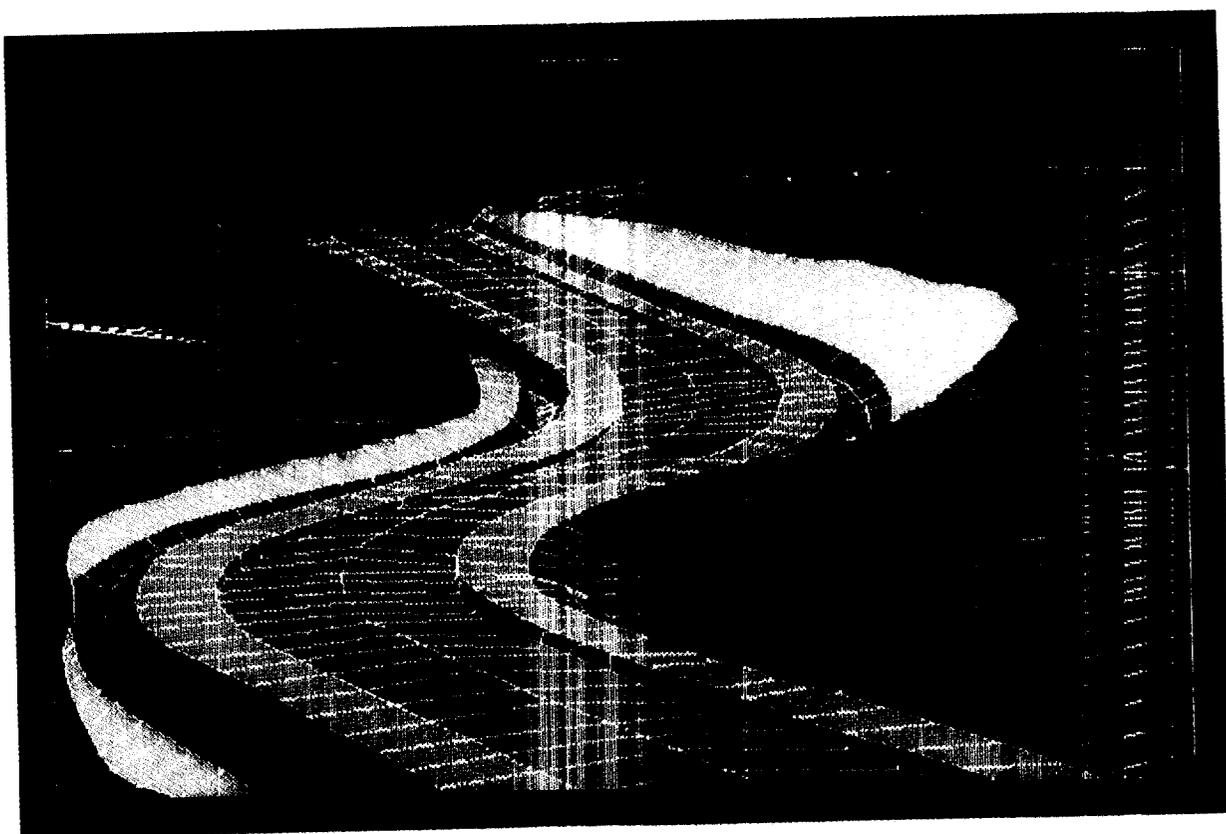
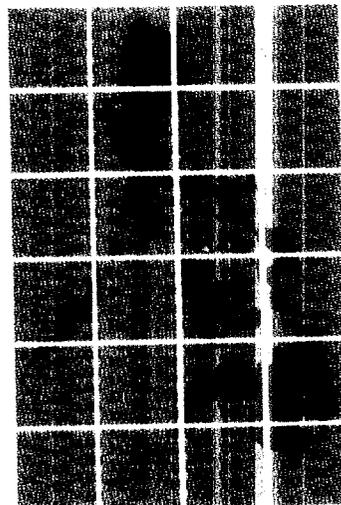


RMS

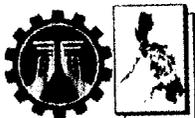
ROAD MAPPING SYSTEM

System Maintenance Guide



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
RURAL INFRASTRUCTURE FUND PROJECT

