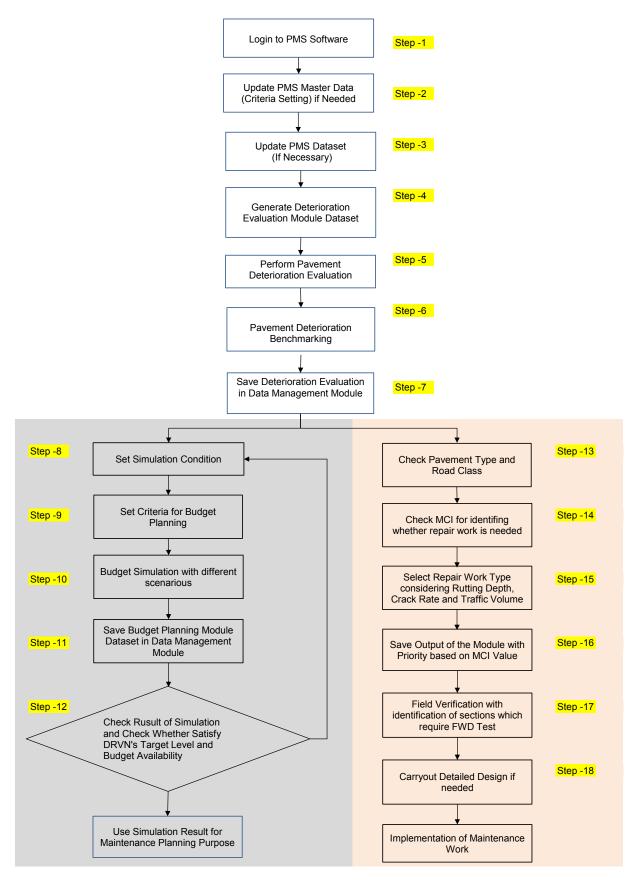
PMS system can be installed in any drive (C:/, D:/, ...) on computer. Upon successful installation of PMS, PMS will be listed up in the start menu.

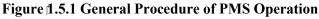
1.4 USER ID AND ACCESS AUTHORITY

It is prerequisite to have user ID to access to PMS system. Two types of user ID can be created by administrator <u>with or without administrative rights</u> 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.





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.

Pavement Deterioration Evaluation

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.

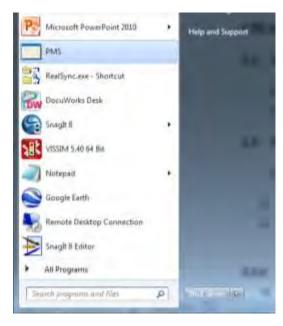
CHAPTER 2 PMS OPERATION

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

User ID	1			
Passwor	d			
-	_	-		_
Login		(Cancel	

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

in	
User ID	
Password	
Login	Cancel

- 3) Click Data Management Module
- 4) Click Update PMS dataset

1	2
Data Management Module	Update PMS Dataset
PMS Master Data	(Latest update: 12/5/2013 9:24:58 Al
PMS Module	Generate Module Dataset
EXIT	Back

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

6) Double Click "DATASET_PMS_20131030.xlsx" file

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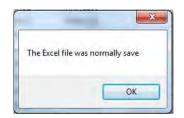
Software check the data validation of the PMS Dataset file uploaded into the system.
 "Checking files ..." message will be appeared on interface.

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

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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

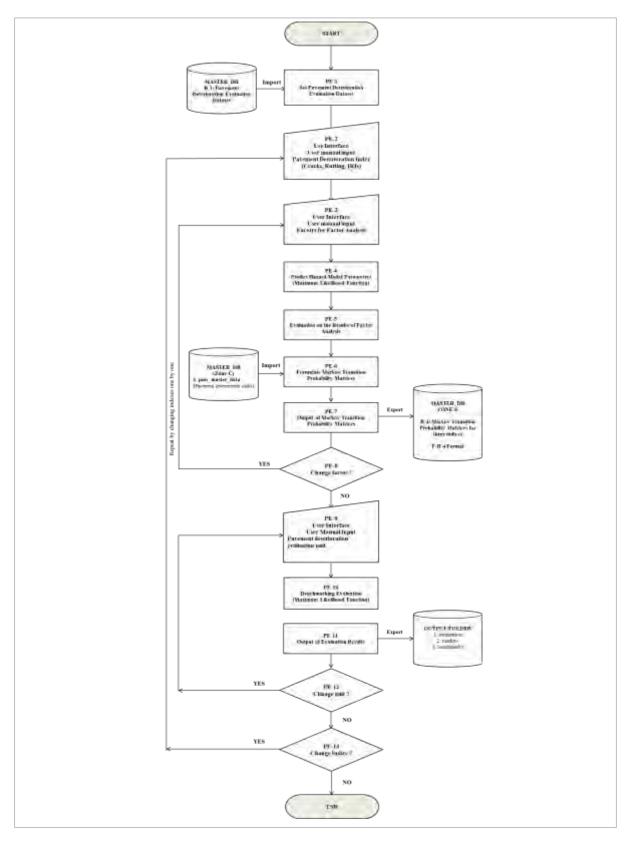


Figure 2.3.1 Flowchart of Pavement Deterioration Module

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

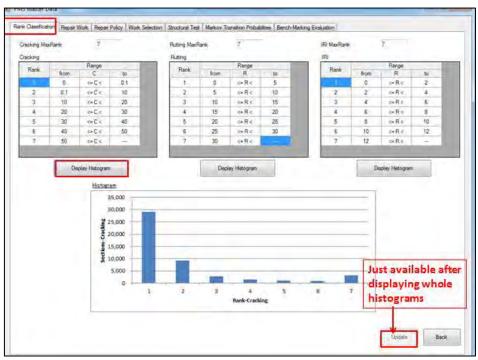
2.3.3 Setting the Ranking for Crack, Rutting and IRI

This function is enabled only for user having administrative right.

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

asset menu	
Data Mana	agement Module
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РМ	S Module
	EXIT

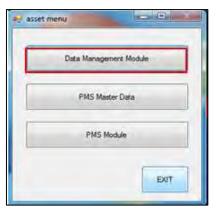
- Select "Ranking Classification" Tab, then set / modify the ranking for Crack, Rutting and IRI
- 3) Click "Display Histogram" for Crack, Rutting and IRI after setting / modifying ranking and then click on "Update" button. All three indices (i.e. Crack, Rutting and IRI) shall set and display histogram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



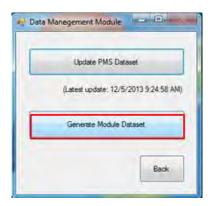
Note: If you don't display histogram for whole damage types (crack, rut, IRI) the Update button will not available.

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"

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Suppl Parries	
	(Latest update:)
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	(Latest update:)

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

Selection of variables	
Pavement Type	
Pavement Thickness	
Climate - Annual Precipitation	
Climate - Temperature	
Topographic Conditions	
Repair Method	
Heavy Traffic Volume	

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.

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2.3.5 Estimate the Hazard Parameters

1) Back to Asset Menu, then click "PMS Module"

asset menu	
Data Man	agement Module
PMS	Master Data
PN	IS Module
	EXIT

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.

Pavement Deterioration Evaluation Module
Budget Playwig Middle
Ferner Work Flavwey Mexico
End

- 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

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

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- 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

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- 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"

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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)

	Estimated	Calculation	
Ratings	Constant	PaveType	for cell No1
1	-	<	
2	-	×	
3	-	*	Omit the
4	4		other cells

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)

ted Parameter:	Error or an ill	-Bai terre	Omit cell
200	Estimated	Parameters /	Calculation
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2	+	-	-
3	1	×	Omit the
4		x	Jother cells

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

	gal value		
ed Parameter:		Parameters	keep cell No
Ratings	Constant	PaveType	Calculation
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2	-		for cell No2
3	-	×	LOmit the
4	-	×	other cells

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.

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2.3.6 Calculate the Pavement Deterioration according to Markov Module

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

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0.2995	0.0000	-0.1228		75.0376	0.0000	-7.3560	
0.9112	0.000	-0.3650		45.6693	0.0000	-5.4274	
1.6044	-0.5453	0.6493		35.8315	-2.3984	4.3380	
2.1444	0.0000.0	-1.1924		30.0265	0.0000	-5.7332	
2.1444	0.0000	-1.4228		26.3222	0.0000	-5.0296	
2.5083						-	
							Display Result

- 2) Evaluate Pavement Deterioration in case of cracking
- **3)** Click on "**Execute**" button to conduct Pavement Deterioration Evaluation with average value of variables

rage					Settings
Value of	"Pavement Type" "Heavy Tratfic Volume" 	0.0053 0.1503	Quration of Markov matrix Transition Interval	1 ► Years 30 ► Years	

- 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

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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

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- 2) Calculate Pavement Deterioration Evaluation in case of cracking
- 3) Select specific separator : "Road Name" or "RRMU" or the other

1	Chefore C-after	enterval	const	Pavement Type	Heavy Traffic Volume	Road Name	RRMU	RRMU Field	Pavement
	1	4	1	0	0.214890832701	NATIONAL HIG	RRMU2	RRMC236	AC
	1	4	1	0	0.214890832701	NATIONAL HIS.	RRMU2	RRMC236	AC
	2	4	1	0	0.214890832701.	NATIONAL HIG	RRMU2	RRMC236	AC
	t	4	1	0	0.214890832701	NATIONAL HIG.	RRMU2	RRMC236	AC
	1	4	1	0	0.214890832701	NATIONAL HIG	RRMU2	RRMC235	AC
	1	4	1	0	0 214890832701	NATIONAL HIG	RRMU2	RRMC236	AC
	1	4	1	0	0.214890832701	NATIONAL HIG.	RRMU2	RRMC236	AC
	1	4	1	0	0.214890832701	NATIONAL HIG.	RRMU2	RRMC236	AC
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	1	4	1	0	0.214890832701	NATIONAL HIG	RRMU2	RRMC236	AC
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	1	4	1	0	0 214890832701	NATIONAL HIG	RRMU2	RRMC235	AC
	1.	4	1	0	0.214890832701	NATIONAL HIG.	RRMU2	RRMC236	AC
	4	4	1	0	0 214890832701	NATIONAL HIG.	RRMU2	RRMC235	AC

4) Click "Execute" button to calculate

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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.

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4	HATIONAL HIS	15	1295	1.029728	1.000000	0.0000003	£ 553386	8.129477	
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6	ANTIGNAL HIG	1825	163080	0 582994	1 000000	0.008767	\$ 396597	1056254	
7	NATIONAL HIS	7429	689875	1.290114	1.000000	0.000000	0.573291	0.195310	
- 2	HATTOMAL HIGH	37	7540	1.03025	1.000900	0.000000	0.622103	0.125228	
	HETIONS, HIS	26	2545	1,297928	1.000000	0.000000	0.666751	1.135277	
10	ANTIONAL HIG	2913	260330	0.887597	1.000040	0.004113	\$ 486787	1087603	
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6) Data summary is also available in "Summary" Tab.

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- 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

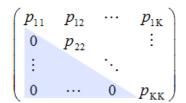
						Settings
	Road Character	istics		Conditions		
1	Value of	"Pavement Typi	0.0053	Transition Interval:	30	Years
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The values that were set is displayed in **Parameters** sheet

(2) Matrix

	A		J.	- 0.	1	F	G	11.
10		Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7
1	Rank1	0.910824369	0,077570663	0.00882104	0,001947711	0,000573541	0,000181074	8.16017E-05
3.	Rank2	0	0.754995749	D.161348864	0.051459007	0.019866797	0.007799978	0.004529606
0	Rank3	O	0	D.424713481	0,267722344	D,156316864	0.053038222	D,068209089
5	Rank4	0	0	0	0.222257175	0.267770064	0.21927354	0.290699221
ō.	Rank5	O	0	0	0	0.140130341	0.234636137	D,625233522
7	Rank6	0	0	0	0	0	0.100816509	0.899183491
1	Rank7	0	0	0	0	0	0	1

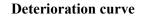
• Transition matrix is displayed in Matrix sheet as shown above.

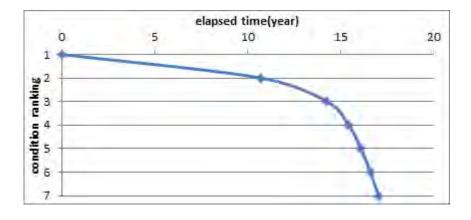


- Pij expresses the probabilities of changing of road network from rank i to rank j after 1 year.
- An example:
 - B2= 0.91 it means after 1 year 91% road network will change from rank 1 to rank 1 (i.e. remain in same ranking level)
 - C2= 0.077 it means after 1 year 7.7% road network will change from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

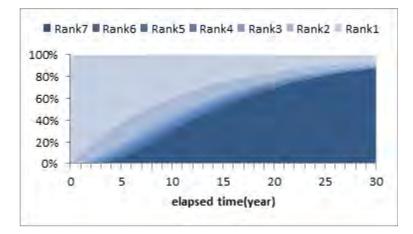
The deterioration curve is displayed in **Curve** sheet.





(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

ID	Specific	Numbe rof	Longth	onoilon	Specific Parameter 1	Specific Parameter	Specific Parameter			Hazaro	l Rate					Accun	nulated Life	e Span		
	Separator Name	Sample s	Length	epsilon	Parameter1 (Constant)	2	3	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	þnal 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	<u>ΑΥ 6-1(THE OI</u>	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	<u>ΑΥ 6-2(THE OI</u>	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 RO	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	<u>þnal highwa</u>	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	þnal 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

Benchmarking results are shown with epsilon sheet as shown below.

- 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

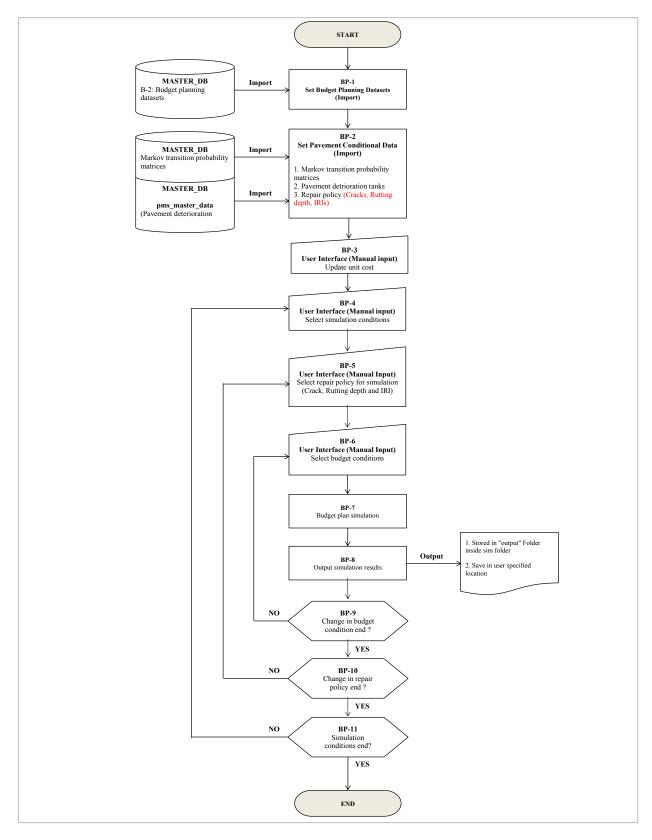


Figure 2.4.1 Budget Planning Flowchart

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"

Data Management Module	Update PMS Dataset
PMS Master Data	(Latest update: 12/5/2013 9:24
	Generate Module Dataset
PMS Module	Generate Module Dataset

3) Select target group for simulation.

