Microcomputer Conversion

Washington State Pavement Management System for Cities and Counties

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Derald R. Christensen

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Washington State Transportation Center (TRAC)
135 More Hall, FX-10
University of Washington
Seattle, WA 98195

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16. ABSTRACT

This report documents the joint development of a Pavement Management System (PMS) for use by the cities and counties of the state of Washington. This system makes full use of existing analysis software and experience provided by the Washington State Department of Transportation (WSDOT) through its on-going pavement management procedures. The system is currently being implemented and is expected to be used by most cities and counties within Washington State.

The joint efforts of the cities and counties in the development, implementation and training associated with the final PMS was very successful. This should help to develop an improved environment for the overall management of pavements within the state.

The system was implemented on IBM-PC type hardware and is structured so as to provide a complete stand alone management system for pavements as well as for general inventory, traffic and other pavement related data. The software is still under development with the final release expected in July of 1987.

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MICROCOMPUTER CONVERSION OF WASHINGTON STATE PAVEMENT MANAGEMENT SYSTEM FOR CITIES AND COUNTIES

by

Derald R. Christensen
Senior Research Associate
Washington State Transportation Center (TRAC)
University of Washington
Seattle, Washington

Washington State Department of Transportation
Technical Monitor
Newton Jackson
Pavement Design Engineer
Construction and Materials Office

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MICROCOMPUTER CONVERSION OF WASHINGTON STATE PAVEMENT MANAGEMENT SYSTEM FOR CITIES AND COUNTIES

CONCLUSIONS

The major conclusion of this study was the joint development of a Pavement Management System (PMS) for use by the cities and counties of the State of Washington. This system makes full use of existing analysis software and experience provided by the Washington State Department of Transportation (WSDOT) through its on going pavement management procedures. The system is currently being implemented and is expected to be used by most cities and counties within Washington State.

The joint efforts of the cities and counties in the development, implementation and training associated with the final PMS was very successful. This should help to develop an improved environment for the overall management of pavements within the state.

The system was implemented on IBM-PC type hardware and is structured so as to provide a complete stand alone management system for pavements as well as for general inventory, traffic and other pavement related data. The software is still under development with the final release expected in spring of 1987. However, a full working version is currently under evaluation and has been released to several cities and counties with satisfactory results.

INTRODUCTION

This effort started from a joint interest within the state for the implementation of the WSDOT PMS for each of the individual cities and counties. The State Aid Office helped develop this interest and the mechanism for implementing it by providing microcomputers and partial funding for the implementation of the program. Additional funds were provide by the state research office and by the individual agencies themselves. It was also decided to have the University of Washington do the work through the Washington State Transportation Center (TRAC).

The actual implementation for the development of the PMS was structured around two committees and their interaction with the University of Washington. The first committee (the Steering Committee) had the responsibility for funding and overall guidance while the technical committee was responsible for the technical guidance and direct interaction with the University personnel. The project followed an earlier feasibility study which provided the initial guidance as to if and how the existing state PMS could be modified and made to work for county use. (2)

COOPERATIVE DESIGN EFFORT

Interactive Committee Structure

The technical committee was made up of representatives from various cities and counties of varying size and geological location. Also, several state personnel played an intermittent role. The meetings all took place at the University of Washington at approximately two to three week intervals over a period of about nine months.

The basic procedure was to develop an outline for the program and to work through this step by step at each meeting and review the results from the previous time period. The actual user's reference manual was developed during and through this interactive process along with the final structure and detail of the program. Also, the detailed instructions for the programmers were developed and agreed upon through this process.

Joint Implementation and Training

The cities and counties are working together in the training programs which have developed out of this work and are in the process of developing their own support personnel for the ultimate implementation and support of the system state wide. This program should prove to be a model for other states and agency groups to follow.

RESULTS

Introduction

This is a short summary report of the pavement management project which provided the funding for the development of this Pavement Management System (PMS). The user's and training manual and reference guide, which will come out of the final phase of this project, should be used for more detail. The project analysis portion of this computer package originated within the Washington State Department of Transportation's (WSDOT) Materials Laboratory and was developed around the states long term goals for managing its highway system. The automation of the WSDOT system and its implementation on a microcomputer was actually initiated by the city and county agencies within the state through their combined foresight in understanding the future role of microcomputers and their effective use as a management tool.

The primary objective in the development of this system was to develop a single package which could be used by all agencies within the state, thereby providing a uniform mechanism for

comparing each individual need as it relates to funding and long term planning. This was accomplished through joint cooperation among all interested agencies within the state and the University of Washington. Therefore, the resulting package is a combination of all the different requirements of these agencies. This has resulted in some data entry items and a program structure that would have developed differently given a more unified design criteria from a single source. However, it is felt that this approach has produced a more versatile program that should have appeal to a large variety of end users.

The program was developed using a database management system called Revelation and runs on top of the PC/MSDOS operating system, thus giving full access to it. This also gives full access to any DOS function or to any desired software which runs under PC/MSDOS. The program runs on the IBM PC/XT and AT and most compatible microcomputers. The Revelation database system has many advantages, the primary one being that the system only stores the information (data) which is entered (that is if a value is not entered no disk space is used or required). It also contains a powerfully structured implementation of the BASIC programing language. These two features allow complete freedom in defining the number and size of fields and how the final structure of the program appears and interacts with the end user. This can be done without concern about wasted data storage and other problems inherent to other database programing environments. Also, this database system can be compiled for faster operation and easier low cost distribution. The only disadvantage is that for smaller files, its performance is somewhat slower than for some of the more popular microcomputer based database management programs. However, its relative performance as the file size increases will eventually surpass most other packages.

The program combines several options for entering the pavement management data and how that data is handled, analyzed and presented. The basic premise on which the project analysis is based is that of developing performance curves from actual pavement condition rating (PCR) data or from default performance curves (either provided by the program or specified by the end user). Also, the user can use any combination of the above within a given roadway system or combine this with a process based on a simple visual rating scheme. These performance curves are then used to predict optimum project level repairs based on user definable rehabilitation alternatives, their relative performance curves and cost data. Also, a network level analysis is available which gives the overall network level cost to maintain a given level of overall network performance, or it can be based on budget constraints.

The primary advantage of the design of the this package is its ability to be modified and continuously updated to meet each individual end users application. This is accomplished through the different options which are built into both the database and

project analysis portions of the program. These modifiable variables allow the end user to "fine tune" the final system to a particular application. They also allow for extreme variations within a given application. The key items or concepts associated with this are the following:

a) User defined and modifiable performance curves for both the existing pavements and the rehabilitation alternatives.
b) User definable rehabilitation alternatives and their respective performance characteristics.
c) User definable repair strategies and their respective applications and costs.
d) The ability to select the source of the performance curves from any combination of the following options: 1)curves are calculated from field collected, pavement condition ratings, 2)program provides or user specifies default curves, or 3) curves are computed from visual ratings which consist of a simple, subjective visual approximation of the overall characteristics of a given segment.
e) A flexible, hierarchical project level file structure with built-in variable structuring capabilities.
f) A versatile network level numbering and categorizing system.
g) A user definable data input structure for project sampling, inventory, traffic and repair data.

The program also contains the capability for maintaining general inventory data, traffic data and a repair and history file. The program can be used for maintaining a complete record of all of the above information.

The user of this software package should note that this program provides an agency with a relatively simple tool for evaluating their overall road/street network. Sound judgement and good design practice is still required to implement annual maintenance and rehabilitation programs.

SOFTWARE SPECIFICATIONS

The software required to run the program is either a runtime version of the Revelation database management system or a complete Revelation Development Package, and of course the PMS software which was developed using Revelation. Revelation is a complete programming environment and could be used for all business and some scientific applications. It is also available in a networking version. This allows for multiple access to the same databases with all the file locking and protection that is necessary for maintaining a large system with multiple data entry and access.

HARDWARE SPECIFICATIONS

The hardware requirements are an IBM PC/XT or AT or most any compatible. The computer system used must have a minimum of 512K of memory and a compatible graphics printer. It should also have an 8087 math co-processor, a color adapter (graphics) and a hard disk. And For the larger agencies a larger hard disk with a cartridge or other hard disk back up system is recommended. Without all of the above options the system will not perform to most individual agency requirements and will become completely impractical unless it is a vary small application. For the larger agencies it is recommended that an AT machine be used or that one of the enhanced processor cards be used in the XT. Some of these cards claim to surpass the AT performance, but try it first. The 8087 or 80287 math coprocessor is a must for running the optimizing program. It will reduce the overall run time by a factor of 30 to 40. Also, the Revelation package uses the 8087 extensively.

USING THE PROGRAM

Introduction

A thorough understanding of the user's guide and reference manual is necessary in first learning to understand and apply this software package. Once the system is understood only the input field definitions and/or the help screens will need to be consulted to answer questions which may arise while entering information or collecting field data. Each individual input variable is keyed to the Form or data entry screen number where it is to be entered. This is to aid in locating and understanding the relative locations of these different data fields.

The user interface to the program is through a system of menus and on-line help screens. The help screens can be accessed at any point in the program for information relating to the specific item the user is currently at by simply pressing the F1 key. A higher level of help is also available through a separate help menu screen. Most of the Users' Guide is accessible in one form or another within the help options. It is possible for a user having only a basic knowledge of how to access the help procedures and of the basic PMS program file structure to learn how to use this system from interacting with the computer.

The complete Menu system and related data entry screens are given in appendix A and B. The individual menu items are relatively self explanatory, and with a basic understanding of the overall pavement management system concepts in use, the user can maneuver through the system with relative ease. Remember that at any point the F1 key will give help information relative to that position in the program and a carriage return will return the curser to the original point in the program.

The file structure, as it relates to the pavement management portion of the program, uses a project level file to define the basic roadway information and to which all other information, within the project relates back to. The project breakdown of the overall roadway network system is generally related to a roadway section of uniform construction and characteristics and should be related to an actual or potential repair or initial construction project. All other information within the PMS is eventually related back to the project level. This includes all performance curve calculations, project level repair strategies and network budgeting and prioritized repair listings.

At the pavement and geometric data level of the program the system is broken down into two sub-levels to help accommodate data entry, collection and system management. These are the segment level and sample unit level. There is some flexibility in this definition to help accommodate different applications. That is, if a single segment is used the project and segment levels are in essence combined and basic field data entry, if desired, can still be done at both the segment and sample unit level. The geometric data can be entered at both the project and segment levels depending on the consistency of the relevant data and on the desires of the user. Also, the PCR data can be entered at the segment or sample unit levels depending on whether continuous or spot sampling techniques are used. See figure 1 for the basic program structure.

Only the project and segment level descriptive data is required if the program is to be used for a data entry and inquiry system only. If the visual rating data is added (Form 3 - 23,24 & 25) to this the complete pavement management system is accessible. From this point only time for accumulating the required pavement condition data and the desires and understanding of the user restrict the full use or implementation of the complete software package.

The proper division of the agency's system into individual uniform projects is essential for the project analysis portion of the program to function as designed. The performance curves are computed (or averaged) at the project level and both the project level optimization and the network budgeting calculations are centered around this concept. For the system to function properly (that is, to give realistic results for both the performance and budgeting portions of the program), uniform project definition is essential. The individual projects can be subdivided and/or linked together at any point and the project limits can be redefined through the use of the setup menu entry screen.

General Capabilities of the Program

The program consists of 22 menu selection screens, 10 of which would be considered the primary program access screens (See appendix A and B for more detail). There are over 100 menu and data entry screens in total. The User's Guide and Reference

Manual should be consulted for complete detail and use of these screens. Built into this program menu structure is the access to the normal data entry screens for the different input data forms and for the input data for the analysis portion of the program. All data is keyed to the form number and location and to the project in which it was collected. The structure is organized so as to minimize the complexities and learning time associated with the application of the program.

Additionally there are several key features which greatly enhance the use and application of the program. This includes a general custom report generation menu which allows the simple creation of custom reports which can contain any portion of the data within the system in any desired field order and sorted by any field or multiple level of fields.