CADD MAPPING PROJECT



LOUIS BERGER INTERNATIONAL

In coordination with

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

PN-ABX-986

R M S

Road Mapping System

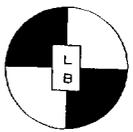
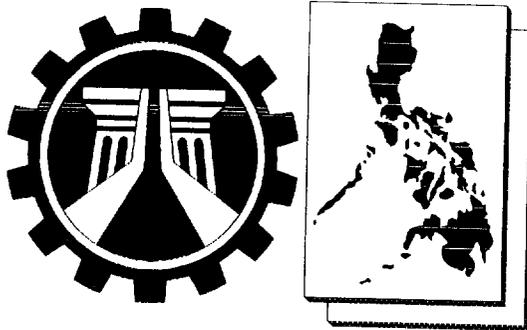
System Maintenance Guide

**REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
RURAL INFRASTRUCTURE FUND PROJECT
PROJECT NO. 492-0420**

**TECHNICAL ASSISTANCE TO THE DPWH
FOR AN INTEGRATED CADD MAPPING
AND DATA MANAGEMENT SYSTEM
(CONTRACT NO. 492-0420-C-00-2173-00)**

**DPWH ROAD MAPPING SYSTEM
SYSTEM MAINTENANCE GUIDE**

This (Activity) was completed through the assistance of the United States Agency for International Development (A.I.D.). The views, expressions and opinions contained in this report are the author's and are not intended as statements of policy of either A.I.D. or the author's parent institution.



LOUIS BERGER INTERNATIONAL, INC.

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This document is a guide to the maintenance of the DPWH Road Mapping System (RMS). The RMS is a computer program and associated data files which enable maps and data tables of the Philippines road network to be easily produced and output.

The network and feature data files provided during the initial installation of the RMS are liable to change over time for any of the following reasons:

- new roads may be built;
- existing roads may be realigned;
- existing roads may be abandoned;
- errors in the base map spatial data may be discovered;
- existing feature attribute data may be updated as a result of changes in road characteristics;
- new feature data may be added to the system as a result of new data collection or integration efforts.

For all these reasons, it is necessary to have a systematic way of updating the data contained in the RMS.

With the exception of updating feature attribute data, updating cannot be left to end users; rather, RMS maintenance personnel are charged with this task. Typically, procedures for ensuring the regular flow of data update requests from the field to the RMS maintenance office would be implemented, and annual or semi-annual Department-wide updating efforts would be carried out to ensure that all RMS users had available the most recent data.

To be effective in their role, RMS maintenance personnel must be knowledgeable ArcCAD and MapInfo users and must, of course, be completely familiar with the concepts and use of the RMS.

The purpose of this document is to explain the principal procedures and software tools which have been developed to carry out the various types of data updating tasks and other maintenance activities which RMS maintenance personnel would be likely to perform.

Successive chapters treat the following topics:

- system installation;
- modifying spatial data;
- modifying feature data; since this task is likely to be carried out by functional

units responsible for the various types of data, only general guidelines are given here;

- adding or deleting features from the data dictionary and the RMS.

Installation of the RMS on a PC-compatible computer involves the following general steps:

- installation of Microsoft Windows;
- installation of the MapInfo for Windows GIS package;
- installation of the RMS software and associated data files; and
- setting various default parameters.

Discussion of the installation procedures of Microsoft Windows and of MapInfo for Windows is beyond the scope of this document. The RMS was developed using Windows version 3.1 and MapInfo for Windows version 2.0.1 and should run without problem under all compatible versions of Windows and MapInfo for Windows.

MapInfo is a multi-platform GIS package. In addition to Microsoft DOS and Windows, versions exist for the Apple Macintosh and for various workstations. MapInfo Corporation claims that applications and data developed for one platform can be ported without recompilation or data conversion to other platforms. This claim has not yet been able to be verified in the particular case of the RMS; however, given MapInfo's explicit multi-platform design, it is likely that porting the RMS to other MapInfo-compatible platforms would be a relatively easy task.

2.1 RMS SOFTWARE AND DATA INSTALLATION

System Requirements:

In order for RMS to run the following requirements are needed :

HARDWARE :

- Any 80286,80386 or 80486 based microcomputer with at least 4 MBytes of RAM.
- Any monitor supported by Microsoft Windows. For best results, a VGA color monitor is recommended.
- A mouse supported by Microsoft Windows
- A Hard Disk Drive with 10 MBytes of disk space for program and feature files. Depending on the number of provinces to be installed (estimatly 600 Kbytes for each provinces), it will require additional disk space.
- a printer or plotter (optional)

SOFTWARE :

- Microsoft Windows 3.0 or later installed on the hard disk and running on standard or enhanced mode
- MapInfo for Windows ver 2.1 or later installed on the hard disk
- RMS Installation Disk

Software Package :

The software package is consist of the following :

- Installation disk (1 High Density 3.5 inch diskette) ;
- Feature Files Data Disk (1 High Density 3.5 inch diskette) ;
- a USER, System Maintenance Guide and System Documentation;
- Spatial Files Data Disk (High Density 3.5 inch diskettes);
- RMS Program Disk (1 Double Density 3.5 inch diskette)

Installation Procedure :

The System Requirements(both hardware and Software) have to be met in order to effectively run the RMS.