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e ta	8-9-10-10 10-10	135 139 147 148	10 V e	****			2		

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

Inpu	it fie	2_markov Results files	Repair un	t Cost R	anking	Repair Policy	Sim Cor	dtion	Budget	and the second
No.		Repair work type	Unit Cos (VND/m2	t For Budget Planning	Color in Budget Planing Module	1				
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	Proad be	d renovation	1	5		A COLUMN				
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				Delete Repair M	lethod		Add Repair	Aethod.		Result
				Dekte Repar M	lethod		Add Hepar	/ethod		Result

2.4.5 Setting Repair Policy

Image:	Pp2Ms ColeReg	Reads New Reads and Cod	Rento R Rent H1 2 3 4 8		Sta Sector	llutgel
	4 4 4	•		>2 Settin	g repair poli	evels
						Pores

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.

Input file Simulation Dur		epar unt Cost	Ranking Re the simulation		Condition	Budget
Times of Real	Enter Martin		imes of realiza			
						Result
	loost. 1	C-4	2.	mi	1 83	Save
Cost	Length	Crack.	Rit	IRI	Risk	

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 "No" 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

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2.4.8 Budget Planning Results

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

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3.00	452,810,700.08	15448.199-00	100278.100.00																		
1.00	497,487,100,08	41.988.000-RG	188,825,958,00																		
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13	175501780	65627428	371828158							100.00											
17	1/06/19/00	60172000	107919210																		
24	TTT ARTS	60123406	010100430								1000	B.T.		2235	3.6.5	111	441	1221	202		
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13	177226410	65915750	572710000																		
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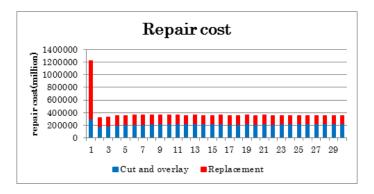
2) Cost

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 Midterm maintenance budget planning.

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

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

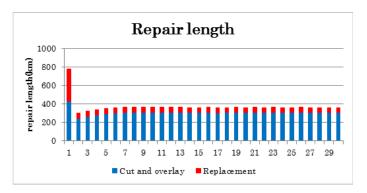
Repair cost for whole target sections



3) Repair Length

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

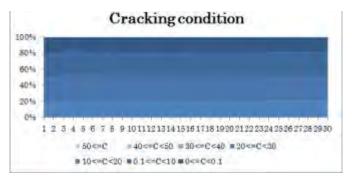
Repaired length of whole target sections



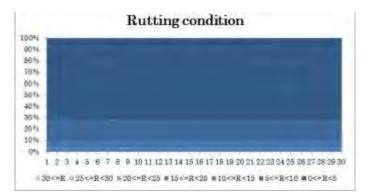
4) Crack, Rut and IRI Condition Transitions

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



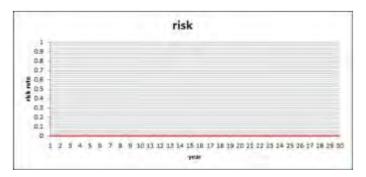
2.4.9 Risk

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.

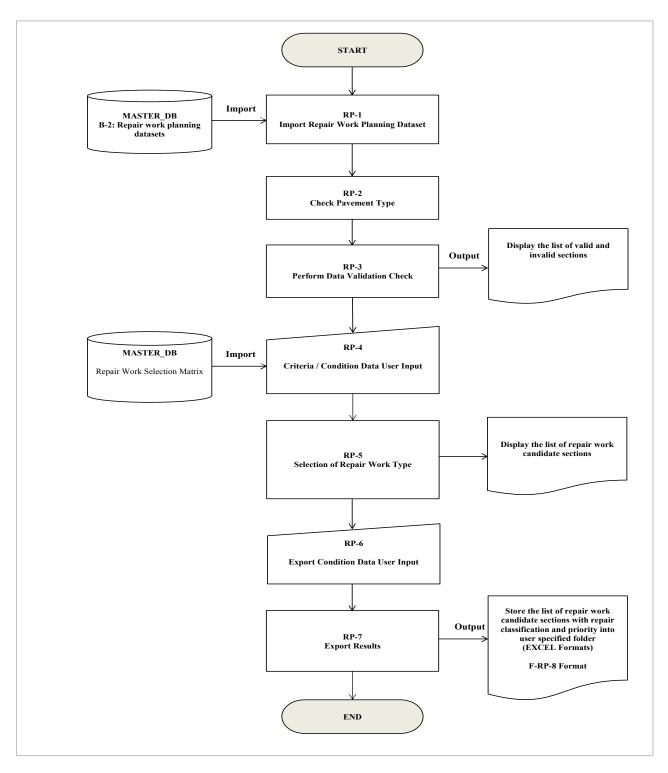


Figure 2.5.1 Annual Repair Working Planning Flowchart

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

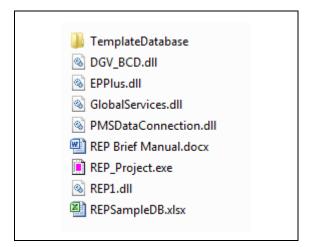


Figure 2.5.2 Files and Folders for Repair Work Planning Module

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.

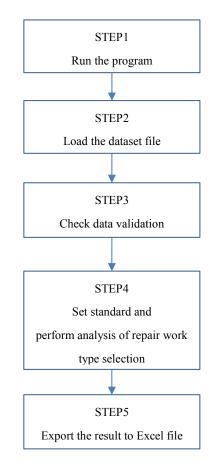


Figure 2.5.3 General Steps of Annual Repair Work Planning

(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.

퉬 TemplateDatabase
🚳 DGV_BCD.dll
🚳 EPPlus.dll
GlobalServices.dll
PMSDataConnection.dll
REP_Project.exe
🚳 REP1.dll

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

🔜 Annual Repair Planning		
Source Dataset		
Path of Source Dataset	C:\Users\Dell\Desktop\REP Development\REPdatabase\REPSampleDB.xlsx	Select file Load data
Validation checking		
Pavement Type AC - Asphalt		
Proper sections		
Improper sections		
Improper Value		
Perform checking		
Repair Work Selection		
Analyze Repair Work		
Export result lists		

(2) Load the dataset file

 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.

Source Dataset						
Path of Source Dataset	C:\Users\Dell\Deskto	pp\REP Development\REPdatabase\REPSampleDBxls	x Select file		Load da	ata
Validation checking		7	1			-
Pavement Type AC - Asphall	- 🛃 Open an excel file	<u></u>	1			9
Proper sections		velopment + REPdatabase 🛛 👻 🕻	Search REPdatabase		_	
Improper sections	Organize New folder			- +	H	0
Improper Value	Favorites	Name *	Date modified		1	-
Perform checking	Desktop	Core_AnnualRepairPlanningDataset.xlsx	06/02/2014 2:351			
	- SP Dropbox	module_data_set_repair.xlsx	24/01/2014 5:201	1	-	1
Repair Work Selection	E Recent Places	Rew_module_data_set_repair.xlsx	04/02/2014 1:40	2		
	tibraries	Org_REPSampleDB.xlsx	06/02/2014 5:11	3	No	R
Analyze Repair Work	Documents	REP_OutputTemplate.xlsx	11/02/2014 2:531			
	J Music	REPSampleDB - Copy.xlsx	11/02/2014 11:23	4		
Export result lists	Pictures -	REPSampleDB.xlsx	12/02/2014 12:14	5	1	
	Videos	REPSampleDB1.xlsx	09/02/2014 10:59	6	2	-
		REPSampleDB3.xlsx	10/02/2014 2:31	7 8	4	-
	Computer	InitCost.xlsx	11/02/2014 10:07 🗸	9	5	
	3131EM (C.)	- 4	Þ	14 4	▶ H	Sa
	File	name: REPSampleDB.xlsx	Excel 2007 files (*.xls	sx)		-

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

Jource Dataset			
Path of Source Dataset	C:\Users\Dell\Desktop\REP Development\REPdatabase\REPSampleDB.xlsx	Select file	Load data

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.

Source Detected						
Path of Source Dataset	C Chara Del Desid	to REP Development	REPdatatione (REP	SampleO6.Abx	Select Me	Ined da
Velidation checking	-					_
Pavenera Type	3		Road invent	sky/		
Proper sections	1	1	1	1		T
Improper sections	Route No	Route Name	Branch No	RRMU	RRMU Field	Road
Incroper Value					Office	Class
Perform checking	1	aliant.	u.	RRMU2	RRMC235	1
	1	NATIONAL HIG	0	RRMU2	RFIMC236	1
Repair Work Selection	1	NATIONAL HIG	¢	RRMU2	RRMC236	18
Lefter (1999 "Married)	T	NATIONAL HIG	0	RRMU2	RRMC236	1
Safe (V)/m	t	NATIONAL HIG	0	RRMU2	RRMC236	V.
	1	NATIONAL HIG.	0	RRMU2	RRMC236	IV
Corrent Int	1	NATIONAL HIG	0	RRMU2	RRMC235	111
		NATIONAL HIG	0	RRMU2	RRMCZ36	HI.

- Source Data

(3) Validation Check

- 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.

Source Dataset					[
Path of Source Dataset	C:\Users\Dell\Desktop\	REP Development\f	REPdatabase\REPSar	npleDB.xlsx	Select file	Load data
/alidation checking	1				1	1
Pavement Type AC - Asphalt	Road	Latest Repair				
Proper sections mproper sections mproper Value	m Number of Lanes	up ọr Down	Pavement Type	Width, m	Year/Month of Latest Repair (yyyy/mm)	Repair Lane
Perform checking	100	P0	œ	6		0
	2	D	AC	6	1998/01	2
Repair Work Selection	2 2	D	AC	6		
Tepair Work Delection	1	-0.	AC	6		
Analyze Repair Work	2		noValue	6		
	2	U	AC	6		
Export result lists	2	1	CC .	6		1
	Manager Provide State		100			

- 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

 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.

# i	of Flephet T	Pepar W	lonics for Road	Class J, II, and	Ni iniciase MC	l value is s 5	Repair Works for the other Road Classes (W. V) in case MCI value is <u>5</u> .								
		Light defects						Medium	defects		Reavy defects				
	Ruttin	g Depth	Rutting Depth level T 0 ~ 25 mm					Ruting Depth level 2 25 + 40 mm				Rutting Depth level 3 40 = = mm			
1	Traffic Volume (Ifeavy Vehicle: AADT)		TV level 1 0+100	TV level 2 100-250	TV level 3 250+1000	TV level 4 3000+=	TV level 1 0+100	TV level 2 100+250	TV level 3 250-1000	TV level 4 1000	TV level 1 0-100	TV level 2 105+250	TV level 3 250+1000	TV level / 1000	
	Light	Creck level 1 0-5 %	No repar	No repair	No repair	No repair	No repair	No tepair	No repair	Dut and DL Stime	OL 30mm	OL 30mm	OL 50mm	Out and OL Stimm	
(CH)	defects	Dack level 2 5+15 %	No repar	Nomper	Surface treatment	Suitace treatment	DI. 30mm	OL 30mm	OL Stime	Exand DL 70mm	OL Sime	OL 50mm	OL Stime	OL and OL 70mi	
Crask rate (C	Medium defects	Crack level 2 15+35 %	OL 30mm	OL-Sümer	OL 50mm	OL 70mm	UL Some	OL SOmm	OL 70mm	Cut and DL 70mm	OL 50mm	OL Simm	OL 70mm	Cu sel OL 70mm	
Cra	Heavy	Crack level 4 35×50 %	Cit and OL Sh	Columnia D(States	Galant Di Shini	Bq	-Cist and - DD-500ms	The and The data	Lite and Co. One	Ri	Out and DL 50ms	Gil and Cil Schen	Galanti O. Sala	- Di-	
	Hertenta.	Crack local 1 122-100 S			24	121	1								

- 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</u> <u>input the unit cost of the corresponding year because unit cost of repair work items</u> <u>will change every year considering the market prices of materials and labors</u>.

Nc.	Repar Type	Description	Cartered	Cenefication Nerre	Line Cost (1000 VND)	Unit of Guartely	Cale
	No repar	Repair works are not needed, but pavement intrintoring needs to be continu.	T	No or Minor Repair			
	Surface treatment	Roubne mantemance, matchine matching to recover road pervenient	1	No. or Minor Repar			1
	QL 30mm	Overlay 30mm - New payement layer will be placed on the existing payement	2	Madium reduit	250	#2	
	OL 50mm	Overlay 50mm - New pavement layer will be placed on the existing pavement.	2	Medium repair	400	mZ	
	OL 70mm	Overlay 70mm - New pavement layer will be placed on the conting pavement.	.2	Medium repar	500	112	
	Est ant OL 30mm	G.4 and Dvertay 30mm. New pavement layer will be places after cutting pav-	2	Madaum misain	285	m7.	
1	Cut and OL 50mm	Cut and Overtay 50mm New pavement layer will be places after cutting pav	2	Modium replain	400	m2	
	Cut and OL 70mm	Out and Overlay 70mm - New prevenent layer will be places after cutting pay .	2	Medium répair	550	m2.	
-	Big reparts	1. Surface and binder replacement. 2. Whole layer replacement, 3. Subgrade	3	Big repair			

* All the unit costs of "Medium Fleger" group in Winteble can be updated by user and applied to the current analysis

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

Setting for Ru	tting Dept	h leve	els (mm)			Setting for [N	lo Repair] d	lecision	1		
Level 1			Rutting Depth	< 25	∃	Set "No Rep	air" type if I	MCI val	ue is larger than		5.0 🔹
Level 2	25	≤	Rutting Depth	< 40	3	Setting for Ci	racking rati	o levels	; (%)		
Level 3	40	2	Rutting Depth			Level 1	-		Cracking ratio	<	5 🕂
Setting for Tra	affic Volum	e leve	els (vehicles/days) ———			_		-		
Level 1			Heavy AADT	< 100	÷	Level 2	5	≤	Cracking ratio		15 🛨
Level 2	100	≤	Heavy AADT	< 250	÷	Level 3	15	≤	Cracking ratio	<	35 🛨
Level 3	250	≤	Heavy AADT	< 1000	÷	Level 3	35	≤	Cracking ratio	<	50 🛨
Level 3	1000	≤	Heavy AADT			Level 3	50	≤	Cracking ratio		

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.