Also, the data can be sorted or divided into any subset and stored in a new or separate DOS subdirectary. This allows for easier and quicker handling of larger databases and for a convenient way of handling the repair file. Access to these different subdirectaries is available within the program. Some of the other features of the program are: 1) projects, segments, and sample unit data can be deleted in groups or as separate items, 2) data can be averaged for segments and/or sample units, 3) general and detailed help screens are available for all features within the program, and 4) the program will automatically print its own data input forms, which includes all pertinent project identification data and previous surface condition rating information. There is also a setup menu which allows access to the different input variables as well as giving access to the setting up of the system for different computers, printers, and plotters.

Program Input and Output

The program has the ability to generate its own data input forms (See appendix B). The initial set up of the system requires the use of Form 1 and Form 3. Copies of these forms can be generated using the program. Once data has been entered on these forms, all subsequent forms can be generated by the program with all the relevant information already printed on the forms. This helps to reduce the hours required to fill out these forms and will reduce the chances for error. The previous years PCR data can also be included if desired.

The program will also generate custom user definable itemized type reports of all the data contained within the program. There is also an option to help locate and define what information is in the system. It will list all project numbers with their associated segment and sample unit numbers. This includes the inventory, traffic, repair and history information.

All files are referenced to the project in which they are collected. This includes the inventory, traffic, repair and history files. The inventory, traffic and repair data is entered into the system in a general type format which contains the beginning mile post (BMP), ending mile post (EMP), the date, and the comment information with each individual entry. Through the use of the BMP and the EMP the program will associate these data with the appropriate segment/s. The BMP is referenced to the beginning of the project or segment in which the data is collected. If the EMP is blank or zero the program assumes a single point or sample unit type entry. A situation in which the BMP and the EMP is set to zero(blank) implies that the associated information is related to the overall project.

The program allows the user to modify the project limits. This includes the division of individual segments between adjacent project end points as well as the subdivision or combination of separate projects or segments. If a segment is split between two adjacent projects, the data associated with the original segment are stored with both the new segments, which are formed as a result of the subdivision. When combining or modifying project boundaries the user is given the option of which data to retain.

The program is made up of two basic parts, the data entry editing and display section, and the project analysis section. The project analysis section has several input variables which are user definable or the program will supply default information. One of the key input variables is the deduct array which defines the relative deduct values associated with each of the pavement condition rating parameters. To comply with the intent of the program the state has provided a deduct array which will be used to make relative comparisons among the different end users. To allow each agency to comply with this criterion and still have or experiment with their own deduct values, the program maintains two deduct arrays and allows the user to modify all of these values and to do the analysis based on either one or both. (1)

Example Applications

Washington State and Counties

Currently Washington state and its counties are using the system as follows. They have their entire road networks separated into construction projects, with modifiable limits, which are then subdivided into equal segments(0.1 miles for the state and 0.5 miles, in general, for the counties). Pavement Condition Ratings (PCR's) are then taken over approximately 200 foot long sections (complete surface for most counties) near the center of the segment. Field testing of a semiautomated microcomputer based pavement rating device, which is to to be used for recording, storing and analyzing the PCR data over the complete surface area is currently being done. This will result in a tool which will

improve the quality of the data collected and the speed at which it can be obtained and put into the program. The PCR data is stored at the segment level and the geometric and structural data is stored at the project level. The actual visual rating portion of the program is not used (F3-23,24 & 25). The data entry sequence for this application is Forms/Menu Screens 1,2a,3 & 4a.

Washington Cities

A typical city approach which is being used in Washington state is to define the individual project as a single intersection, or from intersection to intersection, or as a group of city blocks of uniform construction and geometrics. In general, the segments would consist of individual blocks and the PCR data is collected as spot samples at the end of each block (the segment) or at 1000 foot intervals if the segments are longer. Some cities are doing PCR's measured over the complete project surface. Intersections, which are paved and maintained separately, are entered as individual projects (or segments) depending on the individual agency's preference and can be completely separate or duplicated within other projects and/or segments by use of the pavement exempt flag. The two node variables are being used by Bellevue to enter the intersection numbers which are used as reference points for their CAD mapping system.

The geometric and structural data would be collected at the project level. The data entry sequence would be Form/Menu Screen 1,2a,3 & 4b.

PAVER Conversion

In converting directly from PAVER, the recommended input sequence follows that of the state and counties (Form/Menu Screens 1,2a,3,4a). By this programs terminology the sections become projects, and the samples become segments. (Another and possible better conversion would be to assume the project and segment to be the same and enter the PAVER samples as sample units, Form 4b. Then at a later date the user could go back and separate the projects into multiple segments if desired.) For random sampling, only some of the segments would contain PCR data. The program accounts for this automatically and does whatever is required to get proper averages as a function of total area and/or lengths. The Branch concept is maintained by use of the Road Number variable in Form 1 of the program. This is set equal to the Branch Number. The program then allows the user to list this variable with all reports or to categorize the data and/or do calculations based on the Road (Branch) Number.

INPUT DATABASE STRUCTURE

Introduction

The project level data is related to separate roadway sections which are of uniform characteristics and should be related to actual construction or repair projects. There are two levels of data below (or subsets of) the project level. These are the segment and sample unit levels of data entry. A project is subdivided into segments which can be any size and the sample units are individual data samples which are referenced to the particular segment from which they are taken. Segments are usually individual city blocks or intersections or some equal increment of a continuous roadway section, while the sample units refer to intermittent pavement condition ratings, core samples, deflection measurements or other types of data which is collected within a segment at a specific point or over a small area. See Figure 1 for more detail.

Also, if there is only one segment per project the program automatically ignores the subdivision of these two elements. Therefore, the data that is collected at the segment level is assumed to be an average for that overall project and is stored at the project level. However, any sample unit data collected are still averaged over the project, where applicable, with the averages being stored at the project level. All averages, where applicable, are weighted by the relative length (or area) and also by the user definable weighting flag if specified. The program assumes the PCR sample unit data (F4b) to be separate inputs for the interpretive portion of the program if they are present and only a single segment exists. If data are only available for a single segment the program uses this single measurement as the performance rating for that year for that project. If sample unit data are not present, the program completely ignores this level of data operations.

If possible the agency should use a project numbering scheme which starts near a convenient central location, possibly near its maintenance facility. The system should radiate in a circular fashion in such a manner as to best accommodate future maintenance, repair and management plans. Numbering schemes can be used, such as combining zone or district numbers at the beginning of a five digit project number, to help locate and communicate information.

The project concept is essential for the proper operation of the project and network level analysis sections of the program. The performance curves, and the project level optimization and the overall network budgeting analysis are all computed based on the project as defined in the initial set up of the street network system.

Where applicable, all input data fields with variable type input such as Surface Type and Functional Class will have the capability of being modified or added to through the program setup menu. Data is not stored for all entries not having a specified default value if nothing is entered.

Project Data

Introduction

A recommended procedure is to use the projects as defined earlier, that is, to the highest degree possible define the individual projects (in sections as long as possible) over relatively continuous roadway sections with similar construction, geometrics and material properties. When actual construction is done and only portions of a project are rehabilitated, use the project boundary change section to redefine the new project at that time. If the complete project will be rehabilitated within one to two years it is recommended that the original project be maintained or reestablished at the time of completion. The pavement exempt flag can be used to remove projects or segments which are already slated for repair from being considered by the optimizing and network programs. Consideration should be given to the ease of locating information and to the ultimate use of and interaction with the final system. If the primary use is to collect and maintain the PCR data, a consecutive numbering scheme will help to ease the operators work and will reduce errors. Always leave an increment of at least ten between adjacent projects or segments for future changes or modifications.

In residential areas use individual blocks or intersection to intersection boundaries to define the project and segment limits. If intersections are in more than one project, use the pavement exempt flag to exclude its actual use by the program from the project of lower functional class or use. For a continuous roadway, use equal increments of about 0.1 to 0.5 mile to define the segments. This is the single most important step in implementing a PMS. Recheck all data and interdepartmental or agency coordination. Drive the complete roadway system with a complete listing of the PMS network. Make sure all project, segment and sample unit boundaries and definitions are realistic and accurate.

Project Data Entry Form/Menu Screen 1 (F1)

This is the primary input form and is used to establish the initial system boundaries. It is important that the projects be selected and laid out with care, the project analysis portion of the program depends on the careful definition and maintenance of

the these projects definitions. There are several project numbering schemes built into this form along with all the information relevant to the individual project description and boundaries.

Geometric and Structural Data Form/Menu Screen 2a (F2a)

This form is used to maintain the primary geometric, structural and drainage/shoulder information. This data can be entered at both the project (Form 2a) and at the segment level (Form 2b). The primary use of the segment level entry is to allow the user to enter changes or discontinuities which may occur within a current project or within the past history of the underlying pavement structure which makes up the current project. The general use of the segment level geometric and structural data is to supplement the project data. That is, if roadway structural or geometric data such as width, underlying pavement thickness, type or varying subbase materials should be encountered, this can be recorded at the segment level. Also, if varying drainage conditions are encountered a single entry in the segment at which this occurs will enable the user to keep track of this information. The program will automatically use the worst case data where applicable and will assume that once a segment entry is encountered that that information is applicable until another segment level entry change occurs.

The project level entry is the primary entry and this information is assumed consistent until the program encounters a segment level entry, at which point the new information will take precedence.However, segment level entry(Form 2b) can be used exclusively if desired. One of the most important pieces of information which can be entered here is the current pavement's year of construction. This and some of the other information may be difficult to obtain, but as much as can be found will help. The program makes use of most of the information in this form, if it is available, when generating default performance curves.

Segment Data

Introduction

The segment level of the program is designed for data entry, editing, and previewing of all information associated with the individual segments which make up a given project. A project can be separated into as many segments as desired. Each segment can have sample unit data associated with it. If the pavement condition ratings are taken as individual spot samples and there are to be more than one per segment, this information is entered at the sample unit level (F4b) and the program will average these

samples and store these averages at the segment level as well as at the project level. If the pavement condition rating data are collected as continuous data or there is only one spot sample per segment, this information will be entered into the database at the segment level. All segment level pavement rating data (F4a-21 thru 40 and/or F3-23 thru 32) is keyed to or stored by the year in which the survey was taken. This data is stored permanently and is automatically accessed by the interpretive portion of the analysis routines when computing performance curves for the individual projects.

The visual rating data are entered at the segment level (Form 3) and are averaged internally and stored at the project level of the database. The averaging is automatically weighted according to pavement length (area) and by the separate weighting flag if specified. The program will use the visual data in place of actual data if the operator sets the Rating Flag equal to 2 (F1-06). The visual data are not averaged for the different years; the data for the last year entered are used for the current analysis. The visual data will allow the analysis portion of the program to function as designed prior to the minimum of the three survey periods (2 years of surface condition ratings plus the original construction date) if the user desires. Also, this will allow the agency to have a mix of visual and Pavement Condition Rated streets within its network. These visual ratings, if used in conjunction with the actual surface ratings, also serve as an internal reference against which to check computed data and as an internal flag to advise the user of potential problems. Also, the visual data can be used in place of the PCR data if bad or questionable data are encountered. They are also used to make programming type decisions and help to enhance the overall performance of the system. The overall system will operate from visual rating data only if desired or necessary. Data list and reports can also be keyed to these fields.

Geometric and Structural Data Form/Menu Screen 2b (F2b)

The geometric and structural data can be entered at the segment level (Form 2b) in place of or as well as at the project level. In general the segment level entries are used to indicate where discontinuities exist in a particular variable within a given project. An example is when a new pavement project is laid over an existing roadway which consisted of more then one pavement type (combines two old projects). Another example is where the soil or drainage conditions change substantially within a given project. The program will prompt the users to whether they want to override the project level data or leave it as is. This is done on a project by project basis. If projects are combined and there are differences in form 2a, the program will put the form 2a data into form 2b. This form can be used in place of form 2a if desired.