Insert the RMS installation disk in drive B:.Invoke the installation procedure by typing : *INSTALL* . The system will give a step by step procedures on how to use RMS Installation Software. During the installation the following have to be entered :

1. Windows Directory
2. MapInfo Directory
3. RMS System Directory (the directory where to install RMS, the default directory is \RMS)
4. RMS Feature Files Directory
5. RMS Spatial File Directory

The RMS install will then create the RMS, Feature Files and Spatial Files directory based on what was specified (If the directory did not exists). Copying of files is automatic.

Feature Files and Spatial Files :

All Feature Files and Spatial files will be stored in the directories that were provided. Feature data files are supplied on a separate disk (Feature File Data Disk). Spatial Files are organized by province. Spatial file data diskettes (which are numbered) have subdirectories corresponding to individual provinces, with nothing in the diskette's root directories.

In installing the Spatial Files, a menu will be provided that consist the list of provinces. The Enter key is used to Select/Unselect from the menu.

Choosing the menu item ALL PROVINCES will require at least 30 MBytes of disk space from the hard disk, since it will install all available provinces spatial files. Another alternative is installing only those provinces that are needed.

After pressing the ESC key, RMS will start installing the provinces that were selected. It will ask for the diskette/s that contain the province/s to be inserted and start copying the file to the Spatial File directory. It can be run again to install additional Spatial files if needed.

The Spatial Files can also be copied to the Spatial Directory using the DOS Copy or XCopy Command. A file SFILES.LOC is provided which contains the list of province with their corresponding disk number and directories.

RMS Configuration File :

The RMS.INI is the configuration file of the RMS Software in the Mapinfo directory. It is the first file needed by the system in order to run. It contains the list of directories needed by the system.

- Windows Directory
- Mapinfo Directory
- RMS System Directory
- Feature File Directory
- Spatial Files Directory

There are three ways to create or change the RMS.INI :

- by running the RMS Installation Software, the RMS.INI will be automatically created ;
- using the PREFERENCES menu item from the RMS Software (see Users' Manual);
- using a text editor.

Creating a RMS Icon :

Creating the RMS icon (Program item) will have to be done under the windows environment. It is recommended to create the RMS program item under the MapInfo group.

How to create a program item ?

- 1 - Open the Mapinfo Group
- 2 - From the File menu in Program Manager, choose New.
- 3 - Select the Program Item option, and then choose the OK button, the program item properties dialog appears
- 4 - Type the following on the Program Properties Dialog Box
 - Description : RMS
 - Command Line : RMS.exe
 - Working Directory : RMS Directory (ex C:\RMS)

- Shortcut Keys : None
- 5 - Choose the Change Icon button to see the RMS icon then choose the OK button.
 - 6 - Choose the Ok button, the dialog boxes closes and the RMS Program Item appears on the MapInfo Group.

RMS Program Disk :

The RMS Program Disk contains the following files

- ADPTINS.LSP
- POPINS.LSP
- FEABLK.LSP
- IMPBDY.MBX
- IMPPOP.MBX
- IMPSEG.MBX
- IDENT1.MBX
- IDENT3.MBX
- UPDATAD.MBX
- UPDATE1.MBX

How to run RMS :

RMS can only run under the windows environment

- 1 - from the MapInfo Software, choose the USRPRO.MBX using the RUN menu item. (see MapInfo Manual for more information)
- 2 - Clicking on the RMS Icon

2.2 SETTING SYSTEM PARAMETERS

Before the RMS program is installed, MapInfo should be entered and the **Preferences** menu item in the **Edit** menu should be selected. Go into the **Preferences** dialog box, click on the **Map...** button and select metric distance and area units.

As stated earlier, modifications to spatial data can include segment additions, deletions or realignments. In the RMS, such modifications are first made to the ArcCAD coverage corresponding to the province segment data and a new, clean coverage is rebuilt.