		-		Light	defects			Medium defects		Heavy	defects		
	Rutting	g Depth			eptin level 1 5 mm			Ruting Depth level 2 25 × 40 mm		Rutting Depth level 3 40 + = mm			
0		Volume hicle: AADT)	TV level 1 0+100	TV level 2 100-250	TV level 3 250+1000	TV level 4 1000	TV lev D+10	e Select a repair type	1	TV level 2 100+250	TV level 3 250+1008	TV level 4 1000+=	
	Light	Crack level 1 0+5 %	No mpair	Novepar	No repair		Tio m	Surface treatment OL 30mm OL 50mm		OL Stem.	OL Sümm	Out and OL Stimm	
(010)	defects Crack level 2	No repair	No repair	Surface treatment	Surface treatment	OL 30	OL 70mm Cut and OL 30mm Cut and OL 50mm Cut and OL 50mm	•	OL 50m	OL SOMM	Gatandi OL 70me		
CITACK THEN (C	Medium defects	Crack level 3 15:35 %	OL 30mm	Di. 50mm	OL Som	ÓL 70mm	QL 50	Big repains		OL Stime	OC 70mm	Sidard OL 70m	
CIN		Crack level 4 35+50 %	Cut and Cil. Somm	Gurand OL 50mm	Cut and OL Tom	pq mane	Cut a GL 50	OK	ł	Gir and QL Signs	Gut and DU?/Brim	Bug reposed	
	defects	Crack level 5: 50+100 %	Big	Dig reptors	Bg	Bg	Bg	Big Big Big Big mpan mpan mpan		Ag relater	Big	Exp	

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.

	23	1	NATIONAL HIG	0	RRMU2	RRMC236
Default setting	24	1	NATIONAL HIG	0	RRMU2	RRMC236
	25	1	NATIONAL HIG	0	RRMU2	RRMC236
	26	1	NATIONAL HIG	0	RRMU2	RRMC236
Cancel	27	1	NATIONAL HIG	0	RRMU2	RRMC236
Accept and Run	28	1	NATIONAL HIG	0	RRMU2	RRMC236
	29	1	NATIONAL HIG	0	RRMU2	RRMC236

(5) Export the Result to Excel file

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

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.

Select sections to display					
Road Name	Branch	Direction	From KM	To KM	
NATIONAL HIGHWAY 1	•	• •	•	•	Select section

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

Select section	is to display					Export to Exc	Export to Excel file			
Road Name		Branch Direction	From KM	To KM	-					
All	•	•	• •	•	Select sectio	ns With cu	stomization	Export		
			Ro	ad inventory						
No	Route No	Route Name	Branch No	RRMU	RRMU Field Office	Road Class	Construction Year			
113	84	NATIONAL HIG	0	RRMU2	RRMC319			10		
167	138	NATIONAL HIG	0	RRMU2	RRMC373	Î.		15		
103	74	NATIONAL HIG	0	RRMU2	RRMC309	V		9		
192	163	NATIONAL HIG	0	RRMU2	RRMC398	VI		18		
84	55	NATIONAL HIG	0	RRMU2	RRMC290	VI		7		
79	50	NATIONAL HIG	0	RRMU2	RRMC285	1		6		
81	52	NATIONAL HIG	0	RRMU2	RRMC287	10		7		
19	1	NATIONAL HIG	0	RRMU2	RRMC236	1		0		
157	128	NATIONAL HIG	0	RRMU2	RRMC363	00		14		
40	1 <i>4</i> 111	NATIONAL LIC	n	DDMIIS	DDMC340	W		2 *		

- 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

1	A Def	6	- + /0	- A	2	-	-	8. 19	- ===	VAL TAVE		unber		- 20		- 3		1 7	香田	E Auto	20	7 8
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		Brunch	Rast		File P	olt			taxter of	ido ar	Preset	Hidth.	Dade B Rate	Rutting Depth	IRL.	-	Traffic Industre	Report	Atte	te canal		
10	Roude Name	tis	Cars	ta:		at in	m	Length, m	Lame	Dever	Type	m .	TU101.	Average,	10.0			rethic	Calchage		Quantity	Figs 1
	a line and the	1-1		- 1		21	1.4				-		24.0		1.0							-
	HE HATLONIAL HERHWAY I		ш 11	138	1700	135	isie	300		1	和武	13,14	0.2	1	11.22	0.01		Call Woman	Heghum repair Neghum repair	400 m		135
	L'A FAITTERAN, HEIPHWARK		III	190	1001	1VI	1	10		0	AL.	8.00	18.9		3.84	1.23			Trivian retain	Line as		
	OL NATIONAL PROMINENT		III	1907	1000	1921		1	3	T	AC	0.24	30.9	41	4.03	1.34	275.3	GL 70mm	Playbury repair	100 m	a l	7
	PRO REALTER AND THE PROPERTY OF T		III	230	200	730	328	100		0	142	3.78	32.5	78	0.74	2.4		(3. 50mm)	Persian report	-400 m		281
	15 TATIONA, HEHMAN 41		1.	30	.290	- 20	30	60	1	N	35	341	31,8	29	1.75	1.41		08, 30mm	patient sates	258.4		. 33
	HT HATTONIK HEOHINAN N		111 III	224	300	224	640	100		P	H.	3,48	39.7	-40		1.4		O. Nmit	party weather	300 =		12
	PERMITTENAN PERMIAN II SE NATIONAL PERMIAN II		III III	205	-100 D	200	110	100		N. C.	AC.	3,30	11.0	34		1.47			Preduce (apie) (Neckury report	100 m		200
	11 hattonia repentar 70		IN.	25	100	17	100	700		ż	2	3.16	21	41		190		Cl. 30mm	Holly Hole	28 1		20
	51 NATIONAL HEGHNAT		TI I	-41	100	-41	208	100		ũ.	Te	3.8		30		1.59			Predium repair	152.0		100
	46 hattoNik Hitziwas a		III	177	000	177	606	100		ii ·	àc.	3.10	100			16			Niedure recent	550 P		574
	A TANKED A AND TAKE OF		1	3E	300	31	SIL			E .	AC.	3.13		37		1.63		L. River	Parchast INDER	200 0		157
	the busiceness and the second state		111					100		1	1.0		the second		1 100	1.84			thank in correct	5/10.00		1.84

- 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.

2-45

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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i

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.

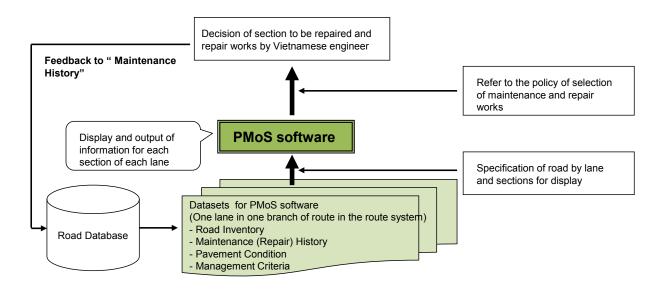


Figure 1.1.1 Image of Workflow of Road Pavement Maintenance Using PMoS

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.

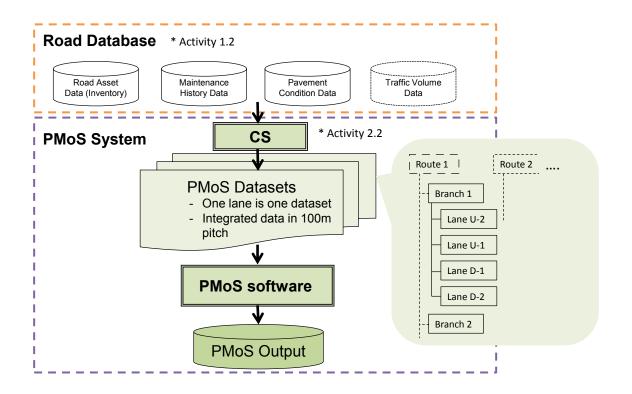
1.4 USERS

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.





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.

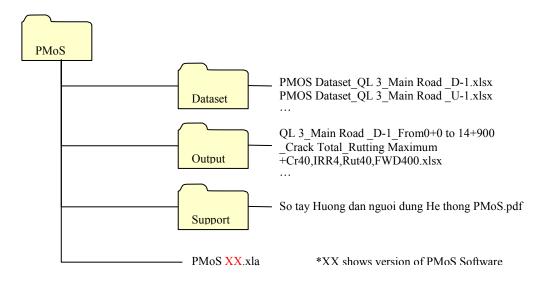


Figure 1.6.1 Folder Structure of PMoS

CHAPTER 2 INSTALLATION OF PMoS

2.1 INSTALLATION OF CS

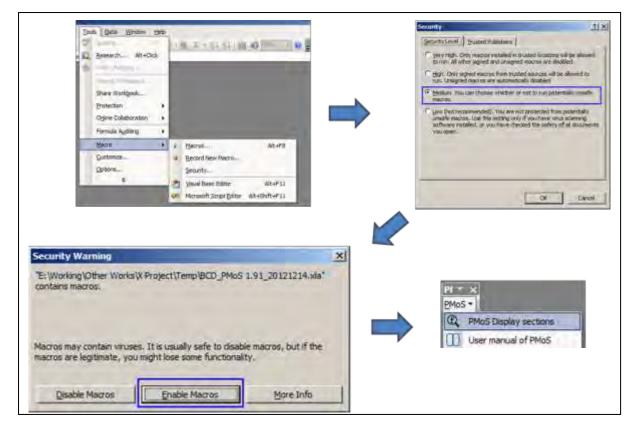
Instruction of installation process of CS is described in CS user's manual

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)

Image: Second
Print Name formation Print Implified primation Implified primation Impl
3 fines (provid) X - type more The second se

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.

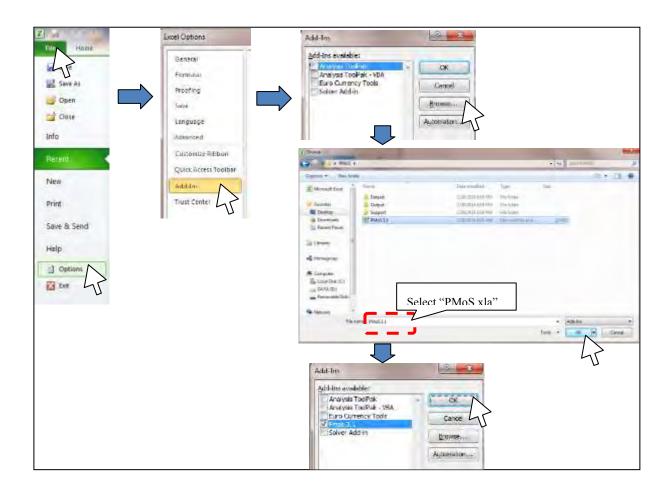


Figure 2.2.3 Installation of PMoS add-in (Office 2010)

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 D	ata							
								Loca	ation				
Boad ID	Road Nama	Route No	Route Branch	Direction	Lane	Date of	fro	om	t	0	Pavement	Structure	Crossing
Road ID	Road Name	Koule No	No.	Direction	Position	update	Km	m	Km	m	type	type	type
1	2	3	4	5	6	7	8	9	10	11	12	13	14

	Pavement Condition Data										
	Road condition										
•		Crack F	late (%)		Rut Dej	pth (mm)			FWD (<i>µ</i> m)		
Year/month of survey	Cracking	Patching	Pothole unrepaired	Total	Average	Maximum	IRI (mm)	Year/month of survey	D _{0max}	D _{150max}	
15	16	17	18	19	20	21	22	23	24	25	

				Maintenance	History Data					
lst(2	1st(2010)		2011)	3rd(2	2010)	4th(2	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	В	
3	Tunnel	Hầm	Т	
4	Shade Fence	Lưới chống đá lở	R	
5	Other structures	Kết cấu khác	0	

2) Crossing type

Crossing type is classified into five (5) categories.

	Crossing Types			
1	Intersection	Nút giao		
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	СС	
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

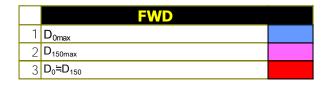
Maintenance history is classified into nine (9) categories. Past three (3) year maintenance records are shown in output file.

	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	



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

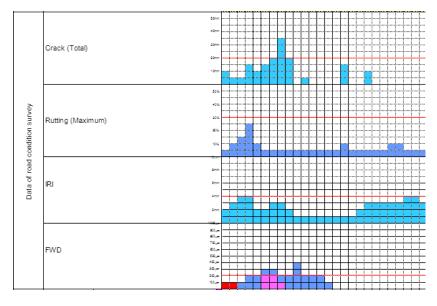


Figure 3.3.1 Road Condition Data in Output file (Image)

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 Nam e and Route No.	National Highway 3 3	Location (From - To)	кМ 0+0 · кМ 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.

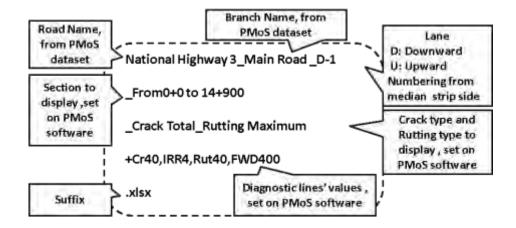
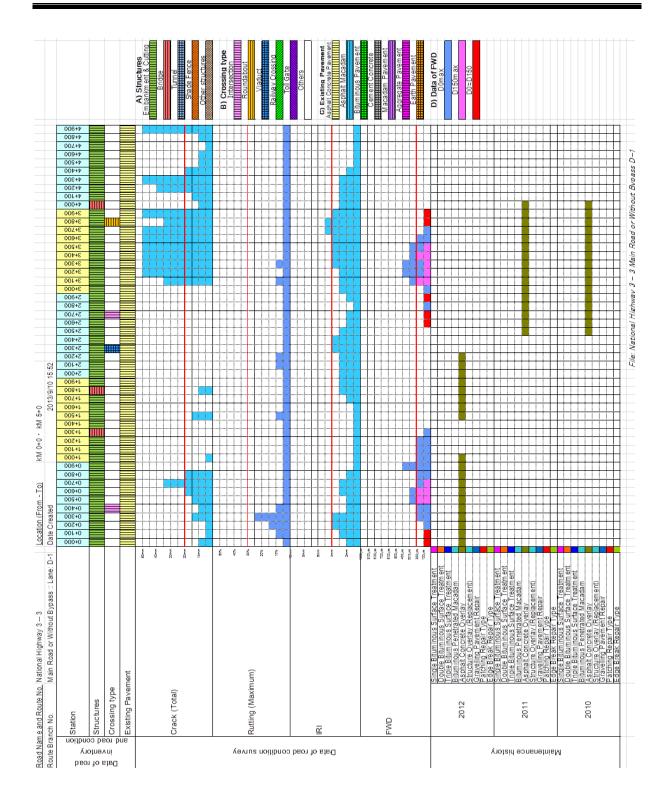


Figure 3.3.2 Naming Rule of PMoS Output File



Capacity Enhancement in Road Maintenance in Vietnam

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.