Segment Data Entry Form/Menu Screen 3 (F3)

This form is used to define the individual segment boundaries, the segment level variables and the visual ratings. It is recommended that the visual ratings be taken and maintained each survey year. Current visual data allows the program to make many internal decisions which will enhance the overall performance of the program as well as allowing the end user to run any part of or all of the system without PCR data (Forms 4a or 4b). As a result of the nature of the PCR data, there will always be a few segments and or projects for which there is insufficient data or the data is questionable, and some internal decision must be made as to how this project/segment will be handled. The program allows for either default performance curves or for visual data to be used in such cases. It is important that the agency carefully examine these options and that a realistic alternative be provided for each project.

Pavement Condition Rating Form/Menu Screen 4a (F4a)

This form is used for collecting the actual pavement condition rating data. A photographic guide to the various distress severities and extents should be consulted prior to and during the survey period. It is recommended that the raters attend training courses and that they be retrained prior to each field survey. Surveys are generally taken every two years, but may be taken at a yearly interval.

The visual rating data (F3 -23, 24 & 25) on this form are stored and maintained by the year in which the data were collected. These data are stored permanently and are automatically transferred to the history file when a street is rehabilitated or rebuilt. Extreme care must be taken in collecting consistent data for each project on each survey or the project level analysis portions of the program will not function properly and the overall objective of the pavement management system will be lost.

This information can be entered at either the segment or sample unit levels. The segment form (4a) is used for continuous or single point spot sampling (PCR) while the sample unit form (4b) is used for multipoint spot samples within a given segment. Both data entries can be used for different projects within a given agency's application. The program will automatically handle this operation if sample unit data (Form 2b) are present. These data are averaged over the individual sample units and/or segments to the project level. The interpretive portion of the program averages the segment and/or sample unit data to compute a performance curve for each project.

Individual slab data for PCC pavements can be maintained using the the sample unit data entry form 5. See project sample unit entry number F5-113.

There are two separate Forms/Menu Screens for this entry; one for flexible pavements (asphalt concrete and bituminous), and one for rigid pavements (Portland cement). The program will automatically produce the proper form/menu screen based on the pavement type which was entered in form/menu screen 1.

Sample Unit Data - Pavement Related

Introduction

The sample unit level of the project database is used for entering information that is associated with individually sampled data such as point (small area) pavement condition ratings, pavement coring data, deflection testing, etc. These data are directly associated with the segment in which they are collected.

Pavement Condition Rating Form/Menu Screen 4b (F4b)

For spot samples any combination of the BMP, EMP, their verbal description, the roadway width and comment entries can be used to define and locate the individual spot samples. These same sample areas should be returned to and used for subsequent PCR sampling in future years. See F4a for more detail.

General Sample Unit data entry form - Form 5 (F5-xxx)

This is a general form and is used for the pavement related sample unit data as well as for entering data into the inventory, traffic and repair files. All entries used on this form have thirteen common fields. These are the code number, date, BMP, EMP, nine data entries and the comment fields. Recall that in Revelation only the data that is entered is actually stored, therefore, if a field does not pertain to or is not relevant to the item being collected, leave it out and/or disregard its use. There is a simple code numbering scheme used by the program for the different files associated with this form. They are as follows:

- 1xx - Pavement related sample unit data
- 2xx - Inventory data - project related
- 4xx - Traffic data - project related
- 6xx - Repair data - project related

The only item which is necessary within this section of the program for the pavement management analysis to work is the Traffic Index (TI) value or sufficient traffic data for the program to define this variable.

General Format for entering sample unit data:

Code Number,Date,BMP.EMP,Data(D1 to D9),Comments

Pavement Related, Sample Unit Data Entry Form/Menu Screen 5

Pavement related, sample unit data entry is made at this point in the program. This includes such items as pavement core data, deflection data or any type of individual sampling that relates to the pavement, base material or soil. Existing data entry headings are given below. Additonal headings and discriptions can be defined by the user and added to the program at any time.

Identify Special Features in Segment

Code Number

101 Core Sample
102 Deflection Sample
103 Skid Resistance Measurement
104 Ride Measurement
105 Roughness (ride)
106 Surface Distress
107 Structural Evaluation
108 Profile measurements
109 Material Samples, Soil, Base etc.
110 Moisture Sample
111 Temperature/Freeze Depth Measurement data.
112 Water Run Off Sample.
113 PCC Slab Data
114 Misc PAVER Data
115 House/Parcel Number
199 General Input - use comment to describe what it is.

Inventory Data - field Definitions and Descriptions - Form 5

Introduction

The inventory file is, in general, designed for handling the minimum number of inventory items which are intended for use or needed to effectively operate the pavement management system. However, the data entry and item definition scheme which is used lends itself to a relatively simple but universal type of inventory system. Users can define any list of data item titles and subtitles and the general custom report writing features will allow them to list and categorize whatever is desired. Also, a

simple software interface can be provided for transferring existing inventory files to or from this or any of the other individual files.

The setup menu allows for the addition or modification of the data entry items in all of the form 5 data entries. This includes the pavement related sample unit data (F5-100's), the inventory data (F5-200's), the traffic data (F5-400's) and the repair data (F5-600's). It will prompt you to enter the information which is presented on the screen when the particular code number is entered. Entering an existing code number will allow you to edit the existing inputs while entering a new number will allow the set up of a new entry item. The user will have to keep a record of what each code number represents and what the subvalues stand for. This means that any definition can be redefined or the user can add any new entries that are desired.

Inventory Data Entry

This section of the program uses a general format for entering individual inventory items. The agency will be able to define an additional list of inventory items through the system setup menu. These items can be listed as a group, individually or through simple logical arguments in the general report section of the program or directly through Revelation. Also, some simple report generation options are available.

The Inventory data is referenced to the project in which it is collected. The BMP and EMP variables are referenced to the beginning of the project and will attach the information to the appropriate segment when relevant. A BMP value with the EMP left blank or set to zero indicates a sample point type entry. No BMP or EMP implies that the entry applies to the overall project. If both are set to a value the sample is related to that area of roadway. For most purposes a simple visual estimate of the BMP will be sufficient. Also see the reference manual, the UAB manual and county road log for more detailed descriptions of these inputs.

General Data Input Format

Code Number,Date,BMP,EMP,-Data (D1 - D9)- ,Comments

Code Numbers - Entry

201	Area Numbering System
202	Location/Responsibility Information
203	Mapping Information
204	Utilities
205	Intersection Information

206	Roadway Information (Geometric/Ownership)
207	Curbs
208	Shoulders
209	Parking Lanes
210	Crosswalks
211	Handicap Accessibility
212	Medians
213	Bridges
214	RR xings Information
215	sidewalks
216	Bikeways
217	Pathways
218	Horizontal Alignment
219	Vertical Alignment
220	Intersection Geometrics
229	PCC Slab information
299	General Inventory

Traffic Data - Field Definitions and Descriptions - FORM 5

Introduction

The traffic file is a simple attempt to supply a minimum of traffic data entry, storage and retrieval capabilities. Additional data entry items can be defined through the program setup menu. Report generation and inquiry capabilities are also available in the general report generation portion of the program. Also, see the discussion at the beginning of the inventory section.

Traffic Data Entry

General categories and code numbers

Code numbers	Categories
401	Truck/Transit/Mail/School Bus Routes
402	Traffic Roadway Count and Statistics
403	Traffic Intersection Count and Statistics
404	Truck Counts
405	Traffic Factors
406	Traffic Control
407	Geometrics
408	Railroad Information
409	Accident Data
410	Intersection Information

Repair/Maintenance Data

Introduction

The repair file has several different but related uses. The first is to generate a file (a DOS subdirectary) which contains all of the projects which have been recommended for repairs either by the program or by the operator (See Repair Flag F1-07). This file contains all of the data from the projects, segments and sample units which have been specified for repair and which are contained in the master database files. This file is designed for use by maintenance personnel or others who need to display or transmit this information within the agency. This file was designed to allow the end user to update or change any items that are needed as a result of maintenance or repair operations. This file is generated by the program and any changes which are made in it will not be reflected or made in the main or master database.

Secondly, through an independent procedure, built into the program, the operator can update the master file using the repair file. This can be done without the need for more than one person or department to have direct access to the master database. This helps to ensure a higher degree of security for the master database and allows a uniform and controllable method of updating and maintaining the system. This can be done automatically or manually.

A third use is to give an independent file to experiment with and/or modify in planning actual repair procedures and priority scheduling. The projects in question can be reevaluated and the master database updated and analysis rerun if necessary.

The final use is for entering and maintaining information on individual, sample unit level repairs such as spot repairs, pot holes and utility cuts. The location, size, condition and status of each item can be stored and updated as needed. It is a good idea to have the field crew carry several form 5 sheets and have them record all obvious spot repairs and areas of the roadway which need immediate attention or that should be monitored for future action. The BMP should be referenced to the beginning of the project and should be close enough to allow a repair crew to locate the defect. A rough eyeball estimate should be sufficient in most cases. This information is maintained and stored along with the other repair records and can be accessed directly through the report or display options within the program or through Revelation. This means that the maintenance personnel can access the F5-600 data directly through the repair file or the master data file to get a list of all spot repairs, such as potholes, for the complete roadway network. This will help in scheduling and assigning duties to repair crews.

Major Sources for Repair Information

Obvious Major Repairs - Operator specified in Project file.
Repairs Generated by Program - Priority Array
Sample Unit type repairs, specified by the field crew.

Repair File Entries

601 Maintenance Information
602 Spot Repairs
603 Utility Cuts
604 Pot Holes
605 Crack Sealing
606 Edge Patching Repairs
607 PCC Slab Repairs
608 Drainage Repairs
609 Induction Loop Repairs
610 Traffic Control Devices
611 Street Lighting
612 Brush or Tree Removal
613 Utility Repairs
614 Excessive Cracking

History or Work Completed Data

The history file is used to store several types of historical data. These are the following:

1) Old pavement condition rating data, which are stored, separately for each survey year, for roadways which have been repaired or replaced.
2) History of work completed at the project level. This is also stored by the year in which the repair was completed.
3) Old project data which has had limit or boundary changes.
4) Old pavement log data.
5) Old traffic data.
6) Old inventory and repair data.

This information is not used directly by the program and is accessible through the history subdirectory general report and inquiry sections of the program for whatever use the end user may wish. (Not implemented at this time)

Input for Analysis Routines

Introduction

The analysis portion of this package is based on a system which was developed by the WSDOT's Materials Laboratory over a period

of several years. The system is made up of three separate modules, which in themselves best represent the internal operations of the analysis portion of the system. The first module is referred to as the interpretive (INTERP) section and in essence takes the performance values computed from the PCR data for the different years' surveys and fits an exponential curve to them, which then becomes the performance curve for that project for that given year's analysis. If insufficient or inconsistent data is found the program substitutes either default performance curves or performance curves based on visual data (See F1-06 and 08).

The second program is a project level optimizing routine (OPTAL) which is based on a simple scheme of computing cost for all possible alternatives for a given repair strategy. These repair strategies are established through a series of different input variables. These inputs are listed and defined in detail in the User's Reference Manual.

The last routine is a network level, project repair prioritizing program (NETWORK), which can be run based on either a preselected performance level for the entire network or on a preset budget constraint. The final output is a prioritized list of the selected repair projects and their relative costs. This report also contains any projects specified by the user, see F1-07.