ArcCAD coverages are supplied in separate diskettes separated by subdirectories based on the province name. To extract a particular coverage of a province, copy the EXE file of the province to the hardisk using DOS Copy command, then type the province name at the DOS prompt and the corresponding files will be extracted. AutoCAD DXFOUT command is then used to export the revised spatial data in DXF format.

Program IMPSEG should then be run with the update option. Select the province for which the updated data is to be input, and indicate the name of the appropriate DXF file. Follow the instructions displayed by IMPSEG on the screen to import the ROAD layer into MapInfo format and with the Zone 51 UTM projection parameters.

The result of running IMPSEG with the update option is a new map of the province road network, containing no road identification or stationing information. By comparing the spatial data in the new map to that in the already-existing base map (SEG n n table), the changes between the two can be determined. Program UPDATE1 is used for this purpose. The program highlights any differences between the original and the new segment spatial data, and allows the user to easily carry out the following general tasks:

- delete changed segments from the base network;
- copy changed segments from the update network to the base network, and input the road identifier for such segments.

It also provides a number of utilities to keep track of editing progress. When all editing changes have been made, the user instructs the program to replace the original SEG n n table with the edited table. No information (road identifiers, stationing data) for unchanged segments is lost by this procedure; new segments have province codes and road identification data, but no stationing data associated with them. Program IDENT3 must be run to establish (or re-establish) control points and stationing for the changed segments.

The use of each of these programs is discussed in turn below.

3.1 PROGRAM IMPSEG

Program IMPSEG first asks for the name of the province for which DXF data is to be imported. A scrollable list is displayed with all province names; only one should be selected.

Next, it displays a file selection dialog box which shows the name of DXF files only; the dialog box can be used to navigate through the directory structure if required. Choose the appropriate DXF file and click on the *Open* button.

IMPSEG then asks if the import is the initial import of the segment data or if it is for update purposes. Click on the *Update* button. A message appears reminding the user to select the layer which corresponds to road segments and to choose the Zone 51 UTM projection parameters. A list of all the layers in the DXF file appears on the screen. Click on the one which corresponds to the road segments, and choose the Zone 51 UTM projection by clicking on the *Coordinate* button and selecting the Zone 51 UTM item from the scrollable list which appears (normally the Zone 51 UTM item will be the last element in the list of projections).

Finally click on the *Import* button to carry out the data conversion. The file created by IMPSEG when the update option is selected is called UPSEG nn , where nn is the province code.

3.2 PROGRAM UPDATE1

As explained above, program UPDATE1 is used to compare a base network (SEG nn table) with an updated network (UPSEG nn table), and to facilitate the editing tasks that are necessary to reconcile the two and revise the base network as required.

As a precaution, almost all editing work performed in UPDATE1 is done on copies of SEG nn and UPSEG nn ; at the completion of the editing work, the revised copy of SEG nn can, at the user's choice, be used to replace the original copy. Once the spatial data differences between the copy of SEG nn (which is considered the base network) and the copy of UPSEG nn (which is considered the update network) have been identified, program UPDATE1 provides a number of processing options which enable the user to:

- eliminate a segment from the base network;
- copy a changed segment from the update network to the base network;
- flag a base or update network segment as unchanged even if it was found to be changed by the program;
- save partially-edited data so that work on it can be resumed at another time; and
- replace the original SEG nn with the processed base network.

A number of menu items are added to the usual MapInfo menu bar to enable users to access these facilities. These include menus for initializing the processing (menu Setup), for manipulating the base network (menu Base Net), for manipulating the update network (menu Update Net), and for saving the editing (menu Done).

3.2.1 Menu Setup

Menu Setup includes two menu items:

- **Setup Files**, which allows the selection of the province to be processed;
- **Compare Networks**, which actually compares the spatial data for the base and updated province networks and highlights any segments that are in one but not in the other of the networks.

The **Setup Files** menu item must be selected first. When a province has been selected, the program determines if any editing work has been performed so far. If not, it makes working copies of the *SEGnn* and *UPSEGnn* tables; these will be used for editing purposes, and only after all editing is completed will the original *SEGnn* table be overwritten with the revised table. If no editing work has been done, then the **Compare Networks** menu item must also be selected to carry out a segment-by-segment comparison of the two networks. The comparison will result in segments in the base and update network being flagged as changed, and shaded red and blue, respectively, if they cannot be found in the other network. It suffices for a single node in a line or pline to have different coordinates in one map than in the other, for each of the objects to be flagged as changed.

On the other hand, if editing work on the province has already been done, there is no need to carry out the **Compare Network** operation again. Following selection of the **Setup Files** menu item, the screen will show two maps (the base and update network), possibly with some segments colored red or blue.