PMo	S -
Q	PMoS Display sections
	User manual of PMoS

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.

	-	PMo5 -	Pavement Monitoring System				
1)	Canguage						viét 💼
-	Data Select						,
2) ¦	Path of PMoS	Dataset	2-1)				
	Road Name	and Route No.	2-2)				
	Route Branch	h No				Lane	L
	Section (From	n - To)	2-3)		То		•
3) [Values of Dr	agnostic Lines					
	Crack	40	- %	IRI	4	2	mm/m
	Rutting	40	• mm	FWD	400	2	umim
4) [Type of Crac	k and Rutting			7		
	Crack	Total			-	ili Di	splay (
	Rutting	Maximum			•	X	lose

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.

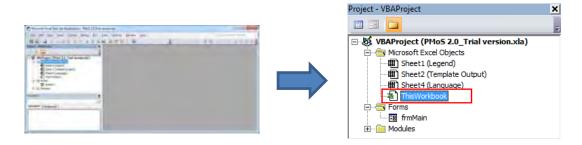


Figure 5.1.1 Flow of setting of the System Sheets

- 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:

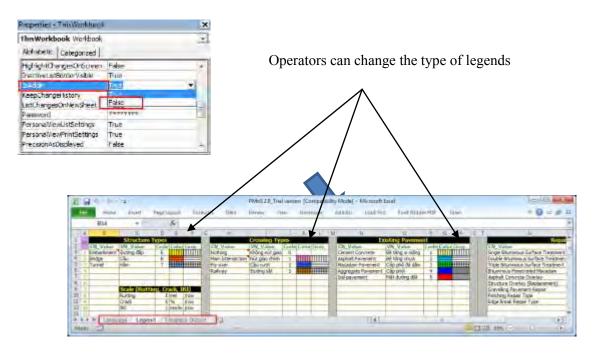


Figure 5.1.2 Flow of setting of the System Sheets

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
	fraLanguage	Language	Ngôn ngữ
	fraDataSelect	Data Select	Chọn dữ liệu
	labPath	Path of PMoS Database file	Đường dân 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)
E	labTo	То	Tới
JserForm	fraLine	Values of Diagnostic Lines	Vị trí của đường phân tích
Use	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	Ðóng

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) THE SOCIALIST REPUBLIC OF VIETNAM



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.

Road Structures	Names of Inspection	Frequencies	Implementation bodies	Inspection Points
A. Roads &	Routine Inspection	Once a day	Road Patrol, RRMCs	
Structures	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

Table 3.1Outline of Road Inspection

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

Table 3.2Traffic Counting

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

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.

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	

 Table 5.1
 Road Network in Japan

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

Breakdown of National roads: from Road Statistics 2008.

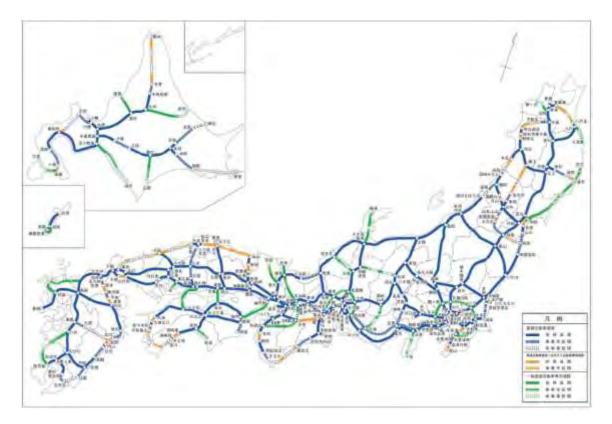


Figure 5.1 High Standard Road Network in Japan

(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.

Class	All Bridg	jes	Bridges over 15 m		Bridges over 100 m	
Class	Number	%	Number	%	Number	%
• Expressways	7,427	1	6,402	4	2,928	17
National Roads	19,995	3	10,794	7	3,191	18
(Designated)	19,995	5	10,794	/	5,171	10
 National Roads 	29.946	9,946 4	12,778	9	2,220	13
(Non-designated)	29,940		- 12,770			
• 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

 Table 5.2
 Bridge Infrastructure

(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.

Class	All Tunnels		Tunnels over 500 m		Tunnels over 1,000 m	
Class	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

 Table 5.3
 Road Tunnel Infrastructure

(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.

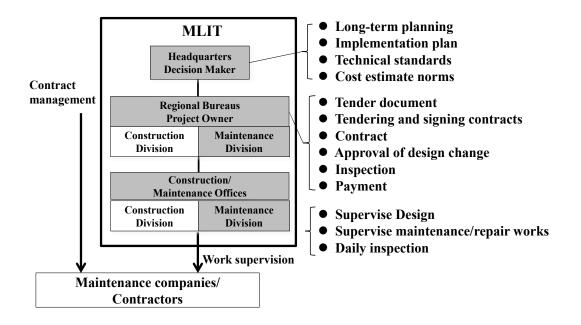


Figure 5.2 MLIT Organization Structure

(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.

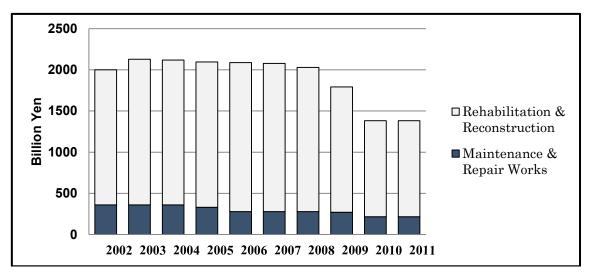


Figure 5.3 Road maintenance and repair budget for MLIT national roads

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.

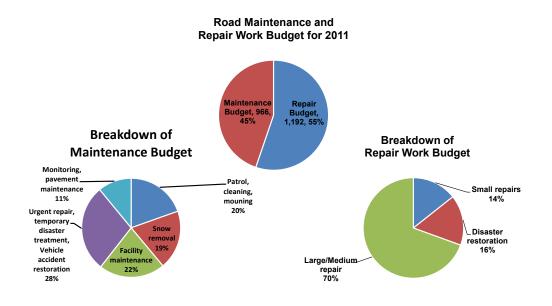


Figure 5.4 Maintenance and Repair Budgets for MLIT National Roads

(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.

Material No. Defects & Deterioretion		Matarial	Na	Defects & Deteriorection	
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	Common	D1	Abnormality at Anchorage zone
		anti-corrosion			
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
	В5	Damages to		D6	Deformation, loss of members
	D 5	reinforcement		Du	Deformation, 1055 of memoers
	B6	Floor Deck Cracks		D7	Clogging
	B7	Creep, Voids		D8	Settlement, movement
Others	C1	Unusual expansion gaps		D9	Scouring

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

(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.

		D /		3.6 3		/• \
Table 5.5	Typical Defects and	Deterioration	by Facility	Members	(Bridge Ins	pection)
			~ _ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~		(p

Facilities	Members	Points to be inspected				
racinties	wiembers	Steel	Concrete	Others		
Pavement	Road surface			Roughness, Cracking, Rutting, Structural capacity		
	Superstructure	A1-A5, C1, D1, D4-D6	B1-B7, C1, D1-D6			
Bridges	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.

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

 Table 5.6
 Expressway Facility Inspection Manual

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.
- \checkmark 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.
- \checkmark 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.
- \checkmark 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

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

Table 8.1Inspection Methods by Type

(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

Inspections & Surveys	Frequencies
1. Initial Inspection	• <u>Within 2 years</u> or <u>within the warranty periods</u> specified in the construction contract dossiers <u>after the opening of facilities to the public</u>
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; <u>Pavement condition survey; Once every 3 years</u> <u>Bridges/Tunnels; Once every 5 years</u> <u>Road safety facilities and road management facilities: Once every 10 years</u> (Note) <u>However, if the facilities are once rated as "C"</u> in the diagnosis of the periodic inspection, <u>the next inspection should be carried out no later than two years</u> after the previous inspection. <u>Also, if the facilities are once rated as "D" or "E"</u> in the diagnosis of the periodic inspection, <u>the inspection should be carried out no later than one year</u> after the previous inspection. <u>Also, if the facilities are once rated as "D" or "E"</u> in the diagnosis of the periodic inspection, <u>the inspection should be carried out no later than one year</u> after the previous inspection. However, <u>upon completion of repair works</u>, 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

Table 9.1Inspection Frequencies

CHAPTER 10 DIAGNOSIS OF INSPECTION RESULTS

(1) Diagnosis Criteria

Rating	Diagnosis Criteria	Degree of Damages	Impact on functions	Impact on environmen t	Need of repair works (Urgency)	Measures
А	 No damage or minor damages are identified. 	Small	Small		Low	 No repair works
В	 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)
С	 Medium to large damages are identified Progress of damages is anticipated within coming 5 years. Repair works are needed within 5 years. 	Medium-larg e	Medium-larg e		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
Е	Large impacts on environment or road users are anticipated.			Large	High	• Urgent repair works

Table 10.1 Diagnosis Criteria

(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 $MCI \le 5.0$.
- (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.</p>
- (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.

	Dutting Durth		Light defects			Medium defects				Heavy defects					
Rutting Depth				Rutting De	pth < 25 mm			25 mm <= Rutting Depth < 40 mm				40 mm <= Rutting Depth			
Tra	affic 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	
CR < 5 % Light		CR < 5 %	No repair			No repair Cut and OL 3			Cut and OL 50 mm	OL 30 mm	OL 30 mm	OL 50 mm	Cut and OL 50 mm		
(CR)	defects	5 % <= CR < 15 %	No r	epair	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	
ack rate (C	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	
5 5	Heavy			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			
	defects	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															

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

		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
	Surface						
Repair work design	Binder						
	Base & subbase			Pavement deterioration up to the bottom level of rutting depth is to be removed and overlay is then implemented.		**************************************	~
	Subgrade						
Classification		Routine mainte.	Medium repair	Medium repair	Big repair	Big repair	Big repair
ChabShifeation		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.

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

 Table 12.1
 Survey Staff Arrangement for Road Pavement Inspection

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.

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

 Table 12.2
 Staff Assignment for Bridge Inspection

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.

 \checkmark 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.

Structure	Member	Damages	Initial inspection	Routine inspection	Periodic inspection	Unschedul ed inspection	Survey & Design
Road Pavement	Asphalt pavement	a. Pot holes/ Peeling/ depressions		Х		Х	As requested
	/Concrete pavement	b. Gaps in surface level		Х		Х	
		c. Rutting	XX	Х	XX	Х	As requested
		d. Cracks	XX	Х	XX	Х	

Structure	Member	Damages	Initial inspection	Routine inspection	Periodic inspection	Unschedul ed inspection	Survey & Design
	e. Longitudinal roughness (IRI)/ corrugation		XX	Х	XX	Х	
		f. Thin layer pavement peeling		Х		Х	
		g. Water puddles		Х		Х	
		h. Pumping		Х		Х	
		i. Blistering (*) In case of asphalt pavement.		Х		Х	
		j. Damage to joint seals		Х		Х	
		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

~				Evaluation of Damage Criteria				
Structure	Member	So	ort of damage	D	C	В		
Road 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.			
	Asphalt	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.			
	pavement/	iii)	Rutting	There is rutting over 25 mm in depth.	There is rutting from 15mm to 25mm in depth.			
	Concrete pavement	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			

 Table 14.2
 Evaluation of Damage Criteria

Structure	Member	Sort of damage	Evaluation of Damage Criteria		
			D	С	В
			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 i (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.

Structure s	Membe rs	Damages	Initial inspection	Routine inspection	Periodic inspection	Unschedule d inspection	Survey & Design
Steel Bridge Superstruc ture	Steel girder/ Steel	a. Abnormal deflection	Х		Х	Х	As requested
	floor deck/	b. Abnormal sound	Х	Х	Х	Х	
	Steel	c. Abnormal vibration	Х	Х	Х	Х	
	piers (pylons)	d. Abnormal expansion gaps	Х		Х	Х	
		e. Movement	Х		Х	Х	
		f. Water leakage, puddles	Х		Х	Х	
		g. Bridge under clearance	Х		Х	Х	
		a. Fatigue cracks	Х		Х	Х	
		b. Deformation/ buckling	Х		Х	Х	
		c. Looseness and falling of rivets and HTBs	Х		Х	Х	
		d. Deterioration of paint	Х		Х		
		e. Corrosion	Х		Х		

 Table [15.1
 Inspection Methods

(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 15.2Inspection Devices

Damages		Common Devices	Special Devices		
a. h	Abnormal deflection Abnormal noise	• Levelling for camber	 Vibration measurement Noise measurement 		
b. с.	Abnormal vibration	measurement	• Noise measurement		

d.	Deterioration of paint	• Video, Photos	Measurement of impedanceMeasurement 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.

	Damages	Focus Points of Inspection
a. b. c.	Abnormal deflection Abnormal noise 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)

Table 15.3Focus points of inspection

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.