Default Performance Curve Data

Default performance curves are needed for both existing pavement type as well as for the different rehabilitation alternatives. These curves take the following general form.

$$R = C - mA^{B}$$

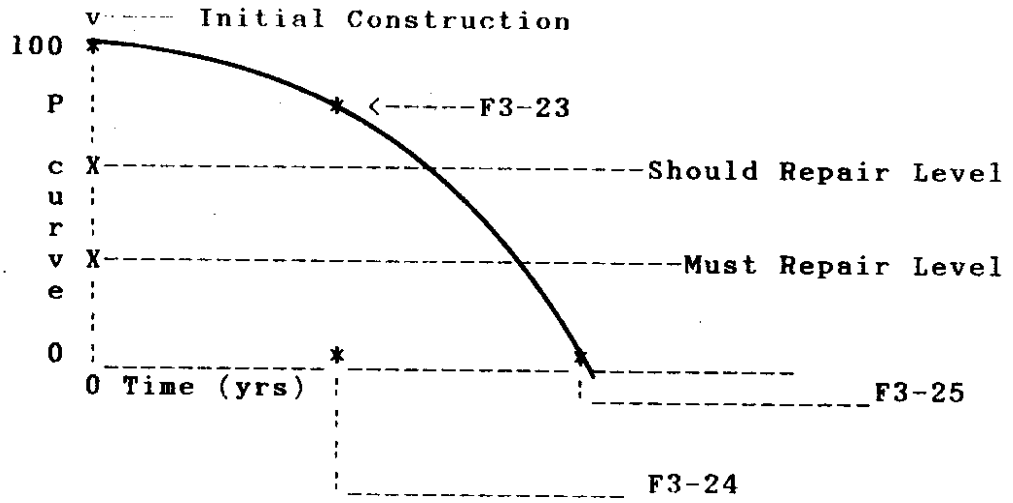
where:

R = Pavement Rating value
C = Constant = 100
m = Slope parameter
B = Curvature parameter
A = Age or independent variable

Visual Performance Curves - Computed form Visual Data

The program uses the performance curves computed from the visual data when specified through the use of the variable F1-06. The visual performance curve is computed from the visual data

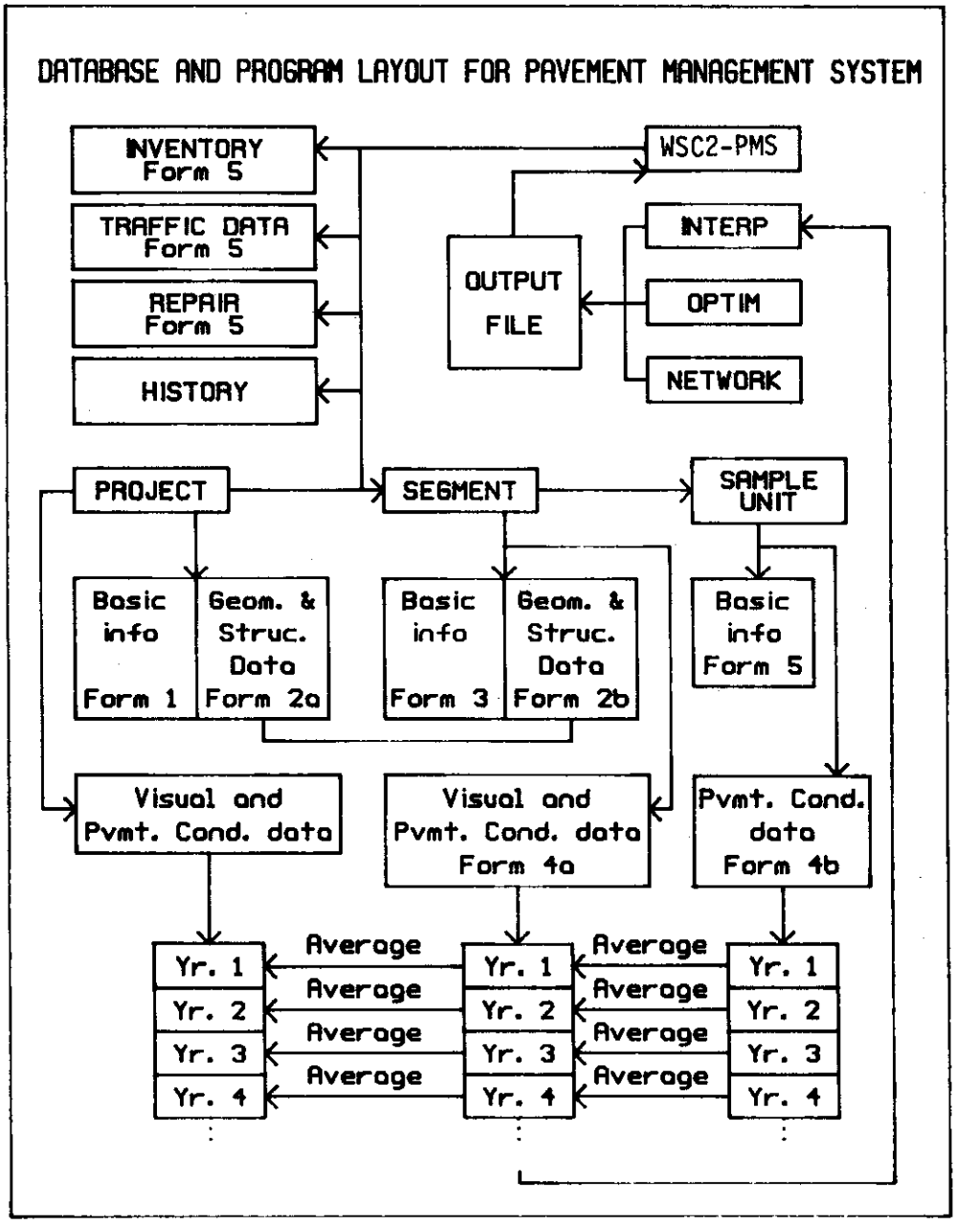
(F3-23 thru 25) as shown below. An initial rating of 100, plus the F1-23,24,& 25 variables establish three points on the performance curve as illustrated below. This allows the simple computation of an exponential curve which fits through these points which is represent by the above equation. This curve is shown on the graph below.



References:

1. Nelson, T.L., "Development and Implementation of Washington State's Pavement Management System", WSDOT Report WA-RD 50.1, Materials Laboratory Report No. 177, September, 1982.

2. Kulkarni, F., "Feasibility Study of a Pavement Management System for Washington Counties", WSDOT Report WA-RD 62.1, June, 1984.