Then the actual editing can take place.

3.2.2 Menu Base Net

A segment that is marked as changed in the base network is one for which there is no exactly corresponding segment in the update network. Manipulations of the base network basically consist of deleting changed segments, or indicating that a changed segment is to be retained despite the change; this is known as canceling the change flag.

The menu items provided to facilitate manipulating the base network include:

- **Show All Changed Base Segments**, which simply highlights (selects) all segments in the base network which are marked as changed; segments which are not marked are either those which really do not differ between the base and the update network, or those which do differ but for which the change flag has been canceled (see menu item **Cancel Segment as Changed**);
- **Select Next Changed Base Segment**, which selects the "next" (in no particular order) segment flagged as changed, or indicates that no such segments remain in the network;
- **Delete Changed Segment**, which deletes from the base network a single selected changed segment. Segments for which the change flag has not been set, or segments in the update network, cannot be deleted with this menu item. Note that the menu item operates on a single selected segment. The selection can be done using the **Select Next Changed Base Segment** discussed above,

or using any of the regular MapInfo selection tools and methods;

- **Cancel Segment as Changed**, which resets (cancels) the change flag of a single selected changed segment in the base network, and repaints the segment using the default segment color so that it no longer appears red.

3.2.3 Menu Update Net

A segment that is marked as changed in the update network is one for which there is no exactly corresponding segment in the base network. Manipulations of the update network basically consist of adding changed segments to the base network and providing the road identifiers of these added segments, or indicating that a changed segment is not to be considered as changed despite its differences; this is known as canceling the change flag.

The menu items provided to facilitate manipulating the update network include:

- **Show All Changed Update Segments**, which is similar to the **Show All Changed Base Segments** menu item discussed in the preceding section except that it highlights changed segments in the update network;
- **Select Next Changed Update Segment**, which is also similar to the corresponding menu item discussed above;
- **Add Changed Segment to Base Network**, which adds a selected changed segment in the update network to the base network. A dialog box is displayed to allow the user to enter the road identifier of the added segment. If the identifier is blank or does not appear elsewhere in the segment table for the province, a confirmation is requested. The change flags for both the update network and the base network copy of the segment are reset, and both copies are redrawn with the default segment color. As before, the segment to be added can be selected using the **Select Next Changed Update Segment** menu item, or any of the usual MapInfo selection tools or methods; however, only changed segments in the update network can be added using this menu item;
- **Cancel Segment as Changed**, which resets the change flag for the selected changed segment and redraws it using the default segment color.

3.2.4 Menu Done

With the menu items in the Done menu, the user can either save an editing session so that he can resume work at a later time, or he can take the edited base network and replace the original *SEGnn* table with it, thus completing all editing for the province.

- menu item **Save to Resume Later** simply saves the working copies of the base and the update networks in their latest state; all editing changes (additions, deletions and change flag cancellations) are preserved but the original *SEGnn* table is not modified in any way;
- menu item **Completely Done** indicates that all additions, deletions and change flag cancellations are complete, and that the original *SEGnn* table can be replaced with the revised version. A dialog box asks confirmation that the original *SEGnn* table is in fact to be replaced before proceeding with the replacement. Since it is not possible to undo the replacement, it would be wise to keep backup copies of the original *SEGnn* tables until the accuracy of the replacement version can be verified.

3.3 PROGRAM IDENT3

Program IDENT3 is used to establish control points and stationing data for all the segments of a road. *Control points* are particular types of point objects which serve to establish the precise stationing of selected locations along a road. All identified roads must have at least two control points per province: one at the road's beginning and one at its end within a province. Additional control points can also be defined at intermediate locations if desired. Control points are kept in tables called *CPnn*, where *nn* is the province code.

Control points are used to establish the stationing of the beginning and ending points of all segments of a road. A road typically consists of a number of segments; control points, however, might be input for only the road beginning and ending points. IDENT3 interpolates between a road's control points to establish the beginning and ending stationing of each segment in the road. It also performs a number of editing checks and manipulations which are normally transparent but which may produce error messages if there is a problem with the road data (for example, a road containing overlapping or completely disjoint segments).

Control points are only used by program IDENT3; no other component of the RMS makes use of them. However, IDENT3 also generates a table named *ROADnn*, which is called the road table and which contains a list of all the identified roads in province *nn*, together with each road's beginning and ending stationing. *ROADnn* is not a mappable table, but it is used by a number of other RMS operations.