Structures	Momhoug	Damagag	Diagnosis	Diagnosis Criteria (Refer to Table 7.1.11)				
Structures	Members	Damages	D	С	В			
Steel Bridge	Steel girder/	f. Abnorm	Less than L/500	Sagging can be				
Superstructu		al	where the bridge	clearly identified by				

 Table 15.4
 Diagnosis of the Inspection Results

Structures	Members	Damagas	Damages Diagnosis Criteria (Refer to Table 7.1.11)						
Structures		Damages	D C B						
re	Steel deck	Deflectio	length is over 40	visual inspection					
	plates/	n	meters (*1)						
		g. Abnorm		Abnormal sound					
	Steel piers	al Sound		arises when vehicles					
	(pylons)			pass by.					
		h. Abnorm		Abnormal vibration					
		al		is identified by					
		vibration		physical inspection					
				or body feeling.					
		i. Abnorm	End girder	 Expansion gap is 	Expansion gap is				
		al	support length is	seen closed or	moving wider or				
		expansio	not long enough.	open wide.	narrower than				
		n gaps	 Parapet & girder 	 Parapet & girder 	design				
			contacted each	contacted each	specifications.				
			other and are	other.					
			broken						
		j. Moveme	Superstructure or	Superstructure or					
		nt	substructure move	substructure moves					
			significantly.	slightly.					
		k. Leaking		Water leakage or	Water leakage or				
		stagnant		puddle is seen	puddles is				
		water		anytime regardless	sometimes seen on				
				of weather	rainy days.				
				conditions,					
		1. Clearanc		Insufficient under					
		e under		clearance is					
		bridge		observed.					
		m.Fatigue							
		cracks		Refer to Table 15.5					
		n. Deforma	Significant	Slight deformation					
		tion/	deformation or	or buckling arises					
		buckling	buckling arises and	C					
			provides significant						
			negative impacts on						
			force-bearing						
			capacity of						
			structure.						
		o. Loosene		• More than 2	There is a missing				
		ss or		rivets or bolts are	bolt observed on				
		falling of		missing on one	one connection				
		rivets		connection plate	plate.				
		and		prate	r				
		HTBs.							
		p. Deterior		Cracks, peeling,	Cracks, peeling,				
		ation of		swelling or rust are	swollen or rust are				
		paint		found over a wide	found in limited				
		Paint		area	area.				
		q. Corrosio	Corrosion on the	Reduction in steel	The potential of				
		n	main members	plate thickness is	corrosion advancing				
			progresses	found due to	to the point of				
			significantly and	corrosion	reduction in steel				
			gives significant	011051011	plate thickness is				
			negative impacts on		observed.				
			the force- bearing		observeu.				
			capacity of the						
	1		structure.		1				

(Note) (*1): Specification for Highway Bridge in Japan, MLIT

			Diagnosis Criteria of Fatigue Cracks Diagnosis Criteria (Refer to Table 7.1.11)					
Structures	Members	Damages	D C B					
Steel bridge	• Welding	Fatigue	Cracks reached web	Cracks appear				
	portions on	crack	plates					
	sole plates							
	• Girder end		Cracks reached web	Cracks appear				
	where cross		plates					
	section of							
	web plate							
	changes							
	• Welding			Cracks appear				
	portions							
	with vertical							
	stiffeners		<u>O1</u>	Definition of a second second				
	Welding portions		Cracks progress onto web plates	Paint cracks appear				
	with gusset		onto web plates					
	plates							
	Butt welding		Cracks appear	Paint cracks appear				
	portions on							
	lower							
	flanges		~	~ .				
	• Welding		Cracks extend over	Cracks appear				
	portions with steel		two thirds of welding length					
	deck plates		weiding length					
	Welding		Cracks appear on	Cracks appear				
	portions		steel deck plates	11				
	between		_					
	vertical							
	stiffeners							
	and steel							
	deck plates End of 		Cracks progress on	Cracks appear				
	stringers		the stringer web	Cracks appear				
	where cross		extending in the					
	section of		direction that could					
	the girder		break the stringer					
	changes							
	• Base of		Cracks extend to	There is potential of				
	vertical		arch chord or to the	breaking vertical				
	members on		stiffeners of the	members				
	the arch ribs		girder					
	• Welding			Cracks appear				
	portions on							
	shoe base							
	plates							
	Corners of		Cracks appear and	Cracks appear				
	steel piers		may progress	Creative environment				
	• Others		Other locations where large cracks	Cracks appear				
			are found					
	1	1						

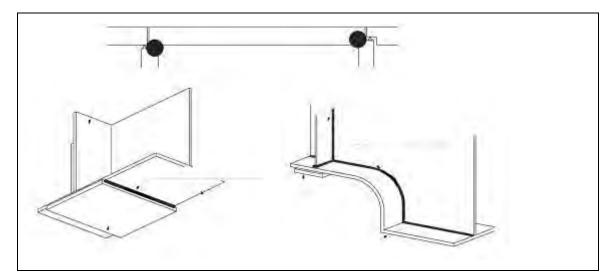


Figure 15.1 Cracks Appearing at Welded Portions of Sole Plates and at Changes in Cross-sections

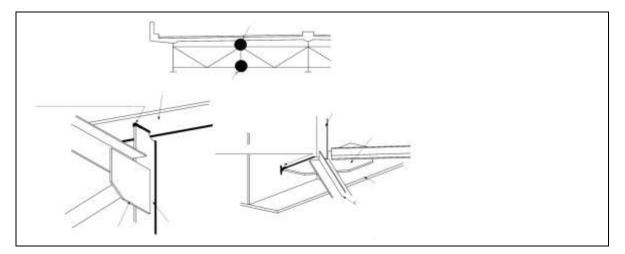


Figure 15.2 Cracks Appearing at the Welded Portions with Stiffeners and gussets

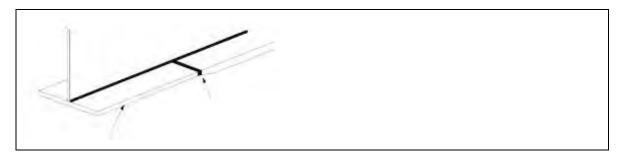


Figure 15.3 Cracks Appearing at Butt Welded Portions on Lower Flanges

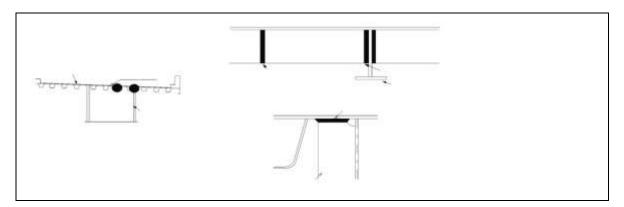


Figure 15.4 Cracks Appearing at Welded Portions with Steel Deck Plates

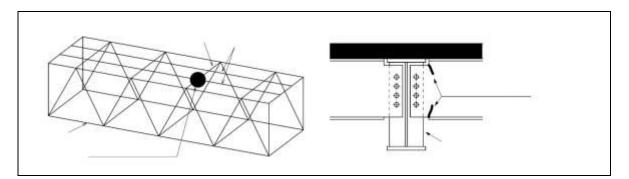


Figure 15.5 Cracks Appearing at the End of Stringers

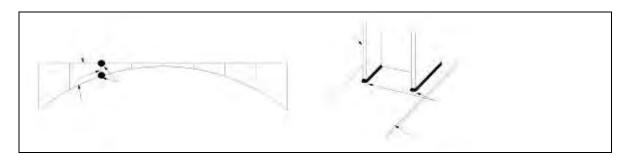


Figure 15.6 Cracks Appearing at the Base of Vertical Members on the Arch Ribs

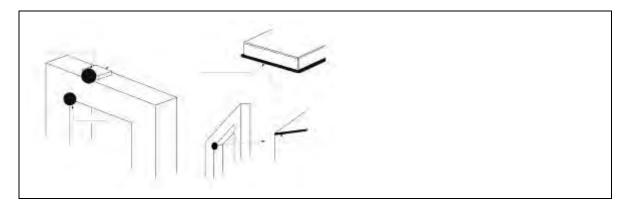


Figure 15.7 Cracks Appearing on Rigid-frame Piers

(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.

	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)	Х	Х	Х	х	х	Х	Х	Х	Х	Х	Х	Х	Х		
Pre-stressed Concrete (PC Bridges) / Pre-stressed Reinforced Concrete Bridges (PRC Bridges)	X	x	Х	X	x	X	x	X	X	Х	X	X	X	х	
Hybrid structure Bridges (Steel plus Concrete)	Х	Х	Х	Х	Х	Х	Х		Х	Х	Х	Х	Х	Х	Х

 Table 15.6
 Defects and Deterioration by Bridge Types

(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 13	A				-
Structure s	Members		Damages	Initial inspection	Routine inspection	Periodic inspection	Unschedule d inspection	Survey & Design
Concrete Bridge	Reinforced concrete	a.	Abnormal deflection	Х		Х	Х	
Superstruc ture	Pre-stressed concrete	b.	Abnormal sound	Х	Х	Х	Х	As requested
	Composite	c.	Abnormal vibration	Х	Х	Х	Х	
		d.	Abnormal expansion gaps	Х		X	Х	
		e.	Movement	Х		Х	Х	
		f.	Water leakage and puddles	Х	Х	X	Х	
		g.	Under clearance of bridge	Х		Х	Х	
		h.	Cracks	Х		Х	Х	
		i.	Concrete peeling	Х	Х	Х		
		j.	Exposure of steel bars and corrosion	Х	Х	Х	Х	
		k.	Voids	Х		Х		
		1.	Honey-comb	Х		Х		
		m.	Free lime	Х		Х		
		n.	Color change and deterioration	Х		Х		
		0.	Rusty fluid	Х	Х	Х		
		p.	Steel material rupture and projection	Х	Х	X	Х	

- (b) Inspection devices
- 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.
- 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.

	Criteria of Diagnosis (Refer to Table7.1-11)					
Inspection Devices	D C		В			
Measurement of neutralization		Neutralization	Neutralization			
with phenolphthalein liquid		progresses and	progresses, but does			
		reaches steel bars	not reach steel bars			
Measurement of the depth of						
steel bar coverage by						
non-destructive instrument						
Measurement of compression		Compression strength	Compression strength			
strength with Schmidt hammer		is far below its design	is a little lower than			
		value.	its design value.			

Table 15.8Inspection Devices

- 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.

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			

Table [15.9	Focus Points of Inspection	ı
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(b) Crack Patters

Table 15.10Crack 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
h	Creat nottorn noor	-	ear 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.
	0 1 44 4))))	ttern 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
))))	ern 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
e.	Crack pattern near construction joints	Figure 15.12 Crack Pattern Cracks running vertically or horizontally along construction joints Cracks near construction joints on the	at a Quarter Point of the Span Improper concrete adhesive power at cold joints. Improper treatment of construction 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
		LUUUUUUU_	

	Crack Pattern	Outline	Main causes of Cracks
		Figure 15.13 Crack Patt	ern near Construction Joints
f.	Crack pattern near segment joints	Cracks near segment joints	Lack of PC material tensile force
		Figure 15.14 Crack P	attern 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
l		Cracks on a anchoring concrete at joint portion of cross beams	Improper design of concrete, improper construction of anchoring concretes.
		Figure 15.15 Cra	acks 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 n	ear 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.

Stanotunos	Mamhana	Damagag	Diagnosis Criteria (Refer to Table 7.1-11)				
Structures	Members	Damages	D	С	В		
concrete bridge Superstructure	Reinforced Concrete	a. Abnormal deflection	Abnormal deflection is observed.	Deflection is observed by visual inspection.			

 Table [15.11
 Diagnosis Criteria of Concrete Superstructures

Structuros	Mombors	Domogos	Diagnosis Criteria (Refer to Table 7.1-11)				
Structures	Members	8	D C B				
	Pre-stressed	1 41 1		Abnormal sound			
	Concrete	b. Abnormal sound		occurs when vehicles			
	Composite	sound		pass by.			
	composite	c. Abnormal		Abnormal sensible			
		vibration		vibration is detected.			
		d. Abnormal		Expansion joint gap is	Expansion joint gap		
		expansion		too narrow or too	is beyond the range		
		gaps	C	wide.	of design values.		
		e. Movemen	Superstructure or substructure moved	Superstructure or substructure moved a			
		t	extraordinary.	little.			
		f. Water		There is observed	There is observed		
		leakage		water leakage or	water leakage or		
		and		puddles regardless of	puddles in rainy days.		
		puddles		weather.			
		g. Under		Insufficient under			
		clearance of bridge		clearance is detected.			
		h. Cracks		Refer to			
		i. Concrete		Wide concrete peeling	Partial peeling is		
		peeling		is detected or peeling	detected.		
				spreads.			
		j. Exposure		Steel bar exposure is	Steel bar exposure is		
		of steel		detected and rusting	detected partially.		
		bars and corrosion		of bars progresses.			
		k. Voids		Many large voids are	Voids are detected,		
		R. VOId5		detected.	but not many.		
		1. Honey-co		Many large	Honey-combs are		
		mb		honey-combs are	detected, but not		
		_		detected	many.		
		m. Free		Serious free lime is	Free lime is detected,		
		lime		detected which seemingly corroded	but no serious.		
				steel members.			
		n. Colour		Concrete changes its	Partial change in		
		change		colour on the surface	colour is observed.		
		and		near cracks.			
		colour					
		deteriorati					
		on o. Rusty		Serious rusty fluid is	Some rusty fluid is		
		fluid		detected, in particular,	detected.		
		inuna		from anchors of steel	deteeted.		
				members or PC			
				cables.			
		p. Steel	PC cables broke and	Cracks and rusty fluid			
		material	anchors projected	are observed at			
		ruptures and	out of structures. Also, rusty fluid	anchor portions,			
		projects	is observed at				
		projects	anchors with high				
			potential of				
			anchor projection.				

Table 15.12 Diagnosis Criteria of Concrete Cracks

Mombong	Locations	Damagas	Diagnosis criteria (Refer to Table7.1-11)			
Members	Locations	Damages	D	С	В	
Reinforced	Near end		Large vertical or	Large cracks	Small cracks	
Concrete	girder		diagonal cracks are	extending vertically	extending vertically	
	support	Cracks	observed near	or diagonally near	or diagonally near	
Pre-stressed			bearings with free	bearings.	bearings	
Concrete			lime or rusty fluid.			

Marchan	Turnet	D	Diagnosis criteria (Refer to Table7.1-11)				
Members	Locations	Damages	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.

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.	NH C
Cracks penetrate the concrete decks to the surface due to traffic load.	NH I
Cracks further break down due to interaction between particles, gradually losing shear resistance force.	T
Due to traffic load which exceeds punching sheer force of deck concrete, spalling of concrete material occurs.	

 Table 15.13
 Damage Progress Mechanism

(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.

Structures	Members	Damages	Initial inspectio n	Routine inspection	Periodic inspection	Unschedule d inspection	Survey & Design
Concrete Slab Deck	Concrete slab deck	a. Cracks	Х		Х	Х	
		b. Peeling	Х	Х	Х		As
		c. Steel bar exposure and corrosion	Х	X	Х	Х	requested
		d. Voids	Х		Х		
		e. Honey comb	Х		Х		
		f. Free lime	Х		Х		
		g. Rusty fluid	Х	Х	Х		
		h. Color change and deterioration	Х		Х		
		i. Peeling at repaired portion	х	X	Х		
		j. water leakage	Х	Х	Х	Х	
	Cantilever	k. drainer	Х	Х	Х		

Structures	Members	Damages	Initial inspectio n	Routine inspection	Periodic inspection	Unschedule d inspection	Survey & Design
	concrete slab						
Precast Concrete Slab Deck	Concrete deck joints	 water leakage, free lime, rusty fluid 	Х	Х	Х	Х	
	under the surface	m. water leakage, free lime, rusty fluid	Х	Х	Х	Х	

4) Inspection points

Table [15.15 shows inspection points, inspection items and inspection methods for concrete slab deck inspection.