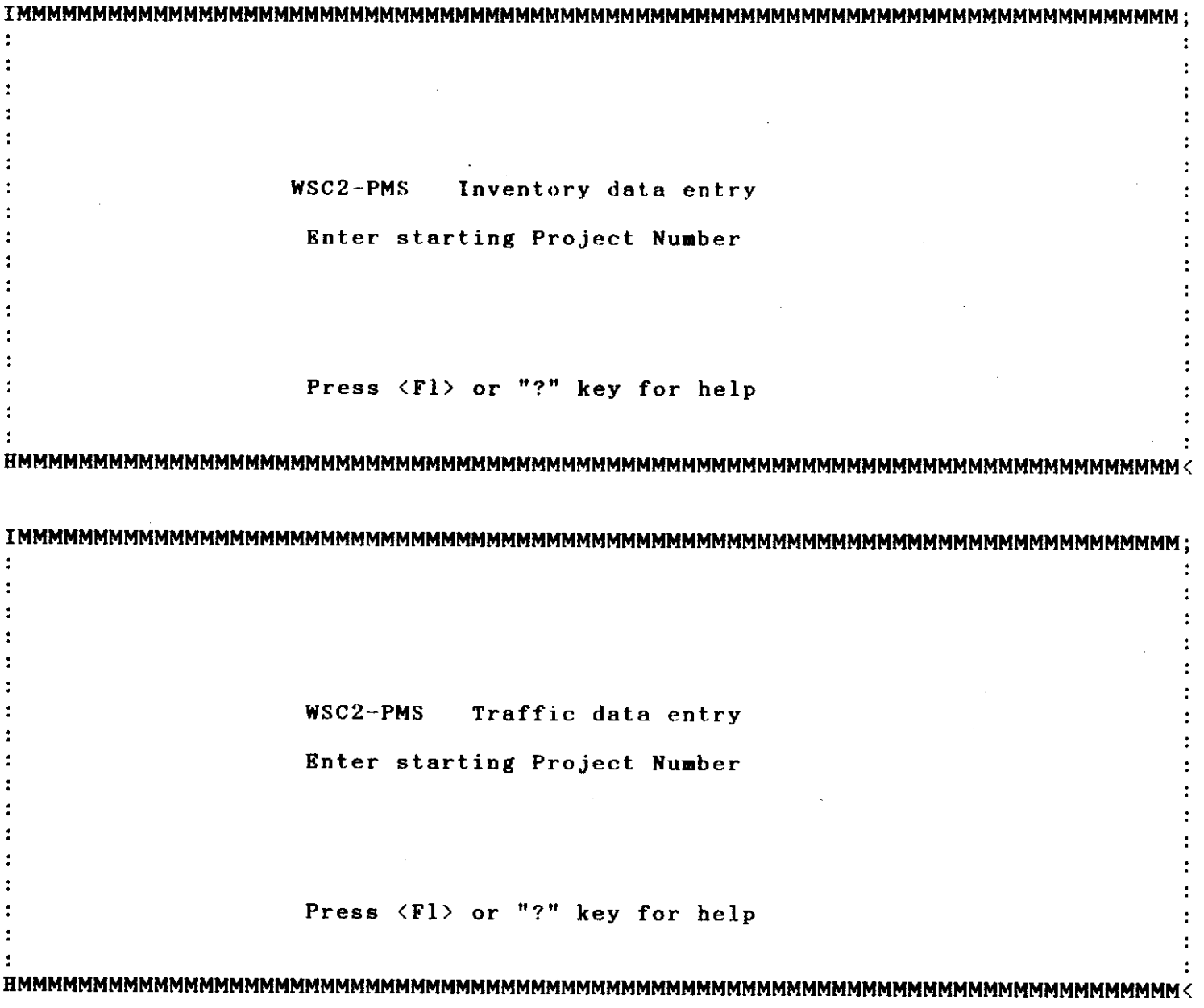
Firure 1. Block Diagram of Program

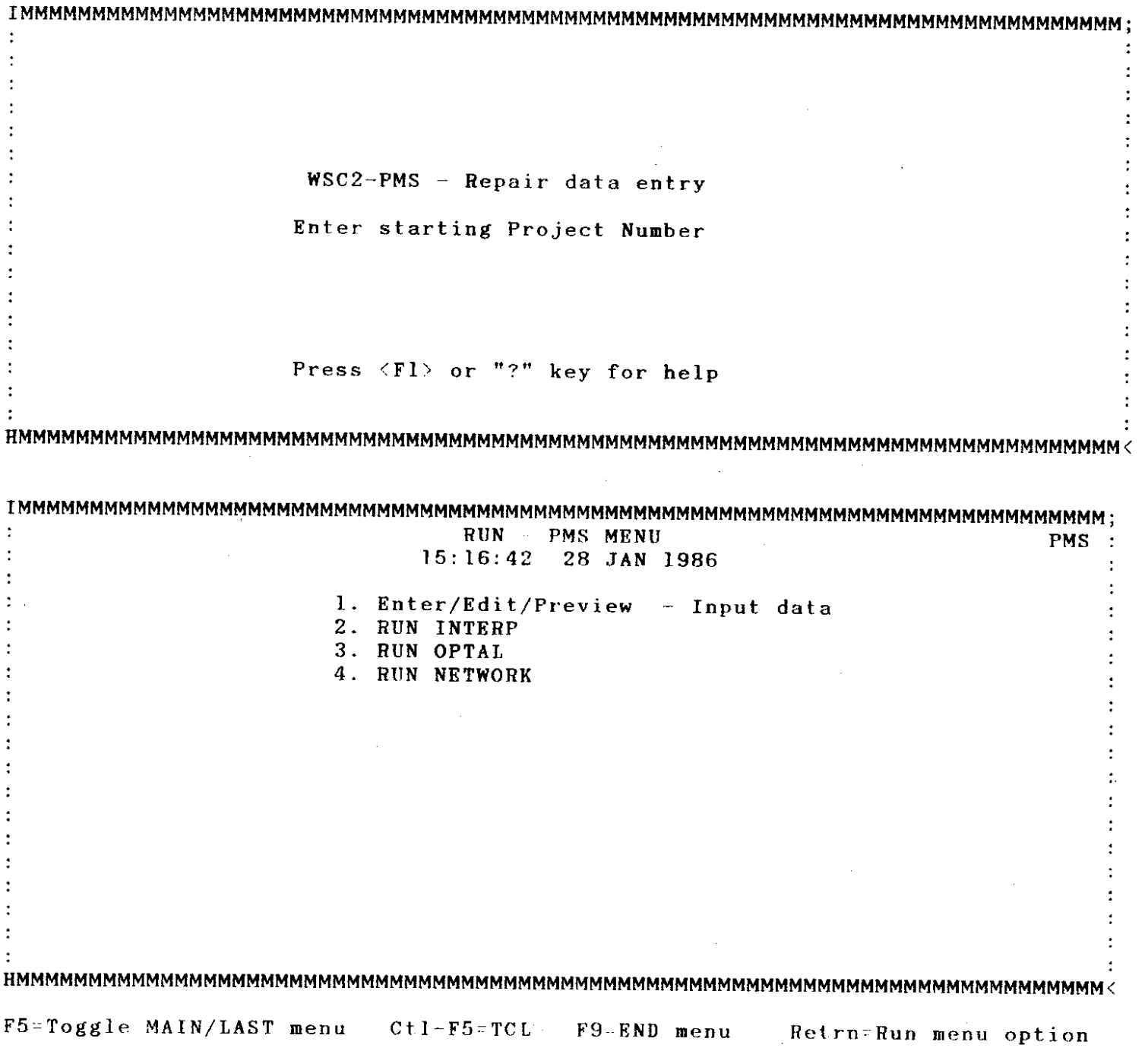
APPENDIX A

MENU SCREENS

```
PAVEMENT MANAGEMENT SYSTEM - MASTER MENU                    PMS
                    09:16:06  28 JAN 1986

                    1. Master Proj/Seg/SU file menu
                    2. Project Inventory entry
                    3. Project Traffic entry
                    4. Project Repair entry
                    5. RUN-PMS menu
                    6. Preview/Edit/Update Menu
                    7. Master Report menu
                    8. Help/Disk Back-up menu
                    9. Set up/Installation menu

F5=Toggle MAIN/LAST menu   Ctl-F5=TCL   F9=END menu    Retrn=Run menu option
```

```
                        Main add / view menu

                    1. Add / View Projects (Forms 1,2a)
                    2. Add / View Segments (Forms 2b,3,4a)
                    3. Add / View Sample Units (Forms 4b,5)
                    4. Performance curves (Project level)

        Ctrl F5 - Abort     F9 - End menu       RETURN - Run menu item
```


WSC2-PMS Inventory data entry
Enter starting Project Number
Press <F1> or "?" key for help
WSC2-PMS Traffic data entry
Enter starting Project Number
Press <F1> or "?" key for help


WSC2-PMS - Repair data entry
Enter starting Project Number
Press <F1> or "?" key for help
RUN PMS MENU
PMS
15:16:42 28 JAN 1986
1. Enter/Edit/Preview - Input data
2. RUN INTERP
3. RUN OPTAL
4. RUN NETWORK
F5=Toggle MAIN/LAST menu
Ctl-F5=TCL
F9-END menu
Retrn=Run menu option

```
PREVIEW/UPDATE MENU                                                    PMS
15:17:54  28 JAN 1986

        1. Subdirectory utilities
        2. Find/List Project/Segment number(s)
        3. Field definitions
        4. Update database
        5. Delete record(s)
```

F5=Toggle MAIN/LAST menu Ctl-F5=TCL F9=END menu Retrn=Run menu option

```
WSC2-PMS subdirectory utilities

        1. Create a conditional subdirectory
        2. Read data from floppy to a subdirectory
        3. Backup a subdirectory on floppy
        4. Move data from main area to a subdirectory
        5. Create a dummy subdirectory with empty databases
        6. Specify/De-specify a default subdirectory
        7. Update data in a subdirectory from data in another
        8. Attach a subdirectory
        9. Remove a subdirectory
```

Ctrl F5 - Abort F9 - End menu RETURN - Run menu item

```
                              Database Update


          1. Compute all distress values and default P-Curve parms.
          2. Average segments for specific projects
          3. Average segments for ALL projects
          4. Average sample units for specific segments
          5. Average sample units for ALL segments
          6. Perform #1 and #3
```

Ctrl F5 - Abort F9 - End menu RETURN - Run menu item

```
                            RECORD DELETE MENU


                    1. Delete Project(s)
                    2. Delete Segment(s)
                    3. Delete Sample Unit(s)
                    4. Clear all databases
```

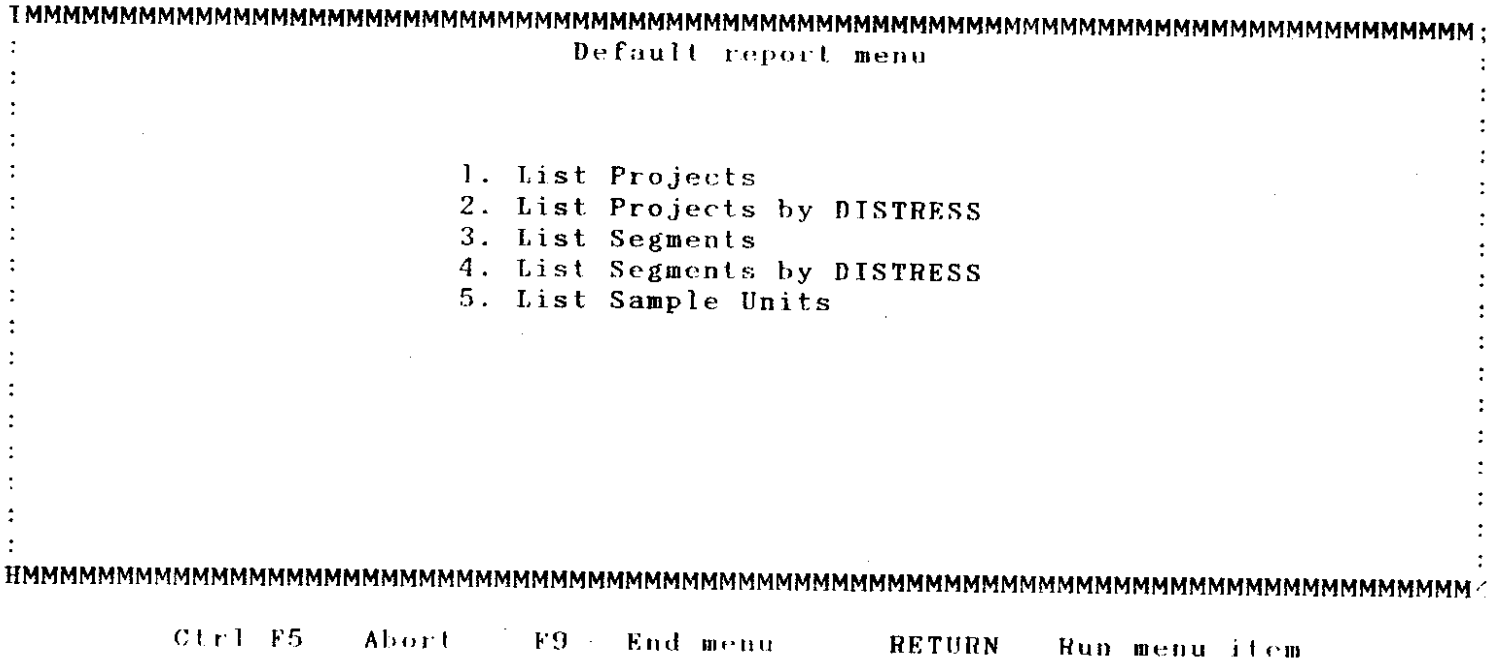
Ctrl F5 - Abort F9 - End menu RETURN - Run menu item

```
                              MASTER REPORT MENU                          PMS
                             15:21:59  28 JAN 1986

                    1. Print survey forms menu
                    2. Default report menu
                    3. Custom report menu
                    4. INTERP - Related reports & I/O data
                    5. OPTAL  - Related reports & I/O data
                    6. NETWORK- Related reports & I/O data
```

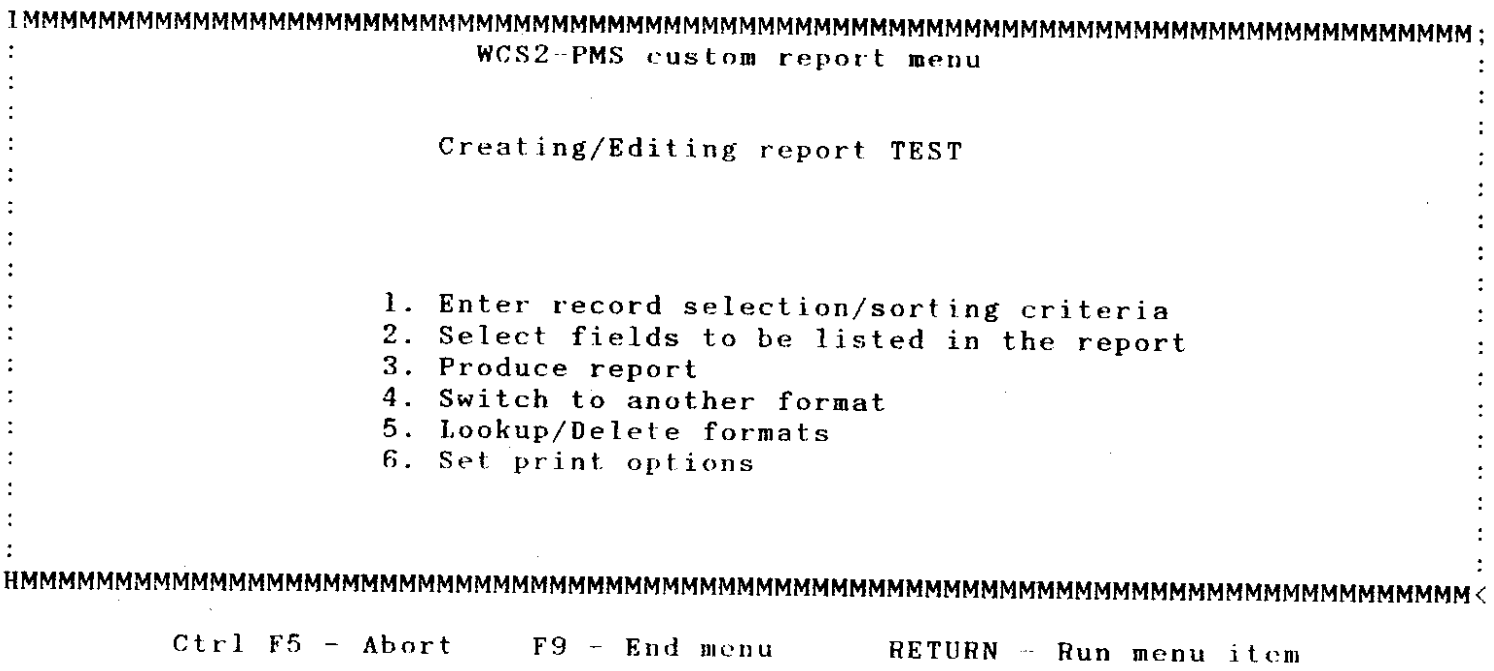
F5=Toggle MAIN/LAST menu Ctl-F5=TCL F9=END menu Retrn=Run menu option

```
                        WSC2-PMS Form Printing Utility

                1. Project Level - FORM 1
                2. Project Level - FORM 2a
                3. Segment Level - FORM 2b
                4. Segment Level - FORM 3
                5. Segment Level - FORM 4a (Flexible Pavments)
                6. Segment Level - FORM 4a (Rigid Pavements)
                7. Sample Unit Level - FORM 4b (Flexible Pavements)
                8. Sample Unit Level - FORM 4b (Rigid Pavements)
                9. Sample Unit Level - FORM 5
```