Program IDENT3 was originally run when the province network data was first established; thus province network data is already stationing, and includes *CPnn* and *ROADnn* tables. However, IDENT3 has to be rerun to update the stationing data of any segments which were modified using program UPDATE1, discussed above. Furthermore, segment modifications with UPDATE1 requires that the stationing for the road be undone and may require control

point deletions or modifications, and road table editing, to ensure a consistent description of the network and its stationings.

The following sections discuss the menus and menu items provided by program IDENT3 for determining segment stationings.

3.3.1 Menu Setup

Menu Setup is used to designate the province whose segment data will be processed. It also allows the user to select standard methods of drawing control points and segments for which stationing data has been determined.

It displays a **Setup Stationing Processing** dialog box with the following items:

- a scrollable list of provinces (only one can be selected);
- an option box allowing choice of input from the keyboard or from a file (only keyboard input is currently implemented);
- a line picker to choose the line style used for drawing stationed road segments;
- a symbol picker to choose the symbol used for drawing control points.

Clicking on the *OK* button validates all the choices made; clicking on the *Cancel* button terminates the program.

3.3.2 Menu Input

The **Input** menu is where most of the work with IDENT3 gets done. It allows the selection of a road for stationing, the input of control points, and the processing of the control point data to derive stationings for each of the road segments. In addition, it carries out a number of editing checks and manipulations behind the scenes, and flags any problems in the road's spatial data.

The various menu items in the **Input** menu are discussed below.

Item **Choose Road** allows the user to specify the identifier of the road for which stationing information is to be determined. If there are no roads in the province having the identifier, the program issues a warning and exits; otherwise, it selects all segments belonging to the road.

Specification of the location of control points is done using the MapBasic tool, which is activated by program IDENT3. Users must first click with the MapBasic tool on the location of a control point, then use the appropriate menu item to provide information about the control point itself.

Item **Enter Beginning Point** marks a location selected with the MapBasic tool as the beginning location of a road. IDENT3 snaps to the nearest endpoint of the selected road and ensures that the control point is positioned exactly at the endpoint. It then asks the user to specify the stationing corresponding to the control point.

Item **Enter Ending Point** is similar to item **Enter Beginning Point**. It marks a location selected with the MapBasic tool as the ending location of a road, and asks the user to specify the stationing corresponding to the control point.

Item **Enter Other Control Points** allows the input of control points for locations other than the beginning or the ending of a road. It snaps to the segment endpoint nearest the location chosen with the MapBasic tool, and asks the user to provide both the stationing of the location as well as a brief description of the location itself (e.g., intersection, bridge, etc.)

Item **Process Road Stationing** is selected when all the control points for a road have been input. It doesn't require any interaction with the user, but verifies the road data and interpolates between control point stationings to determine the beginning and ending point stationings of segments between control points. If any errors in the road definition are identified (gaps or overlaps), an appropriate message is printed. In this case, the user must carefully examine the segments included in the road and revise the identification information appropriately. Only then should IDENT3 be rerun.

A final item in the Input menu, **Undo Road Stationing**, allows road stationing information to be undone if, for example, an error was discovered. The **Choose Road** menu item must first be run to input a road identifier. IDENT3 asks confirmation that stationing for the chosen road is indeed to be undone. If confirmed, it sets all the segment beginning and end point stationings to 0, but doesn't modify the segment province code or road identifier information.

3.3.3 Menu Status

Menu Status provides a number of conveniences to the user:

- menu item **Show Processed Roads** highlights (using **Select**) all roads for which stationing information has been determined;
- conversely, menu item **Show Unprocessed Roads** highlights all roads for which stationing information has not been determined;
- menu item **Clear Status** simply clears the highlight from either of the two preceding menu items;
- menu item **Color Processed Roads** redraws any roads for which stationing has been determined, with the line style selected in the Setup menu.

The RMS can incorporate a wide variety of road feature data. The selection and specification of the types of feature data to be incorporated in the system is a task requiring cooperation between the functional units responsible for the data, and the RMS maintenance staff; this activity is discussed in section 5 below.

However, once feature file data structures have been defined, the RMS is designed to allow updated feature data to be prepared by responsible DPWH functional units with minimal requirements about content or format being imposed by the RMS itself. After the functional units have prepared feature data using the methods, procedures and software they consider most suitable for the task, they then turn over the prepared data, in the form of .dbf files, to the RMS maintenance staff for incorporation in the system.