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	Short-distance visual inspection standing on the scaffolding and hammering
		concrete spalling, range of steel bar exposure, range of voids.	nammering
	Canti-lever	Crack directions, spacing of cracks,	Short-distance visual inspection
	sections	free lime, traces of rusting, concrete	standing on the scaffolding and
		peeling, range of concrete spalling,	hammering
		range of steel bar exposure, range of	
		voids.	
	Upper steel flange	Free lime, traces of rusting, range of	Short-distance visual inspection
	sections	voids, range of concrete peeling and	standing on the scaffolding, abutment
		creep.	and piers.
Upper surface of	Road surface	Scale of pavement, potholes and	Short-distance visual inspection on
concrete decks		repair works in the past, direction of	the bridge pavements.
		cracks, spacing of cracks.	

 Table 15.15
 Inspection points

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

St	Marilan	D	Diagno	osis criteria (Refer to T	able 7.1-11)
Structures	Members	Damages	D	С	В
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	 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

Marshaw	Landiana	Demessio	Diagnosis criteria (Refer to Table 7.1-11)				
Members	Locations	Damages	D	C	В		
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		
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.		
	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.		
	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 traces of free lime are observed near the segment joints.				

Members	Locations	Damagas	Diagnosi	iagnosis criteria (Refer to Table 7.1-11)		
wieniber s	Locations	Damages	D	С	В	
	Near		Cracks are observed		Crocodile cracks are	
	anchors		near the anchorage		observed near the	
			in shear direction		anchorage.	
	Notch of the		Diagonal cracks are			
	girder		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.

Structures	Members		Damages	Initial inspection	Routine inspection	Periodic inspection	Unschedul ed inspection	Survey & Design
Bridge Substructur e	Abutment Pier	a.	Cracks	Х		Х	Х	As
		b.	Peeling and creep	Х	Х	Х	Х	requested
		c.	Steel bar exposure & corrosion	Х	Х	Х	Х	
		d.	Voids	Х		Х		
		e.	Honey combs	Х		Х		
		f.	Free lime	Х		Х		
		g.	Rusty fluid	Х	Х	Х		
		h.	Peeling at repaired portion	Х	Х	Х	Х	
Bridge foundation	Foundation	i.	Scouring/ river bed settlement	Х		Х	Х	
Associated facilities	Associated facilities	j.	Settlement/ movement/ washed out	Х		Х	Х	
Others	Reinforced portions	k.	Reinforcem ent does not function well.	Х		Х		

Table 15.18Inspection Methods

- (b) Inspection Devices
- 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 15.17 Inspection	JII Devices	
Inspection Devices		Diagnosis (Sample)	
Inspection Devices			
Measurement of		Neutralization	Neutralization
neutralization with		progresses and	progresses, but does
phenolphthalein liquid		reaches steel bars	not reach steel bars
Measurement of the			
depth of steel bar			
coverage by			
non-destructive			
instrument			
Measurement of		Compression	Compression
compression strength		strength is far below	strength is a little
with Schmidt hammer		its design value.	below its design
			value.

 Table [15.19
 Inspection Devices

- 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.

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. 	

Table 15.20Focus Points of Inspection

4) Diagnosis of Inspection Results

Table [15.21 shows diagnosis criteria for the inspection of bridge substructures and foundations.

Structures	Membe	Damages	Diagnosis criteria (Refer to Table 7.1-11)						
Structures	rs	Damages	D	с	В				
Substructure	Abutme	a. Cracks	Large crack at	Small cracks at	crack at long				
	nt		support end or	small intervals	intervals do not				
	Pier		cantilevered base	reached to rebar	reached to rebar				
				depth	depth				
		b. Peeling and		Peeled or large	Small creeping				
		creep		creeping					
		c. Steel bar		Sever exposure	Partial exposure				
		exposure &		and corroded	_				

 Table 15.21
 Diagnosis of Inspection Results

Structures	Membe	Damagag	Diagnosis	criteria (Refer to Ta	able 7.1-11)
Structures	rs	Damages	D	c	В
		corrosion			
		d. Voids		Large cavity	Cavities exist
		e. Honey combs		Large honey	Honey combs
				combs	exists
		f. Free lime			
		g. Rusty fluid		Extensive rusty	Leaks water and
				fluid	rusty fluid exists
		h. Peeling at		Peeling or	
		repaired		creeping at	
		portion		repaired portion	
Bridge	Foundat	i. Scouring/ river	Footing or caisson	Footing or caisson	
foundation	ion	bed settlement	or abutment base	or abutment base	
			is scoured deeper	is scoured to	
			than design	exposure	
Associated	Associat	j. Settlement/		Severe damage by	partially damaged
facilities	ed	movement/was		settlement,	by settlement,
	facilities	hed out		movement or	movement or wash
				wash out	out
Others	Reinforc	k. Reinforcement		RC or steel sheet	
	ed	does not		is not connected	
	portions	function well.			

(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.

Structures	Members	Damages	Initial inspection	Routine inspection	Periodic inspection	Survey & Design
Steel Bearing	Body	a. Damages			Х	As
Shoes		b. Corrosion			Х	requested
	accessory	a. Damages			Х	
		b. Corrosion			Х	
	Shoe base concrete	a. Damages			Х	
	Others	a. Abnormal gap margin			Х	
		b. Abnormal sound			Х	
		c. debris or soil piling			Х	
Rubber	Body	a. Damages			Х	
Bearing		b. Corrosion			Х	
Shoes	accessory	a. Damages			Х	
		b. Corrosion			Х	
	Shoe base concrete	a. Damages			Х	
	Others	a. Abnormal gap margin			Х	
		b. Debris or soil piling			Х	

Table 15.22Inspection Methods

3) Inspection points

Table [15.23 shows the focus points of bearing inspection with illustrations.

Table 15.23 Focus Points of Inspection on Bridge Bearin	gs
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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.

Structures	Members	Damages	Judge (Refer to Table 7.1-11)				
Structures	wienders	Damages	D	С	В		
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. Corrosio n	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.		
	Accessori es	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. Corrosio n		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.			

 Table 15.24
 Diagnosis of Inspection Results

Starrate and	Manukana	Democra	Judge (Refer to Table 7.1-11)				
Structures	Members	Damages	D C B				
	Others	f. Abnorma l 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. Abnorma l sound e. debris or soil piling		Loud crashing sound is generated. Shoe is filled with soil or debris	Shoe generated sound. 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.		
	Accessori es	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. Abnorma l 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.

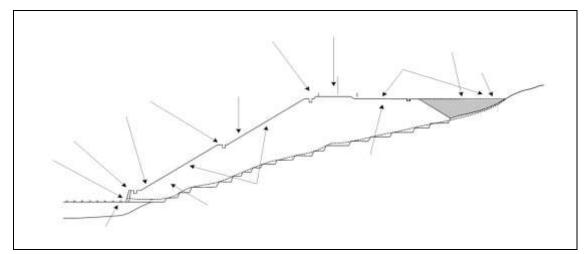
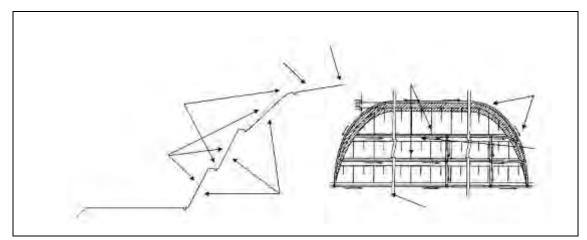


Figure 16.1 Focus Points of Inspection on Embankment Slopes

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	ection Methods for General S	Slopes
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Structures	Membe rs	Damages	Initial inspection	Daily inspection	Periodic inspection	Unschedul ed inspection	Survey & Design
Cut slopes	General	a. Collapse	Х		Х	Х	A a required
Embankmen	slopes	b. Cracks /	Х		Х	Х	As required

Structures	Membe rs	Damages	Initial inspection	Daily inspection	Periodic inspection	Unschedul ed inspection	Survey & Design
ts		swelling /settlement					
		c. surface erosion	Х		Х	Х	
		d. dumping of soil on slope step	Х		Х	Х	
		e. spring water	Х		Х	Х	
		f. tree fall	Х		Х	Х	
		g. plant death	Х		Х	Х	
		h unstable rock rolling stone	Х		Х	Х	
		h. Glowing of hydrophilic plants and weakening of slope	х		х	х	

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.

Structures	Membe rs	Damages	Initial inspection	Daily inspection	Periodic inspection	Unschedul ed inspection	Survey & design
Structurally	Concret	a. cracks/ peeling	Х		Х	Х	
Protected slopes	e block frame in situ	b. loosening /swelling /settlement	Х		Х	Х	As required
	/concret e frame	c. spring water/ drain water	Х		Х	Х	
	Mortar	a. cracks/ peeling	Х		Х	Х	
	spray Concret e spray	b. loosen / Swelling /settlement	Х		х	Х	
		c. Voids	Х		X	Х	
		d. spring water/ drain water	Х		Х	Х	
Masonries	Concret e Block Masonri es	a. Cracks/ swelling/ loosening	Х		X	Х	
		b. Settlement/ movement/ leaning	Х		х	Х	
		c. Abnormal joints	Х		X	Х	
		d. Scouring	Х		X	Х	
		e. Poor drainage or spring water	Х		Х	Х	
	Slope gabion works	a. Steel wire rupture or corrosion	Х		Х	Х	
		b. Deformation	Х		Х	Х	

 Table 16.2
 Inspection Methods for Structurally Protected Slopes

3) Retaining walls

Table [16.3 shows the inspection methods for the concrete retaining walls.

Structures	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unschedul ed inspection	Survey & design	
Concrete retailing walls	Reinforce d concrete retailing	a. Cracks and corner drop	Х		Х	Х	As required	
walls	b. Peeling	Х		Х	Х			
		c. Steel bar exposure	Х		Х	Х		
		d. Settlement or movement	Х		Х	Х		
		e. Abnormal joint gap	Х		Х	Х		
		f. Scouring	Х		Х	Х		
		g. Poor drainage or spring water	Х		Х	Х		

 Table 16.3
 Inspection Methods for Retaining Walls

4) Drainage systems on the slopes

Table [16.4 shows the inspection methods for the drainage systems on the slopes.

Structure s	Members	Damages	Initial inspection	Daily inspection	Periodic inspection	Unschedul ed inspection	Survey & design
Drainage	Slope	a. Damages	Х		Х	Х	
	shoulder drainage/	b. Improper connection	Х		Х	Х	As required
	berm drainage/	c. Debris/ soil accumulation	Х		Х	Х	
	Vertical drainage	d. Water flow hindered by grass	Х		Х	Х	

 Table 16.4
 Inspection Methods for Drainage System on the Slopes

(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.

Structu	memb	Sort of	Diagnosis criteria (Refer to Table 7.1-11)			
res	er	damage	D	С	В	
General		a. Collapse	Slope failure is detected	Small slope failure is		
slopes		_	with high potential for	detected which has less		
			expansion	potential for expansion		
		b. Cracks /	Cracks, swelling or	Cracks, swelling or		
		swelling	settlement is observed	settlement is observed		
		/settlement	which may lead to slope	which may not lead to		
			failure	slope failure		

 Table 16.5
 Diagnosis Criteria for General Slope Inspection

r				1
	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.

		5		V I	*	
nosition	membe	Sort of	Diagnosis criteria (Refer to Table 7.1-11)			
position	r	damage	D	С	В	
Structura l slope protectio n	Concret e block frame in situ /concre	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.	
	te frame	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	

 Table 16.6
 Diagnosis Criteria for Structurally Protected Slope Inspection

	membe	Sort of	Diagnosis criteria (Refer to Table 7.1-11)		
position	r	damage	D	С	В
	spray/ Concret e 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.

Positio	Mem	Sout of damage	Diagnosis criteria (Refer to Table 7.1-11)		
n ber	Sort of damage	D	С	В	
Concret e retailing wall	RC Retai ning 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

Table 16.7Diagnosis Criteria for Retaining Wall Inspection

Positio	Mem	Sort of damage	Diagnosi	7.1-11)	
n	ber	Sort of damage	D	С	В
			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.

Position	Member	Sout of domago	Diagnosi	is criteria (Refer to Tabl	e 7.1-11)
Position	Member	Sort of damage	D	С	В
Slope drainage systems	 Slope shoulder drainage/ Slope step drainage Vertical drainage 	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.	
	• Catch basins	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.

 Table 16.8
 Diagnosis Criteria for Drainage System Inspection

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.

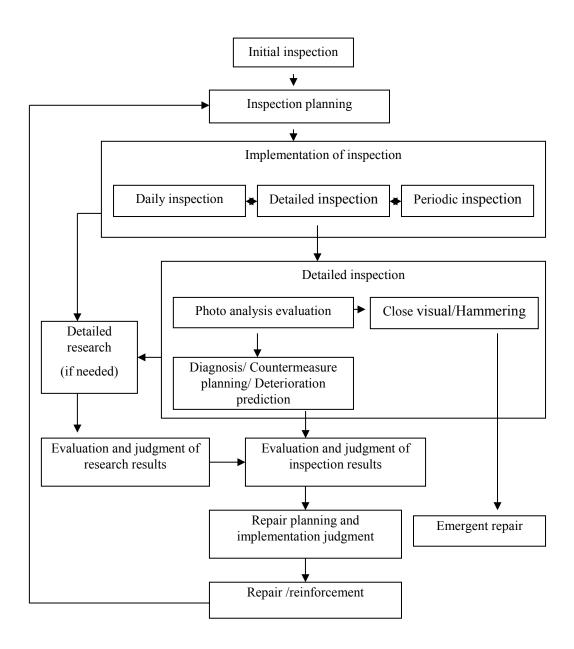


Figure 17.1 Tunnel Inspection Flow

(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

- \checkmark 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.
- \checkmark 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

 \checkmark 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.

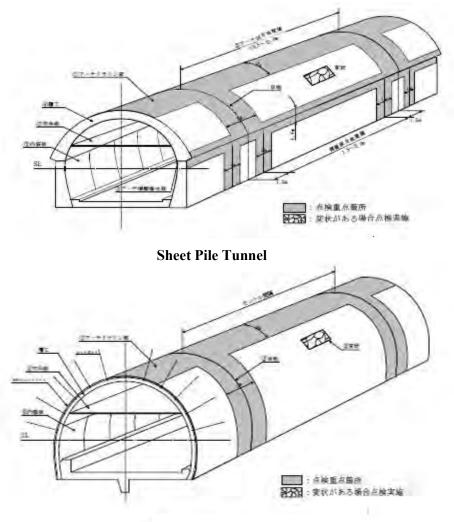
✓ It is necessary to check the concrete inner lining and partial stress when deformation or breaks in the gutter are found.