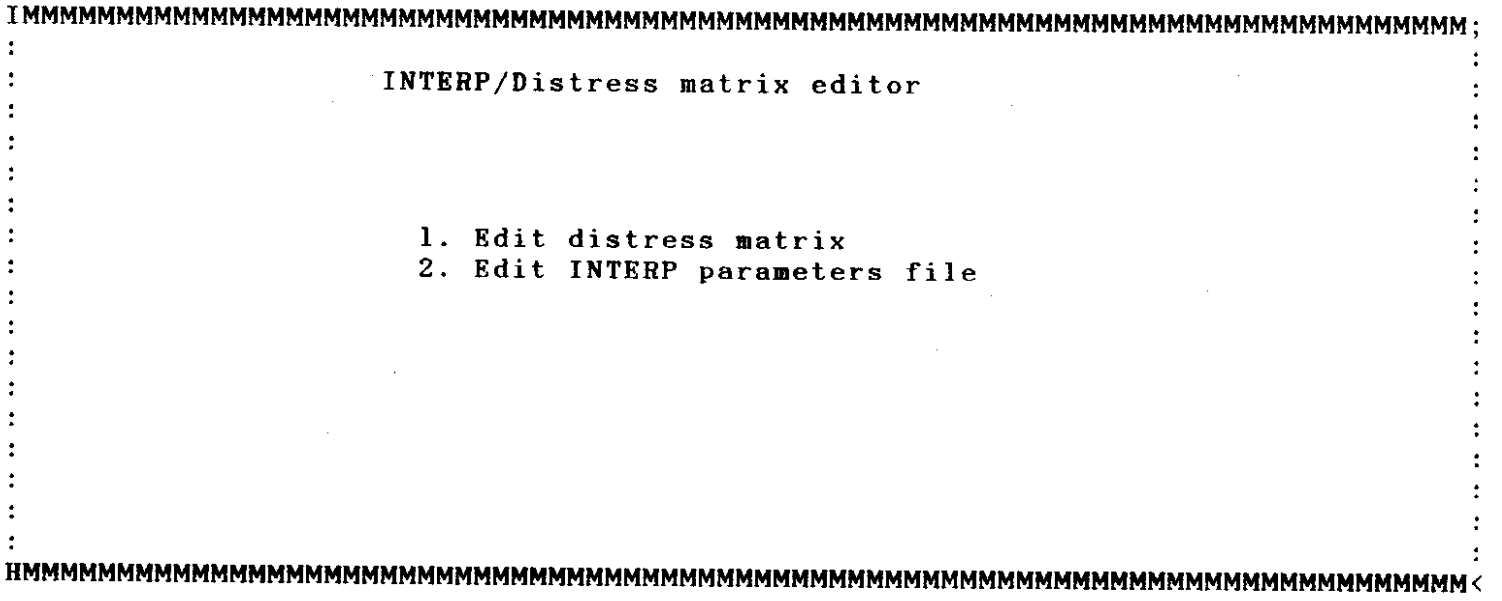
Ctrl F5 - Abort F9 - End menu RETURN - Run menu item

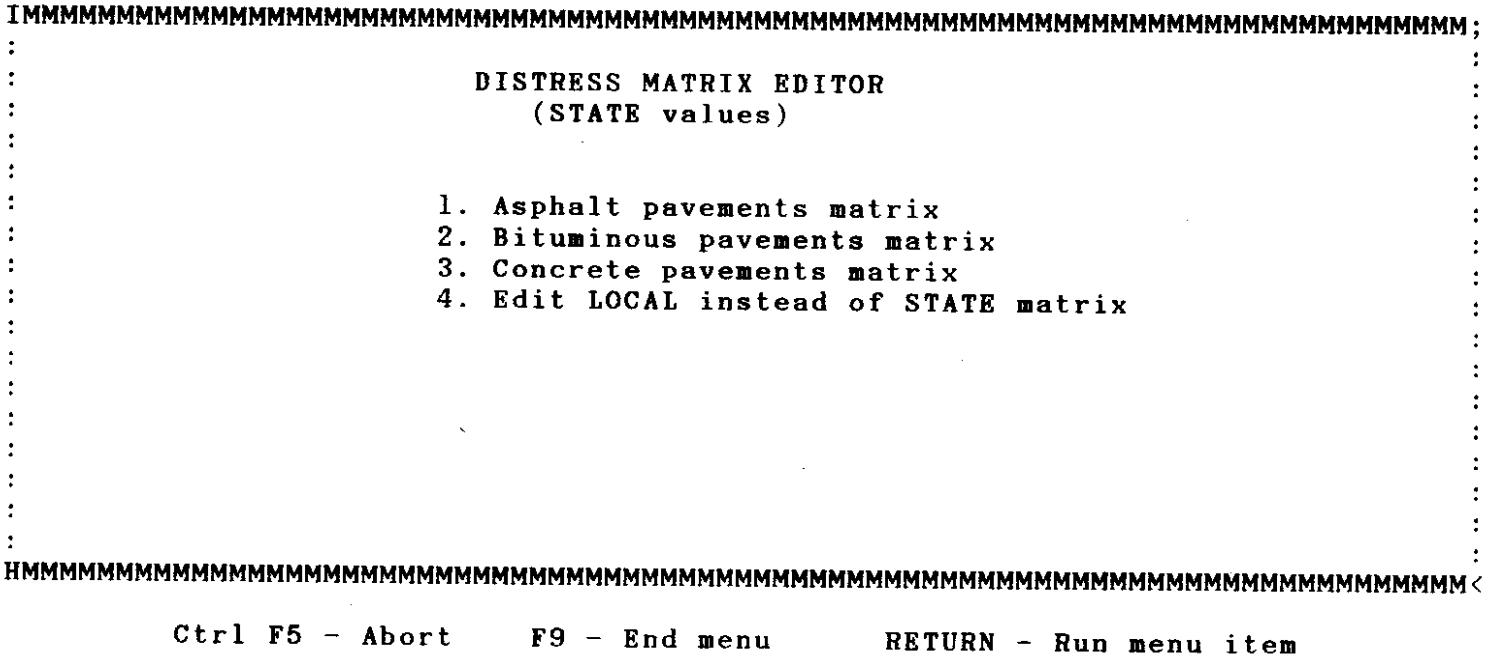


Ctrl F5 Abort F9 End menu RETURN Run menu item



Ctrl F5 - Abort F9 - End menu RETURN - Run menu item


INTERP/Distress matrix editor
1. Edit distress matrix
2. Edit INTERP parameters file
Ctrl F5 - Abort
F9 - End menu
RETURN - Run menu item


DISTRESS MATRIX EDITOR
(STATE values)
1. Asphalt pavements matrix
2. Bituminous pavements matrix
3. Concrete pavements matrix
4. Edit LOCAL instead of STATE matrix
Ctrl F5 - Abort
F9 - End menu
RETURN - Run menu item

```
ASPHALT MATRIX MENU
   (STATE values)

1. Rutting/pavement wear
2. Edge patching
3. Waves, sags and humps
4. Alligator cracking
5. Ravelling/flushing
6. Longitudinal cracking
7. Transverse cracking
8. Patching
9. Edge Ravelling

Ctrl F5 - Abort     F9 - End menu       RETURN - Run menu item

BITUMINOUS MATRIX MENU
   (STATE values)

1. Rutting/pavement wear
2. Edge patching
3. Waves, sags and humps
4. Alligator cracking
5. Ravelling/flushing
6. Longitudinal cracking
7. Transverse cracking
8. Patching
9. Edge Ravelling

Ctrl F5 - Abort     F9 - End menu       RETURN - Run menu item
```

```
                              HELP/DISK BACK-UP MENU                    PMS
                               15:27:44  28 JAN 1986

                        1. Description of all databases and fields
                        2. HELP - INTERP
                        3. HELP - OPTAL
                        4. HELP - NETWORK
                        5. Disk back up menu

F5=Toggle MAIN/LAST menu    Ctl-F5=TCL    F9=END menu     Retrn=Run menu option


                              SETUP/INSTALLATION MENU                   PMS
                                15:30:16  28 JAN 1986

                    1. Basic input variables for PAVMAN
                    2. FORM 5 - Variable I/O setup
                    3. Setup definitions for variable database fields
                    4. Setup input for INTERP program
                    5. Setup input Optimizing program
                    6. Setup input for NETWORK
                    7. Input and output to outside data files and formats
                    8. Install Printer/Plotter/Graphics board

Use this menu item to setup/edit startup message and/or decision flags
F5=Toggle MAIN/LAST menu    Ctl-F5=TCL    F9=END menu     Retrn=Run menu option
```

```
IMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM;
:                       STARTUP MESSAGE AND FLAG SETUP                         :
:                                                                              :
:                                                                              :
:                                                                              :
:                      1. Create/Edit Startup Message                          :
:                      2. Create/Edit Program Flags                            :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
:                                                                              :
HMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM<

      Ctrl F5 - Abort    F9 - End menu     RETURN - Run menu item
```

CODE DEFINITIONS (I-1)

01 CODE ...

02 DESCRIPTION

03 ESCAPE AFTER WHAT "D" VALUE

IMPORTANT:
The description MUST NOT exceed five lines (check line counter). If you do so, other screen information will be overwritten at the time of display. Type <F1> at the DESCRIPTION prompt for editing commands.

CHANGE ?

```
CONCRETE MATRIX MENU
   (STATE values)

1. Rutting/pavement wear
2. Blowups
3. Cracking
4. Ravelling/disintegration/pop-outs/scaling
5. Joint spalling
6. Pumping/blowing
7. Faulting/curling/warping/settlement
8. Patching
9. Edge Ravelling
```

Ctrl F5 - Abort F9 - End menu RETURN - Run menu item

```
Interpreter Parameters Editor

1. Asphalt Default Performance Equations
2. Bituminous Default Performance Equations
3. Concrete Default Performance Equations
4. Asphalt Two Point Regression Matrix
5. Bituminous Two Point Regression Matrix
6. Concrete Two Point Regression Matrix
7. Array of Exponents for Standard Equations
8. Miscellaneous Parameters
```

Ctrl F5 - Abort F9 - End menu RETURN - Run menu item

```
Optimizer Parameter Editors

    1. Original WSDOT Parameter Editor
    2. Modified Parameter Editor (experimental)

Ctrl F5 - Abort     F9 - End menu       RETURN - Run menu item
```

```
Optimizer Parameters Editor

    1. Thickness Factors
    2. Equation Factors
    3. Should and Must repair levels
    4. 'FT matrix' - Asphalt
    5. 'FT matrix' - Bituminous
    6. 'FT matrix' - Concrete
    7. Rehabilitation alternatives matrix
    8. Rehabilitation description matrix
    9. Miscellaneous parameters

Ctrl F5 - Abort     F9 - End menu       RETURN - Run menu item
```

PROJECT record selection criteria

Specify a field("F" number), a relational operator and a valid argument. Then connect each sentence with one of the logical operators AND or OR. You must use fields in Form 1 and Form 2a only.

	Log Op	"F" No.	Rel Op	CDDDDDDDDDDDDDDDDDD Argument DDDDDDDDD
1.		F1-16	NE	PCC
2.	AND	F1-01	GT	1010
3.	OR	F1-02	EQ	1
4.				

Valid relational operators:

=	>	<=	EQ	GT	LE	SW	CN
#	<	>=	NE	LT	GE	NS	NC

Ctrl I - Insert item Ctrl D - Delete item

Enter PROJECT sorting fields

Enter "F" numbers for sorting. Finish entry by entering <ENTER> at the entry prompt ">". Minimize the number of SORT fields to save on sorting time. Use fields from Form 1 and Form 2a only.

> F1-01
>

Ctrl I - Insert item Ctrl D - Delete item

Select PROJECT fields for listing

Select fields that you need listed in order. Make sure that you do not exceed the number of columns available in your printer. The fields must come from Form 1, Form 2a, Form 5I, Form 5T and Form 5R.