Because of this decentralized approach, it is not appropriate to specify particular methods for maintaining or updating road feature data. Some functional units may prefer to use spreadsheets such as Lotus 1-2-3 or Quattro Pro, while others may prefer to use database programs such as dBase, Paradox, or MapInfo itself, for the maintenance of their data.

The only requirements that feature data must comply with are minimal format and sort order conventions, as follows:

- all feature data files must be in .dbf format;
- the name of the .dbf file holding data for a particular feature must always be the same (in fact the file name is stored in the RMS data dictionary);
- the first five fields of each .dbf file must have the following names and types:
 - PROVINCE: Char (2) - the two-digit NSO code of the province;
 - ROAD: Char (10) - the number or identifier of the road;
 - KPO: Dec (8, 3) - the stationing of the beginning of the homogeneous section, to the nearest meter;
 - KPE: Dec (8, 3) - the stationing of the ending of the homogeneous section, to the nearest meter; if the feature is point-like, KPO and KPE will be equal (i.e., the homogeneous "section" will actually be a point);
 - JOINID: Dec (6, 0) - an arbitrary integer which must be unique within the feature file; it may be convenient to set JOINID equal to the record number, but this is not essential.
- after JOINID there may be any number of fields as required for the description of the feature attributes; the specifications (names and data types)

of these fields will have been defined when the feature was initially added to the RMS and must be complied with;

- homogeneous sections should not overlap, although there may be gaps between sections;
- the feature file must be in sort order on ascending PROVINCE, ROAD and KPO.

RMS maintenance staff, on receiving updates of feature data from DPWH functional units, should ensure that the above conditions are satisfied. Once verified, the new .dbf files should be registered in MapInfo and distributed to end users.

No other activities are required to update feature data.

5 ADDING AND REMOVING FEATURES

5.1 THE DATA DICTIONARY

Section 4 dealt with the updating of data for features already included in the RMS; however, it may happen that new types of features need to be included in the system, or that already-included features should be removed for some reason. This is a different sort of operation, involving modifications of a table called the RMS *data dictionary*.

The data dictionary stores information about all features and attributes incorporated in the system. It is a non-mappable MapInfo table having the following structure:

- LEVEL: Small Integer - value 1 if the record describes a feature, value 2 if the record describes a feature attribute;
- NAME: Char (11) - if the record describes a feature, NAME contains the name of the .dbf file holding the feature data (the name shouldn't include the .dbf extension); if the record describes a feature attribute, NAME contains the field name of the attribute within the .dbf file;
- DESCRIPTION: Char (48) - a description of the feature or the attribute corresponding to the record;
- RELATE: Small Integer - RELATE has the same numerical value for all records pertaining to a single feature and its attributes. For example, if there were a traffic feature file with attributes AADT and PeakVol, the three corresponding records in the data dictionary (one for the feature and two for the attributes) would all have the same value of RELATE. This value is 1 for the first feature (and its attributes) in the data dictionary, and increases by 1 for each following feature and its attributes;
- FNAME: Char (15) - only defined for level 2 records (attributes): the name of a MapInfo workspace which causes the standard thematic mapping for the attribute to be drawn; (the name shouldn't include the .wor extension).

Adding and removing features from the RMS involves manipulating the data dictionary appropriately. Program UPDATAD has been provided to facilitate this task.

5.2 PROGRAM UPDATAD

Program UPDATAD allows features to be added to or removed from the data dictionary.

Running the program causes a **Data Dictionary** menu to be installed on the MapInfo menu bar along with the standard menus.

Clicking on the **Data Dictionary** menu causes the following menu items to drop down:

- **Add Feature to Data Dictionary;**
- **Delete Feature from Data Dictionary;**
- **Done.**

Clicking on the **Add Feature to Data Dictionary** menu item displays a dialog box which asks for the name of the .dbf file containing the feature data to be included, and asks for a description of the feature itself. (The .dbf file need not be ready with all attribute data in final form; all that is required is that the structure of the .dbf file be correctly defined.)

The program then displays a dialog box for each of the fields in the specified .dbf file. It asks for a description of the field (attribute itself), and for the name of the workspace to execute for standard thematic mapping of the attribute values. The workspace name may be left blank if no standard thematic presentation is defined; section 5.3 explains how to create such a workspace if one is desired.

When all fields have been processed, select the **Done** menu item to signify that definition of the new feature is completed.