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



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 (Figure 7.1-25)
 - ✓ 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.

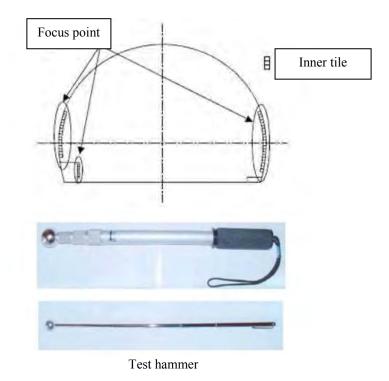


Figure 17.3 Focus Points and Test Hammer

Structure	Position	Member	Sort of damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
Tunnel	Concrete lining		d. Cracks/ corner drop	X	X		Х
			e. Peel	Х	Х		X
			f. Joint gap	Х	Х		X
			g. Leakage/ free lime	Х	Х		X
			h. Deterioration material	X	Х		X

Structure	Position	Member	Sort of Damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
Tunnel	Portal /entranc		a. Cracks/ corner drop	Х	Х		Х
	e		b. Peeling	Х	Х		X
			c. Rebar exposure	Х	Х		Х
			d. Settlement/ movement / tilt	Х	Х		Х

Structure	Position	Member	Sort of Damage	Initial Inspection	Daily Inspection	Periodic Inspection	Research & Design
			e. Joint gap	Х	Х		Х
			f. Scouring	Х	Х		Х
			g. Drain/ spring water	Х	Х		X

Table 17.3 Tunnel Inspection Method (Other Portion)

Structure	Position	Member	Sort of Damage		Daily	Periodic	Research
Structure	rosition	Wielinder	Soft of Damage	Inspection	Inspection	Inspection	& Design
Tunnel	Inner lining		h. Body damage (plate type)	Х	X		X
	plate		i. Body damage (tile type)	X	X		X
			j. Accessory	Х	Х		X
	Ceiling		k. Body damage	Х	Х		X
	plate		1. Accessory	Х	Х		X
	Drain		m. Body damage	Х	Х		X
	system		n. Debris and soil dumping		Х		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.

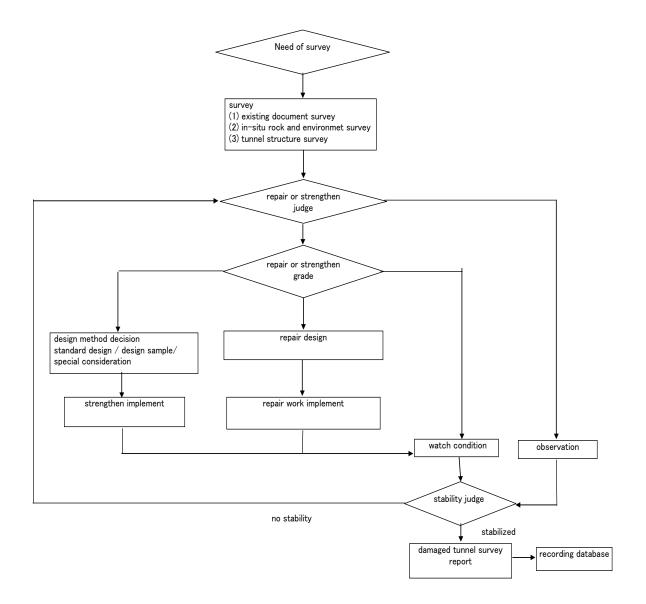


Figure 17.4 Flow of Selection for Repair and Reinforcement

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.

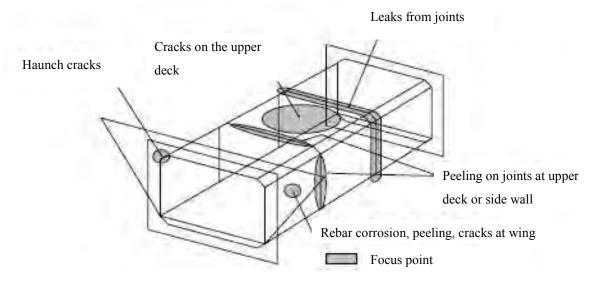


Figure 18.1 Box Culvert Focus Points

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.

Structure	Position	Member	Sort of damage	Initial inspection	Daily inspection	Periodic inspectio n	Research & design
Box Culvert	RC pipe culvert		o. Cracks/ corner drop		X	X	
			p. Peeling		X	X	
			q. Rebar exposure		Х	X	
			r. Settlement		Х	X	
			s. Connection joint damage		X	Х	
			t. Drain damage		X	X	

Table 18.1 Inspection Method (RC Box Culvert)

Table 18.2 Inspection Method (Pipe Culvert)

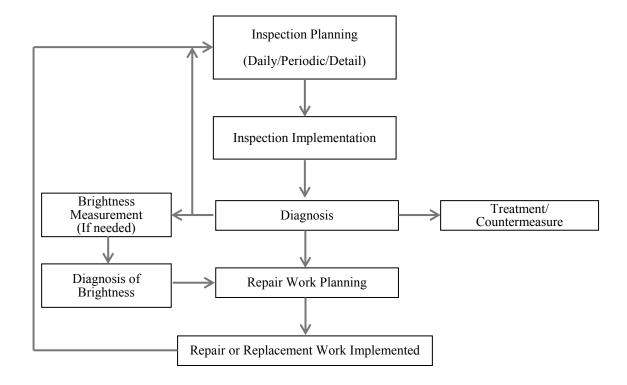
Structure	Position	Member	Sort of damage	Initial inspection	Daily inspection	Periodic inspection	Research & design
Box Culvert	Corrugated pipe culvert		u. Structure damage		X	X	
			v. Corrosion		Х	Х	
			w. Settlement		Х	Х	
			x. Connection joint damage		X	X	

	у.	Drain damage	X	X	
	Z.	Drain damage	Х	Х	

Table 18.3 Inspection Method (Concrete Box Culvert)

	Defects &		Diagnosis criteria	
	Deterioration	C/D	В	Α
Reinforce d 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 Exposure of steel		Large scale Peeling or creeping Severe rebar exposure and	Some peeling or creeping Partial rebar exposure
	bars/ Corrosion Concrete Voids		corrosion 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
Reinforce d 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.



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.

Structure	Position	Member	Sort of damage	Initial inspection	Daily inspection	Periodic inspection	Research & design
Traffic	Guard	Guard	Structure	-	Х	Х	-
safety	rail	rail	Accessory	-	Х	Х	-
			Corrosion	-	Х	Х	-
			base portion	-	Х	Х	-
		Guard	Structure	-	Х	Х	-
		cable	Accessory	-	Х	Х	-
			Corrosion	-	Х	Х	-
			Base portion	-	Х	Х	-
		Wall	Cracks/				
		type railings	/corner drop	-	Х	Х	-

 Table 19.1
 Inspection Methods for Traffic Safety

Table [19.2	Diagnosis f	for Traffic Safety
-------------	-------------	--------------------

Structure	Position	Member Sort of		of Judge		
Structure	rosition	Wiember	damage	D	С	В
Traffic	Guard	Guard rail	Structure	Severe damage or tilt at	damage or tilt at the	Slight damage or tilt
safety	rail			the support pole, beam or	support pole, beam or	at the support pole,
				pipe	pipe	beam or pipe
			Accessory	There are loosened or		There are some
				damaged Fixing devices		loosened Fixing
				or missing bolts	-	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.)
 - \checkmark 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

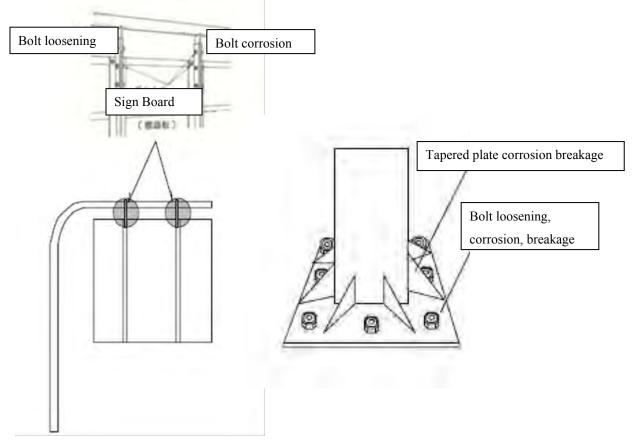


Figure 20.1 Traffic Sign Check Points

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.

Structure	Position	Member	Sort of	Judge		
Structure	rosition	Member	damage	D	С	В
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 deteriorati on		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
	Kilomet re posts		Structure		Deformation, tilt, damage or dust are progressing	There is some Deformation tilt, damage or dust

 Table 20.1
 Diagnosis for Traffic Signs

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-budgetingrepair 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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CHAPTER 1 INSPECTION TARGET

Segment	Subcategory
	• Cut slope
Slope	• Banking
	Ground anchoring
	Retailing wall
	• Rock shield
Slope stabilizer	• Rock cover
	Rock fall prevention General Engineering
	• Other slope stabilities
Culvert box	(Culvert box)

(1) Diagnosis:

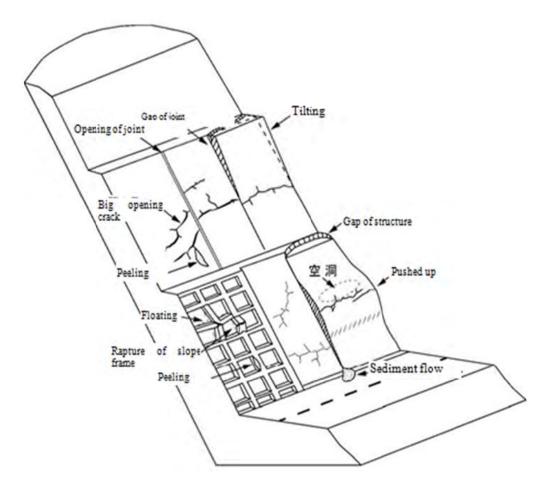


Figure 1.1 Checkpoint of cut slope



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.



(5) The deteriorated mortar debris at slope protection frame. (Ranking D)

CHAPTER 2 EMBANKMENT

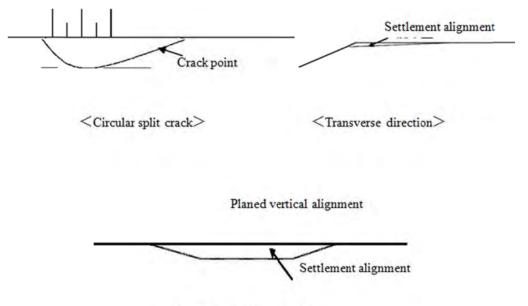
(1) Diagnosis: Next damages are rated D or E.

(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.



<Longitudinal direction>

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.

- \checkmark 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)
- \checkmark Easy to move at anchoring head or bearing plate.



Photo 3.1 Ground anchor ship



Photo 3.3 Failure of concrete head



Photo 3.2 Failure of passive earth pressure structure

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

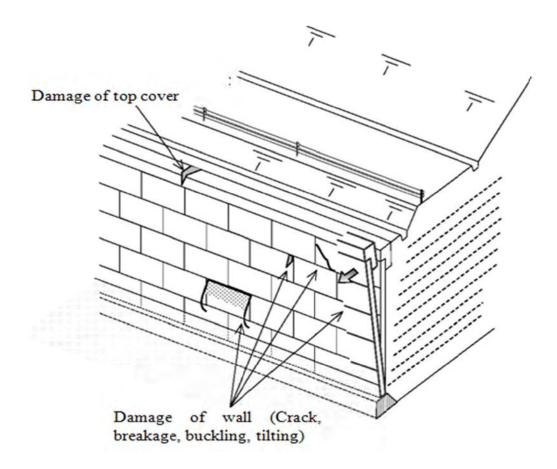


Figure 4.1 Diagnosis of retailing wall

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)
- 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 5.3 Rock fall prevention net, (pylon tilting net rapture wire rope breakage)



Photo 5.2: Member deformation and tilting (Rock fall prevention)



Photo 5.4: Concrete peeling, cracks (retailing wall)



Photo 5.5 Peeling, crack on concrete (retailing wall)



Photo 5.7 Corrosion and rapture of steel member (rock fall prevention net)



Photo 5.6 Steel member corrosion (rock fall prevention H beam base)



Photo 5.8 Corrosion and rapture of steel member (rock fall prevention net)

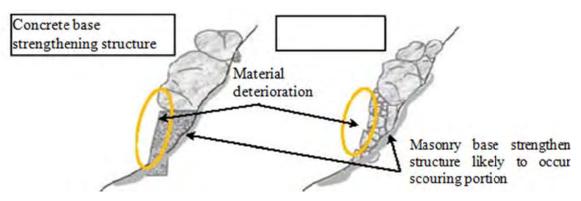


Figure 5.1 Scouring of rock fall prevention or failure of base strengthening structure

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

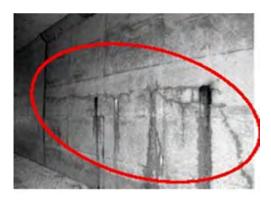


Photo 6.1 : Crack from freezing



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.

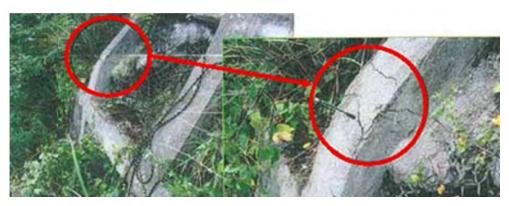


Photo 6.4 : Huge spring water at slope (Rank D or E)

(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.