	"F" No.	....List Heading....	Width	Total columns = 7
1.	F1-01	PROJECT:NUMBER	7	
2.	F1-22	STREET NAME	12	
3.	F1-10	DATE	9	
4.	F1-16	TYP	3	
5.	F1-02	ZONE	4	
6.	F1-03	ROAD#	7	
7.	F1-13	LENGTH	8	
8.	F1-06	RTG	3	
9.	F1-07	REP.	4	
10.	F1-11	EX	2	
11.	F1-12	OWN	3	
12.				

```
                    Ctrl I/Insert  Ctrl D/Delete

Output options for report TEST

Lines / page                62
Print device                P           (<P>rinter  <S>creen)
Print type                  N           (<N>ormal  <C>ondensed  <B>old)




"S" - Save and exit   "E" - Edit   "END" - Quit without saving
```

APPENDIX B

DATA ENTRY FORMS AND SCREENS

Field Data Forms

Instruction for Use of Data Collection Forms

The first form "PROJECT FORM 1" (F1) is design such that all of the information needed to fill it out should be obtainable from internal maps and records. Some field work will be necessary to confirm the project limits and the integrity of the data.

The procedure would be to layout your complete project from office materials, confirm this information with field checks and to key this initial information, contained on the PROJECT FORM 1 into the system. This information should be listed out checked over in detail and final decision should be worked out and agreed on as to the integrity and validity of all information and to the overall layout and organization. At this point the computer is used to print out the other forms with all of the pertinent information, such as street names, project and segment numbers etc. printed on them. The basic PMS is set up at this point and should only require minor changes with time to maintain a current system.

The second form is the "GEOMETRIC/STRUCTURAL Form 2" (F2a, F2b) and contains information relating to the pavement log and the shoulder and drainage information. This form can also be filled out in part in the office. This form is used with either the project level or segment level data collection and entry, depending on whether and how segment level data is to be used. This information is then added to the database as it is collected and can be updated as new data is obtained. The year of construction for the last surface or pavement layer and the thickness are the most impoertant data in the pavement log. The highest pavement layer number is always assigned to the top or current surface layer.

The third form is the "SEGMENT FORM" Form 3 (F3) which contains all of the general or setup data for each individual segment. Again this form can be partially filled out in the office. The major use of this form is for collection of the visual rating data and the individual distress type data. This information can be collected with the pavement condition data or independently. If funds and time permit it is advisable to collect it independent of the surface condition data and to maintain current visual data for all projects, even if the PCR data is being used.

The fourth form is the "PAVEMENT CONDITION RATING FORM" Form 4 (F4a and F4b) which is used to collect the surface condition data. And the final form is the "SAMPLE UNIT FORM" Form 5 (F5) which is used to collect the individual sample unit type data associated with the different files.

These forms can actually be professionally printed on single or multi-layer paper, which are printed on computer style paper and run through the printer with the heading information added by the PAVMAN.

Use of Forms:

Only a certain sequence of the forms are required depending on how the individual agency chooses to set their system up. The following list defines the different possible approaches.

Form 1 only: (+ 5 + 6 + 7 + 8) optional

This would be the case if only a simple inquiry type system is desired. This could still include the inventory and traffic data files.

Form 1 + 2a + 4b : (+ 5 + 6 + 7 + 8) optional

This would imply a system which is using geometric data at the project level and pavement condition data collected at the sample unit level. This is the most likely approach for most users.

Form 1 + 2a + 3 + 4b : (+ 5 + 6 + 7 + 8) optional

Same as above except the visual condition rating data is also included.

Form 1 + 2a + 4a + 6 + 7:

This would correspond to the current WSDOT system.

Note: Any combination of one through 4 is possible, if just one of the "a" or "b" options is included. Forms 5 through 8 can be added as needed or desired. Once a system is choosen care should be taken in adding or combining the different "a" and "b" options.

BASIC PROJECT INFORMATION

Form 1

01	Proj No	[_____]	08	P-Curv Fg	[_]	15	No. Lanes [_]
02	Zone No	[__]	09	Operator	[____]	16	Pmt Type [___]
03	Road No	[_____]	10	Date	[_____]	17	Hwy Type [_]
04	N2	[__]	11	P-Exmt	[_]	18	Class Loc [__]
05	Fed No	[____]	12	Ownership	[_]	19	Class St [____]
06	Rtg Fg	[_]	13	Proj Leng	[_____]	20	Snow [_]
07	Rpr Fg	[_]	14	Rdw Width	[_____]	21	Climate [__]

22 St Name [_____]

23 From [_____]

24 From MP [_____]

25 To [_____]

26 To MP [_____]

27 Comments [_____]

PROJECT LEVEL GEOMETRICAL AND STRUCTURAL DATA Form 2a

For [_____]

01 Proj # [_____] Road # [_____] 04 Oper [____]

Zone No [__] N2 [__] 03 P-Exmt [_] 05 Date [_____]

Pavement Log:

06	No.	01> [____]	02> [____]	03> [____]	04> [____]	05> [____]
07	Year	[_____]	[_____]	[_____]	[_____]	[_____]
08	LTYP	[_____]	[_____]	[_____]	[_____]	[_____]
09	LTHK	[_____]	[_____]	[_____]	[_____]	[_____]
10	LRTG	[_____]	[_____]	[_____]	[_____]	[_____]
11	LCNT	[_____]	[_____]	[_____]	[_____]	[_____]
12	LCTP	[_____]	[_____]	[_____]	[_____]	[_____]
13	LCST	[_____]	[_____]	[_____]	[_____]	[_____]

Shldr.		Left		Right
Width	14	[_____]	15	[_____]
TYPE	16	[_]	17	[_]
Drnge	18	[__]	19	[__]
	20	Parking		[_]

21 Comments [_____]

[_____]

[_____]

SEGMENT LEVEL GEOMETRICAL AND STRUCTURAL DATA **Form 2b**

For [_____]

01 Proj # [_____] Road # [_____] 02 Seg # [___] 04 Oper [____]

Zone No [__] N2 [__] 03 P--Exmt [_] 05 Date [_____]

Pavement Log:

06 No.	01> [____]	02> [____]	03> [____]	04> [____]	05> [____]
07 Year	[_____]	[_____]	[_____]	[_____]	[_____]
08 LTYP	[_____]	[_____]	[_____]	[_____]	[_____]
09 LTHK	[_____]	[_____]	[_____]	[_____]	[_____]
10 LRTG	[_____]	[_____]	[_____]	[_____]	[_____]
11 LCNT	[_____]	[_____]	[_____]	[_____]	[_____]
12 LCTP	[_____]	[_____]	[_____]	[_____]	[_____]
13 LCST	[_____]	[_____]	[_____]	[_____]	[_____]

Shldr.	Left		Right	
Width	14	[_____]	15	[_____]
TYPE	16	[_]	17	[_]
Drnge	18	[__]	19	[__]
	20	Parking		[_]

21 Comments [_____]
[_____]
[_____]

SEGMENT LEVEL INFORMATION Form 3

For [_____]

01 Proj No [_____] 02 Seg No [___] 05 Date [_____]

Road No [_____] 04 Year [__] 06 Oper. [____]

N2 [__]

07 From [_____] 08 MP [_____]

09 To [_____] 10 MP [_____]

11 Seg Typ [_] 14 S-Exmt [_] 17 Dir Ln [___]

12 Seg Len [_____] 15 Wt Avg [_] 18 Tot Pot [__]

13 Seg Widt [_____] 16 Num Ln [_] 19 Tot Utl [__]

20 iNT uTL [__]

Visual Ratings: 21 Node 1 [_____]

23 Pavmt Rtg [___] 0 to 100 22 Node 2 [_____]

24 Apprx Age [__] 0 to 50 yrs

25 Age to Must [__] Years to must repair

26 Cracking [____] % or Number per Slab/Type A=AC T=TC L=LC

27 Rutting [___] Average Depth

28 Corrg/Fault [____] % of Roadway/Change in 10'

29 Ride [_] 0 = Poor 9 = Excellent

30 Texture [_] 0 = Poor, smooth 9 = Excellent

31 Soil Rtg [_] 3 = Poor 5 = Fair 7 = Good 9 = Excellent

32 Drainage [_] 0 = Failed or none 9 = Excellent

33 Comments

[_____]

[_____]

[_____]

SEGMENT LEVEL PAVEMENT CONDITION RATINGS (ACP/BST) **Form 4a**

For [ ]

01 Proj # [_____] 04 Year [__] 13 Seg Width [________]

Road # [_______] 05 Date [________] FC [________]

N2 [__] 06 Oper. [____]

03 | 0/0 8/9 | 1/1 0/1 | 11 14 15 17 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43

Seg #	From	To	Pav Typ	Seg Typ	S Exm	Wt Avg	Dir Ln	Rut	Corru-gat. < 2	Corru-gat. < 4	Corru-gat. > 4	Allig Crk HL	Allig Crk SPL	Allig Crk PUM	Rav/Fl SLT	Rav/Fl MOD	Rav/Fl SEV	Rav/Fl R/F	L/C < 1/4	L/C > 1/4	L/C SPL	T/C < 1/4	T/C > 1/4	T/C SP	Pch. 0.1	Pch. 0.5	Pch. 1.0	Edge cond RAV	Edge cond PAT	Edge cond LAN

Comments

Seg #	Comments

SEGMENT LEVEL PAVEMENT CONDITION RATINGS (PCC) Form 4a

For [____]

01 Proj No [_____] 04 Year [__] 13 Seg Width [________]

Road No [_______] 05 Date [_________] FC [________]

N2 [__] 06 Oper. [____]

0 2 | 0/0 7/8 | 1/1 0/1 | 11 14 15 17 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Seg #	From	To	Pav Tp	Seg Tp	S Exm	Wt Avg	Dir Ln	Rut	Cracking 1-2	3-4	>4	Ravlg SLT	MOD	SEV	Joint Spl <1	<3	>3	Pumpg <9%	<50%	>50%	Faltg <1/4	<1/2	>1/2	Pch <05%	<25%	>25%	Blow

Comments	

SAMP. UNIT LEVEL PAVEMENT CONDITION RATINGS (ACP/BST) **Form 4b**

For [____]

01	Proj # [_____]	02	Seg # [___]	06	Oper. [____]
	Road # [_______]	04	Year [__]	13	SU Width [________]
	N2 [__]	05	Date [________]		FC [________]

0 0 1 1 1 1 1 2 2 2 2 2 2 2 2 2 3 3 3 3 3 3 3 3 3 3 4 4 4 4
3 8 0 1 4 5 7 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3

SU #	From MP	To MP	Pav Typ	SU Typ	SU Exm	Wt Avg	Dir Ln	Rut	Corru-gat. 2	4	>4	Allig Crk HL	SPL	PUM	Rav/Fl SLT	MOD	SEV	R/F	L/C < 1/4	> 1/4	SPL	T/C < 1/4	> 1/4	SP	Pch. 0.1	.5	1.0	Edge cond RAV	PAT	LAN

Comments

SAMP. UNIT LEVEL PAVEMENT CONDITION RATINGS (PCC) **Form 4b**

For [____]

01	Proj # [_____]	02	Seg # [___]	06	Oper. [____]
	Road # [________]	04	Year [__]	13	SU Width [________]
	N2 [__]	05	Date [________]		FC [________]

02	08	10	11	14	15	17	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
SU #	From MP	To MP	PavTp	SUTp	SUExm	WtAvg	DirLn	Rut	Cracking 1-2	3-4	>4	Ravlg SLT	MOD	SEV	Joint Spl <1	<3	>3	Pumpg <9%	<50%	>50%	Faltg <1/4	<1/2	>1/2	Pch <05%	<25%	>25%	Blow

Comments

SAMPLE UNIT INFORMATION

Form 5

For [____]

01 Proj No [_____] 02 Seg No [___]

Road No [_______] N2 [__]