Removing a feature requires clicking on the **Delete Feature from Data Dictionary** menu item. A scrollable list of feature descriptions is displayed, and the desired feature should be clicked on. A verification message is displayed. If deletion is really wanted, confirm the message. As before, select the **Done** menu item to signify that all processing is completed. A final message asks confirmation that the data dictionary changes are to be saved.

5.3 CREATING A THEMATIC MAPPING WORKSPACE

Figure 1 presents a typical workspace used to thematically map feature attribute data. There would ordinarily be no need to laboriously type in a workspace like this; instead, MapInfo's **Shade by Value** menu item can be used to develop suitable line types, colors, etc., as well as suitable legends and fonts for the standard thematic presentation; then the **Save Workspace as** menu item can be used to capture into an ASCII file the workspace instructions needed to replicate the thematic mapping.

The saved workspace will ordinarily contain many details not relevant to the thematic mapping itself; these can be edited out using any ASCII file editing tool. Again, Figure 1 can be used as a guide to see which instructions in the workspace should be kept, and which can be deleted.

```
!Workspace
!Version 200
Set Window Legend
  Position (3.66667,3.09375) Units "in"
  Width 3.10417 Units "in" Height 2 Units "in"
Open Window Legend
Shade Attributes With Type Ranges
  1:1 Line (3,2,0,255) ,
  2:2 Line (3,2,0,49200) ,
  3:3 Line (3,2,0,16776960) ,
  4:4 Line (3,2,0,16711935) ,
  5:5 Line (3,2,0,49407) ,
  6:6 Line (3,2,0,16711680)
Set Legend
Layer Attributes
  Lines On
  Title "Pavement Type" Font ("MS Sans Serif",5,10,0)
  Ranges
    "Unidentified Roads" Display On,
    "Concrete" Display On,
    "Asphalt" Display On,
    "Penetration Macadam" Display On,
    "Surface Treatment" Display On,
    "Gravel" Display On,
    "Earth" Display On
```

Sample Thematic Mapping Workspace
Figure 1

APPENDIX

RMS SYSTEM MESSAGES

SYSTEM MESSAGE	POSSIBLE CAUSE	REMEDY
1. Not valid system directory	Wrong System directory was assigned or directory does not exist	Check the path of your System directory.
2. Not valid Feature File directory	Wrong Feature File directory was assigned or directory does not exist	Check the path of your Feature File directory.
3. No Spatial File directory specified.	-	Specify the correct Spatial File directory.
4. No Feature File directory specified.	-	Specify the correct Feature File Directory
5. No System directory specified.	-	Specify the correct System directory.
6. Road <i>nn</i> of Province <i>nn</i> is not in the Base Map.	The Road in the Feature File Database is not identified in the Segment Table	Compare the Feature File Database to the Segment Table and if needed, identify the road.
7. Road <i>nn</i> of Province <i>nn</i> is in the map but there is no road stationing	- There is no road stationing in the Segment Table - The Road KPE in the Segment Table is less than the stationing in the Feature File Database.	Check Feature File Database and Segment Table and make necessary changes.
8. Non - Contiguous Road	There is a gap in the road stationing in the Segment Table.	- Check Segment Table and compare with the original base map (The portion could be a bridge) - Check Feature Database File
9. Unknown Object Type	A portion of a segment in the Segment Table is not a Polyline or Line	Check Segment Table and make necessary corrections.
10. Cannot Find File	You have specified a wrong directory or file does not exist.	Check if file exist on the given directory.
11. More than 100 features defined	The number of features that the system can handled had been exceeded	Reduce number of features using UPDATAD.MBX
12. You have not selected a province	-	Select a province

SYSTEM MESSAGE	POSSIBLE CAUSE	REMEDY
13. No Features Selected	-	Select a feature
14. No Features to merge	No Features selected to be merged	Select one or more features to merge.
15. No Output Description	No description specified for Feature Merge File	Specify Merge Feature File description
16. No Feature Available	-	Check Feature File
17. No Road List Available	No road identified in the existing province	Identify road/s using INDENT1.MBX and IDENT3.MBX
18. No Worspace File Exist	Cannot find the file in the Feature File directory	Make sure the Workspace file exist in the Feature File directory.
19. Overlapping stations of roads	The KPO is less than the KPE of the previous record in the Feature File Database.	Check Feature File Database and make the necessary changes.
20. Base Map does not exist	The map window is closed	Open the Map window
21. KPE and KPO out of range	The KPO or KPE in the Feature File Database is not within the range of KPO and KPE in the Road Table (RoadTab)	Compare Feature File Database and Road Table(RoadTab) and make necessary changes in the database.