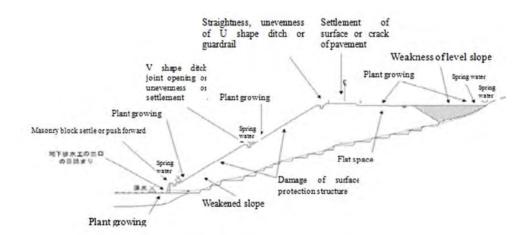


Photo 7.1 : Check point of Embankment

(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 7.4 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

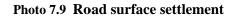


Photo 7.7 : Joint opening and sediment flow





Photo 7.8 Drain system malfunction



(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 7.12 Inside and road surface



Photo 7.11 Flow of water and sediment or joint opening



Photo 7.13 : Example of peeling, floating, cracks at the wing section

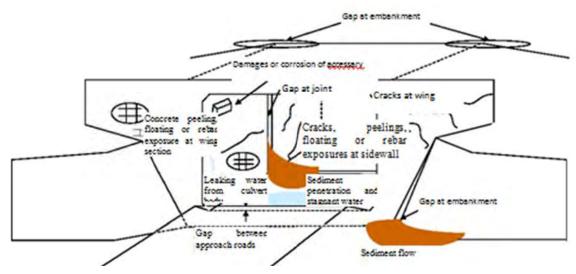
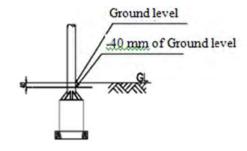
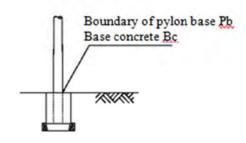


Figure 7.1 Checked point with culvert box

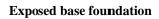
REFERENCE 1 : INSPECTION CONCEPT SKETCH

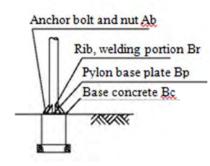
(1) Common





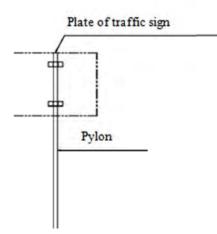
Back filled base foundation



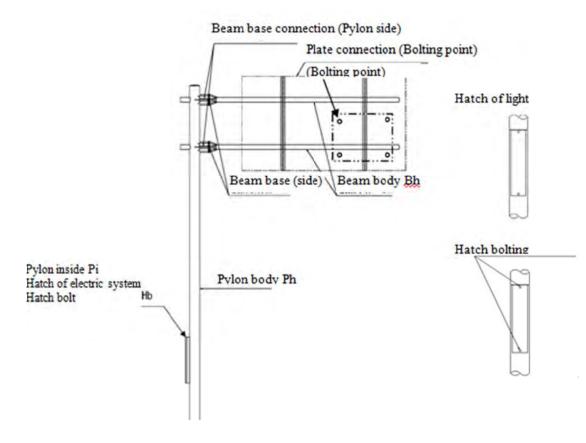


Ref.Figure 1 Pylon base

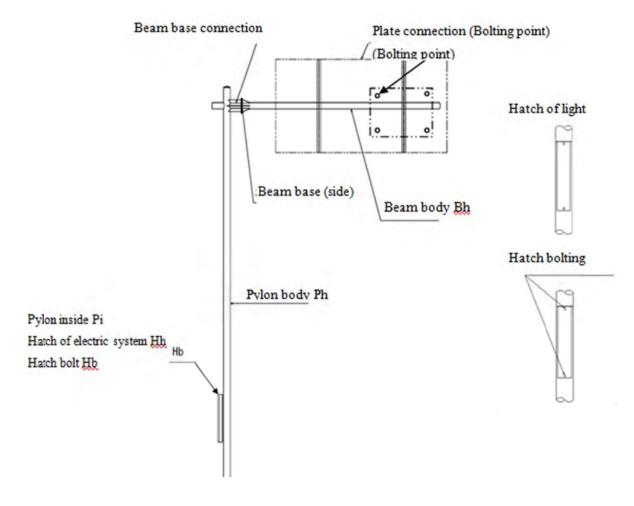
(2) Traffic sign and traffic information



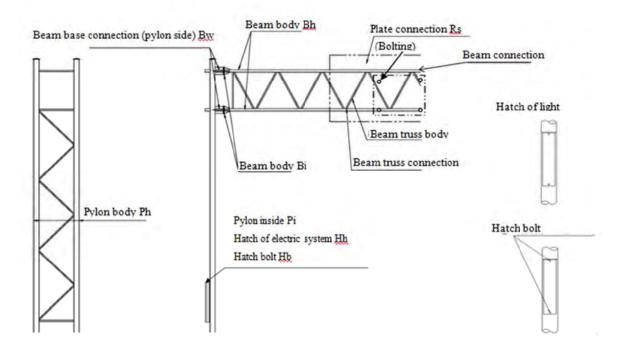
Ref.Figure 2 Road side

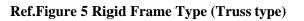


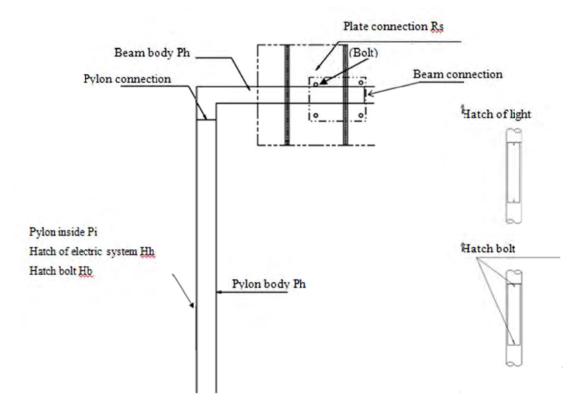




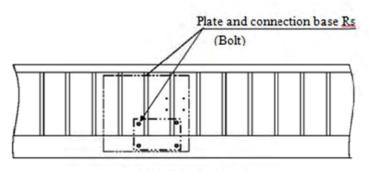
Ref.Figure 4 Overhang type







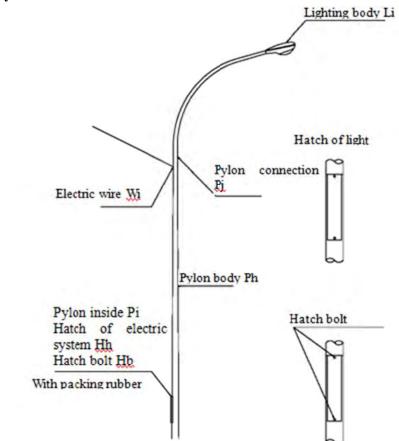
Ref.Figure 6 Rigid Frame Type (Beam type)



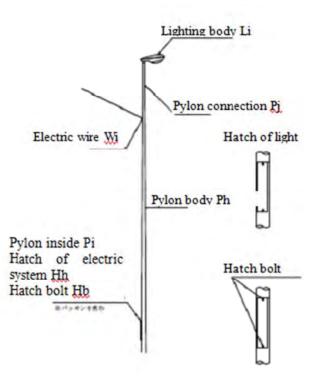
Over Bridge sign Board



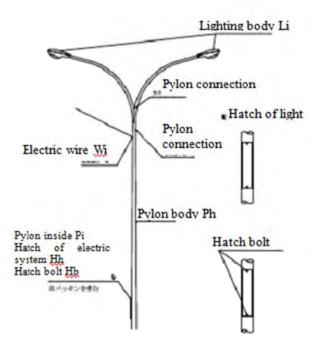




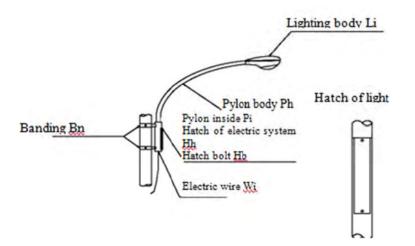
Ref.Figure 8 Pole type (tapered pole)

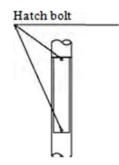


Ref.Figure 9 Straight pipe



Ref.Figure 10 Pole type (tapered pole)





Ref.Figure 11 Attached type

REFERENCE 2 : DAMAGE DIAGNOSIS SAMPLE

(1) Lighting system (Crack)

$\overline{}$	Crack	Portion		Lighting body or connection
	and the second		Situation	Crack and fear of dropping
III	1. 15		Cause	Road traffic vibration
			Countermeasure	Change the lighting.
			Note	
			Situation	
II			Cause	
			Countermeasure	
			Note	
			Situation	Good.
Ι	6		Cause	
		and the second division of the second divisio	Countermeasure	
	A		Note	

\searrow	Corrosion	Portion		Lighting body or connection
		. 18	Situation	Lack of cross section corrosion
III	A	and a second	Cause	Aging
			Countermeasure	Lighting change
			Note	
			Situation	Partially corrosion
II			Cause	Aging
	And the second		Countermeasure	If the progress of corrosion is estimated, repair is needed.
		4	Note	
			Situation	Good.
Ι	COLUMN STREET	The second se	~	
			Cause	
	11		Countermeasure	
			Note	

(2) Lighting body or connection (Corrosion)

	Loosen, dropping	Portion	Lighting bo	ody or connection
Ш	14		Situation	Lighting connection, bolt dropping.
			Cause	Road traffic vibration.
	100 - 2.52		Countermeasure	Bolt refastening or anti-loosening measure is needed.
	A BEIT		Note	
П	A serie to be the series of		Situation	Light cover bolt is loosen.
	12 - Charles		Cause	Road traffic vibration.
			Countermeasure	Bolt refastening or anti-loosening measure is needed.
			Note	
Ι			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(3) Lighting body or connection (Loosen, dropping)

	Rapture, broken	Portion	Strut cross bear	m (Rapture, broken)
III			Situation	Beam base is cracked and dropped
			Cause	Fatigue due to wind vibration.
			Countermeasure	Renew.
	1		Note	
			Situation	
Π			Cause	
			Countermeasure	
			Note	
Ι			Situation	Good.
	4		Cause	
			Countermeasure	
			Note	

(4) Strut of cross beam (Rapture, broken)

	Rapture, broken	Portion	Ру	lon joint
ш	7		Situation	Pylon is fallen due to welding connection by corrosion.
	1.	Cause	Corrosion	
	and the man		Countermeasure	Remove quickly and renew.
			Note	
			Situation	
II		-	Cause	
			Countermeasure	
			Note	
			Situation	Good.
Ι			Cause	
			Countermeasure	
	A CONTRACTOR OF			
	and the second			
	WARD AND A DREAM PROVIDENCE			
			Note	

(5) **Pylon joint (Rapture, broken)**

(6) **Pylon joint (Rapture)**

	Rapture	Portion	Pylon joint	t (Bolt connection)
Ш	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Situation	Bolt connection failed.
			Cause	Road traffic vibration.
			Countermeasure	Renew bolt or pylon change is needed.
			Note	
			Situation	
Π			Cause	
			Countermeasure	
			Note	
Ι			Situation	Good.
	470		Cause	
			Countermeasure	
			Note	

(7) Hatch (Corrosion)

	Corrosion	Portion		Hatch
Ш	86002		Situation	Corrosion with lack of cross section
			Cause	Aging and stagnant water
			Countermeasure	Change pylon.
			Note	
			Situation	Hatch corrosion but not
Π	and the second s			deep.
			Cause	Aging.
			Countermeasure	Repaint or change hatch.
			Note	
Ι			Situation	Good.
			Cause	
			Countermeasure	
			Note	

	Crack	Portion	Pyloi	n base plate
Ш			Situation	Crack on rib plate for fear of falling.
	12 MAR		Cause	Road traffic vibration.
	MALAC		Countermeasure	Need repair or change the pylon.
			Note	
			Situation	
II			Cause	
			Countermeasure	
			Note	
I			Situation	Good.
	AND		Cause	
			Countermeasure	
			Note	

(8) Pylon base plate (Crack)

(9) **Pylon base (Corrosion)**

	Corrosion	Portion	Ру	lon base
III			Situation	Breakage of pylon when digged or scoured at road surface.
	1 man		Cause	Stagnant water at the gap between pylon and road and corroded.
			Countermeasure	Changing quickly of pylon is needed.
			Note	
П			Situation	Corrosion occurred at the bearing pylon and road and corroded.
	C VP C		Cause	Stagnant water at the gap between pylon and road and corroded.
			Countermeasure	Repaint or repair and adding concrete for drain tangent.
			Note	
Ι			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(10) Base plate (Corrosion)

	Corrosion	Portion	Ba	ase plate
III			Situation	Hole by corrosion can be seen
	An A		Cause	The lack of thickness of paint film at welding point and edge
	KAN PA		Countermeasure	Quick renewal is needed.
			Note	
II			Situation	Whole part is corroded but not so deep.
	ETA IN		Cause	Aging and lack of thickness at welding point.
			Countermeasure	Repaint is needed.
Ι			Situation	Good.
			Cause	
			Countermeasure	
			Note	

	Corrosion	Portion	Pylon ba	se (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.
	- delle -		Countermeasure	Repaint is needed and anti- corrosion cap is effective.
			Note	
Ι			Situation	Good.
			Cause	
			Countermeasure	
			Note	

(11) Pylon base (Anchor bolt nut) (Corrosion)

	Rapture	Portion	Pylon ba	se (Anchor bolt nut)
III	ш		Situation	Rapture at anchor bolt due to corrosion.
			Cause	Stagnant water at plate and corroded.
			Countermeasure	Renewal is needed.
			Note	
			Situation	
Π			Cause	
			Countermeasure	
			Note	
Ι			Situation	Good.
	HE WORLE,		Cause	
			Countermeasure	
			Note	

(12) Pylon base (Anchor bolt nut) (Rapture)

	Others stagnant water	Portion	Hatch at pylon	
Ш			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	

(13) Hatch at pylon (Others stagnant water)

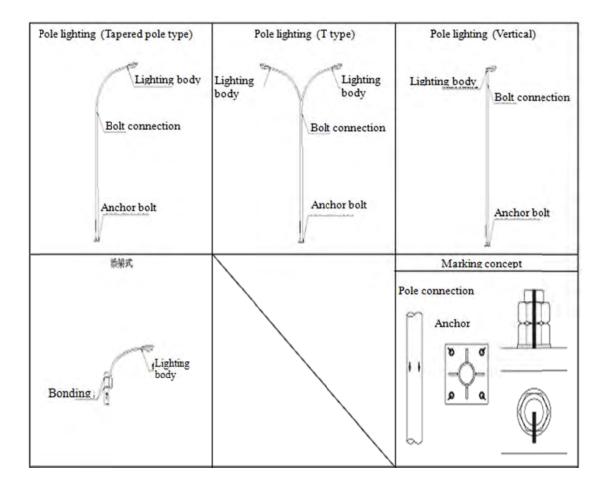
REFERENCE 3: CONFORMATION MAKING INSPECTION

(1) Conformation making inspection (Lightening)

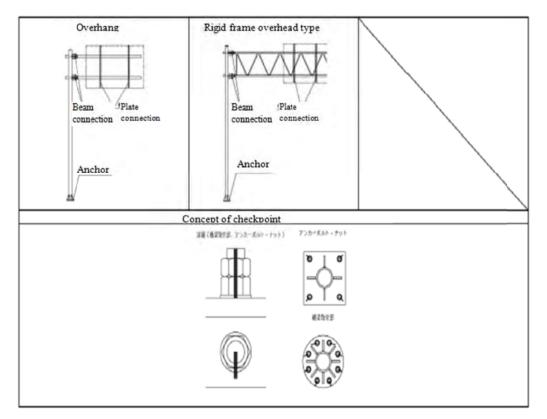
The bolts loosening confirmation marking are widely used for inspection. When there is no marking, the inspectors should mark after checking the bolt situation. The most suitable method for checking the bolt loosening by visual inspection is marking.

Marking implement concept show the next pages.

(2) Lighting pole



(3) Road sign





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