SU #	Code	Date	From MP	To MP	Comments		
D1		D2		D3			
D4		D5		D6		D7	D8	D9

SU #	Code	Date	From MP	To MP	Comments		
D1		D2		D3			
D4		D5		D6		D7	D8	D9

SU #	Code	Date	From MP	To MP	Comments		
D1		D2		D3			
D4		D5		D6		D7	D8	D9

SU #	Code	Date	From MP	To MP	Comments		
D1		D2		D3			
D4		D5		D6		D7	D8	D9

SU #	Code	Date	From MP	To MP	Comments		
D1		D2		D3			
D4		D5		D6		D7	D8	D9

SU #	Code	Date	From MP	To MP	Comments		
D1		D2		D3			
D4		D5		D6		D7	D8	D9

Data Entry Screens

The following is a complete copy of all the actual data entry screens made directly from the program. These screens are identical to the data entry forms except for some minor rearranging to help sample the forms.

```
          BASIC INFORMATION - PROJECT LEVEL                Form 1

01  PROJ #                 08  P-CURV FG              15  NO. LANES
02  ZONE #                 09  OPERATOR               16  PMT TYP
03  ROAD #                 10  DATE                   17  HWY TYP
04  N2                     11  PMT EXMT               18  CLASS LC
05  FED #                  12  OWNERSHIP              19  CLASS ST
06  RTG FG                 13  PROJ LENG              20  SNOW
07  REP FG                 14  WIDTH                  21  CLIMATE ADJ

22  ST NAME    YAKIMA RIVER DR
23  FROM
24  FROM-MP
25  TO
26  TO-MP

27  COMMENTS



CHANGE
<ENTER> same screen    "L" Pavement Log    "END" Quit

================================================================================


        GEOMETIC AND STRUCTURAL DATA - PROJECT LEVEL        Form 2a
        FOR  YAKIMA RIVER DR

01  PROJ #            ROAD#                                 04  OPERATOR
    ZONE               N2                 03  PMT EXMT      05  DATE

PAVEMENT LOG:
06  NO.     01>
07  YEAR
08  LTYP
09  LTHK
10  LRTG
11  LCNT
12  LCTP
13  LCST

SHLDR.          L            R                    21  COMMENTS
WIDTH       14           15
TYPE        16           17
DRAINAGE    18           19

            20  PARKING
CHANGE
```

GEOMETRIC AND STRUCTURAL DATA - SEGMENT LEVEL Form 2b
FOR YAKIMA RIVER DR

01	PROJ #		ROAD #		02	SEG NUM	04 OPERATOR
	ZONE		N2		03	PMT EXMT	05 DATE

PAVEMENT LOG:

06	NO.	01> 1	02>	
07	YEAR			
08	LTYP			
09	LTHK			
10	LRTG			
11	LCNT			
12	CTYP			
13	COST			

SHLDR.		L	R	21 COMMENTS
WIDTH	14	15		
TYPE	16	17		
DRAINAGE	18	19		
PARKING	20			

CHANGE

==========

BASIC INFO / VISUAL RATINGS - SEGMENT LEVEL Form 3

FOR YAKIMA RIVER DR

01	PROJ #		02	SEG #		05	DATE	
	ROAD #		04	YEAR		06	OPERATOR	
	N2							
07	FROM					08	FROM-MP	
09	TO					10	TO-MP	
11	SEG TYP	14	EXMPT	17	DIR LN	20	INT PCH	
12	SEG LEN	15	WT AVG	18	TOT POT	21	NODE 1	
13	SEG WIDT	16	NUM LN	19	TOT UTL	22	NODE 2	

VISUAL RATINGS:

23	PAVMT RTG	26	CRACK.	29	RIDE	31	SOIL RTG
24	APPRX AGE	27	RUT	30	TEXTURE	32	DRAINAGE
25	AGE TO MUST	28	COR/FLT				

33 COMMENTS

CHANGE

PAVMENT CONDITION RATINGS - SEGMENT LEVEL (ACP/BST) Form 4a
FOR YAKIMA RIVER DR

01	PROJ #	02	SEG #	05	DATE	
	ROAD #	04	YEAR	06	OPERATOR	
	N2					
07	FROM			08	FROM-MP	
09	TO			10	TO-MP	3.04
11	SEG TYP	14	EXMPT	17	DIR LN	B
12	SEG LEN	15	WT AVG	18	TOT POT	19 TOT UTL
13	SEG WIDT	16	NUM LN		DIST RTG	20 INT PCH

R U T	CORRU-GATION < 2	< 4	> 4	ALLIG CRK H L	S P L	& P	RAV/FL S T	M D	S V	R F	L/C < 1 / 4	> 1 / 4	S L	T/C < 1 / 4	> 1 / 4	S L	PCH < 5 0	< 1 . 0	> 1 . 0	EDGE COND. R A V	P H	L A N
2 1	2	2	2	2 5	2 6	2 7	2 8	2 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6	3 7	3 8	3 9	4 0	4 1	4 2	4 3

CHANGE

==========

PAVEMENT CONDITION RATINGS - SEGMENT LEVEL (ACP/BST) Severety/Extent

FOR YAKIMA RIVER DR

01	PROJ #	02	SEG #	05	DATE	
	ROAD #	04	YEAR	06	OPERATOR	
	N2					
07	FROM			08	FROM-MP	
09	TO			10	TO-MP	
11	SEG TYP	14	EXMPT	17	DIR LN	
12	SEG LEN	15	WT AVG	18	TOT POT	20 INT PCH
13	SEG WIDT	16	NUM LN	19	TOT UTL	21 R/F

PAVEMENT CONDITION RATINGS:

	SEV	EXT	DIST RTG	
CORRUGATION	22	23		
ALLIG CRACK	24	25		
RAV/FLUSH	26	27	34	RUTTING
LONG CRACK	28	29	35	EDGE RAV
TRANS CRACK	30	31	36	EDGE PCH
PATCHING	32	33	37	EDGE LAN

CHANGE

PAVMENT CONDITION RATING - SEGMENT LEVEL (PCC) Form 4a
FOR MAIN ST - STATE HWY 22

01	PROJ #	02	SEG #	05	DATE		
	ROAD #	04	YEAR	06	OPERATOR		
	N2						
07	FROM			08	FROM-MP		
09	TO			10	TO-MP		
11	SEG TYP	14	EXMPT	17	DIR LN	19	TOT UTL
12	SEG LEN	15	WT AVG	18	TOT POT	20	I PCH
13	SEG WIDT	16	NUM LN		DIST RTG		

R	CRACKING %Panels			RAVELLING Area			JOINT SPL %Joints			PUMPING %Panels			FAULTING			PATCHING %Panels			B
U	1	3		S	M	S	0	1		0	10		0	1/4		1	6		L
T	to	to	>	L	O	E	to	to	>	to	to	>	to	to	>	to	to	>	U
	2	4	4	T	D	V	1"	3"	3"	9%	50%	50%	1/4"	1/2"	1/2"	5%	25%	25%	P

2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	4
1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3

CHANGE

PAVEMENT CONDITION RATING - SAMPLE UNIT LEVEL (ACP/BST) Form 4b
FOR YAKIMA RIVER DR

01	PROJ #	02	SEG #	05	DATE		
	ROAD #	03	SU #	06	OPERATOR		
	N2	04	YEAR				
07	FROM			08	FROM-MP		
09	TO			10	TO-MP		
11	SU TYP	14	EXMPT	17	DIR LN	19	TOT UTL
12	SU LEN	15	WT AVG	18	TOT POT	20	INT PCH
13	SU WIDTH	16	NUM LN		DIST RTG		

R	CORRU-GATION			ALLIG CRK			RAV/FL				L/C <	L/C >		T/C <	T/C >		PCH <	PCH <	PCH >	EDGE COND.		
U				H	S	S	S	M	S	R	1	1	S	1	1	S	.	1	1	R	P	L
T	<	<	>	L	P	&	L	O	E	/	/	/	P	/	/	P	5	.	.	A	C	A
	2	4	4		L	P	T	D	V	F	4	4	L	4	4	L	0	0	0	V	H	N

2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	
1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3

CHANGE

PAVEMENT CONDITION RATING - SAMPLE UNIT LEVEL (ACP/BST) Severety/Extent

FOR YAKIMA RIVER DR

01	PROJ #		02	SEG #		05	DATE	
	ROAD #		03	SU #		06	OPERATOR	
	N2		04	YEAR				
07	FROM					08	FROM-MP	
09	TO					10	TO-MP	
11	SU TYP	14	EXMPT	17	DIR LN			
12	SU LEN	15	WT AVG	18	TOT POT	20	INT PCH	
13	SU WIDTH	16	NUM LN	19	TOT UTL	21	R/F	

PAVEMENT CONDITION RATINGS:

	SEV	EXT	DIST RTG	
CORRUGATION	22	23		
ALLIG CRACK	24	25		
RAV/FLUSH	26	27	34	RUTTING
LONG CRACK	28	29	35	EDGE RAV
TRANS CRACK	30	31	36	EDGE PCH
PATCHING	32	33	37	EDGE LAN

CHANGE

==========

PAVEMENT CONDITION RATING - SAMPLE UNIT LEVEL (PCC) Form 4b

FOR

01	PROJ #	02	SEG #		05	DATE		
	ROAD #	03	SU #		06	OPERATOR		
	N2	04	YEAR					
07	FROM				08	FROM-MP		
09	TO				10	TO-MP		
11	SU TYP	14	EXMPT	17	DIR LN	19	T UTL	
12	SU LEN	15	WT AVG	18	TOT POT	20	I PCH	
13	SU WIDTH	16	NUM LN		DIST RTG			

	CRACKING	RAVELLING	JOINT SPL	PUMPING	FAULTING	PATCHING	
R	%Panels	Area	%Joints	%Panels		%Panels	B
U	1 3	S M S	0 1	0 10	0 1/4	1 6	L
T	to to >	L O E	to to >	to to >	to to >	to to >	U
	2 4 4	T D V	1" 3" 3"	9% 50% 50%	1/4" 1/2" 1/2"	5% 25% 25%	P

2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	
1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	

CHANGE

SAMPLE UNIT INFORMATION

Form 5

```
    FOR
01  PROJ #                          02  SEG  #                    03  SU #
04  CODE       01> 101    02> ....
05  DATE       10/28/85
06  FROM-MP        12.5
07  TO-MP          13.1
08  D1              ACP
09  D2              2.5
10  D3         ........
11  D4
12  D5
13  D6
14  D7
15  D8
16  D9
17  COMMENTS
Core Samples:
     D1 = Type - layer 1 (see F2-08)
     D2 = Thickness - layer 1
     D3 = Relevant material property - layer 1
     etc.
```

==========

INVENTORY DATA ENTRY / UPDATE SCREEN

```
    FOR
01  PROJ #
02  CODE         01>  202  02> ....
03  DATE         10/28/85
04  FROM.MP
05  TO.MP            1.05
06  D1               10.5
07  D2
08  D3
09  D4
10  D5
11  D6
12  D7          ........
13  D8
14  D9
15  COMMENTS
Location / Responsibility:
D1 = Distance (miles) of the route    D5 = Area development
D2 = Signing of travel route          D6 = Travel category
D3 = Special systems                  D7 = Subdistrict
D4 = Legislative district
```

```
                    TRAFFIC DATA ENTRY / UPDATE SCREEN
    FOR
01  PROJ #
02  CODE          01>  401   02> ....
03  DATE          10/28/85
04  FROM.MP            0.0
05  TO.MP              2.7
06  D1                  12
07  D2            ........
08  D3
09  D4
10  D5
11  D6
12  D7
13  D8
14  D9
15  COMMENTS
Bus/Truck/Mail/School Route:
```

==========

```
                          CODE DEFINITIONS                          (I-1)

01  CODE   101

02  DESCRIPTION
Core Samples:
     D1 = Type - layer 1 (see F2-08)
     D2 = Thickness - layer 1
     D3 = Relevant material property - layer 1
     etc.

03  ESCAPE AFTER WHAT "D" VALUE


IMPORTANT:
The description MUST NOT exceed five lines (check line counter).  If you do
so, other screen information will be overwritten at the time of display.
Type <F1> at the DESCRIPTION prompt for editing commands.


CHANGE ?
```