SHRP-P-634

Analysis of Section Homogeneity, Non-Representative Test Pit and Section Data, and Structural Capacity

FWDCHECK Version 2.00

Volume II—Users' Guide

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ABSTRACT

Nondestructive deflection testing using falling weight deflectometers is one element of the monitoring effort currently underway by the Strategic Highway Research Program (SHRP) for the Long Term Pavement Performance (LTPP) study. Because accurate data is key to the success of the LTPP study, SHRP has implemented a number of measures to ensure the quality of deflection data. They include equipment comparison and calibration, standardized field testing procedures and field data checks, and quality assurance software.

Equipment calibration and field data checks built into the FWD data acquisition software are the first line of defense against invalid deflection data. The second line of defense is a computer program, called FWDSCAN, which verifies the integrity, completeness, and compliance with the established test pattern of the field data after it is delivered to the SHRP regional office. For the final stage in the quality assurance process, a computer program called FWDCHECK has been developed to analyze deflection data for test section homogeneity, the degree to which test pit data is representative of the section, the presence of data outliers within the section, and overall reasonableness from a structural capacity viewpoint.

This report focuses on the FWDCHECK program. The report is provided in three separate volumes: Technical Documentation, User's Guide, and Program Listing. The technical documentation gives a detailed description of the program including the analyses and algorithms used. A detailed description of the program usage is provided in the User's Guide. Finally, a complete printout of the computer source code is included in the third volume, Program Listing.

PURPOSE

The purpose of this report is to describe the second FWD Quality Assurance computer program and its usage. The first program, **FWDSCAN**, has been developed to check FWD data for completeness and readability. Program **FWDCHECK** is intended to check FWD data files for:

- Section homogeneity,
- Non-representative test pit and section data, and
- General reasonableness of structural capacity.

An output file summarizing the results of the checking process is generated by the program.

The report is provided in three separate volumes as follows:

- Volume I - Technical Documentation
- Volume II - Users Guide
- Volume III - Program Listing

In this volume - Volume II: Users Guide - a detailed description of the program usage is provided.

BACKGROUND

Before any deflection information can be forwarded to SHRP for inclusion in the National Pavement Data Base, SHRP RCO personnel must check all FWD data to assess whether or not (1) the section tested is homogeneous, (2) the test pit data is representative of the section, (3) data outliers are present within the section, and (4) the data is reasonable from a structural capacity viewpoint. The objective of these checks is <u>not</u> to eliminate data but rather to <u>flag</u> potential errors or problems before the information is processed further.

These checks for section homogeneity, non-representative test pit and section data, and reasonableness of structural capacity estimates are accomplished by means of a microcomputer program called **FWDCHECK**, which has been developed by the P-001B Technical Advisory Staff. The **FWDCHECK** program usage is presented over the remainder of this document. The reader is referred to Volume I - Technical Documentation for a more detailed description of the program. An output file summarizing the results of the checking process is generated by the program.

The program is primarily intended for the analysis of test pits and mid-slab deflection basin test data for rigid pavements (test locations 0 and 1) and test pits and outer wheel path deflection basin test data for flexible pavements (test locations 0 and 3). The program is not

intended to analyze joint/crack or edge deflection test data for rigid pavements (i.e., test locations 2 to 5) nor mid-lane deflection data for flexible pavements (i.e., test location 1).

Before running the program, the user must ensure that a deflection file containing only peak data (i.e., no load- and deflection-time histories) has been created for the pavement section in question. This file is automatically generated by the first FWD Quality Assurance program called **FWDSCAN**. The user is referred to the SHRP document titled "Data Readability and Completeness, FWDSCAN, Version 1.30, April 1992" for the description and usage of this program.

PROGRAM USAGE

FWDCHECK is an interactive program with a consistent set of menu driven screens and extensive error-trapping. As shown in Figure 1, the interface consists of six (6) major screens. The first of these screens is the title screen, where no input is required. The second screen contains the fields required to select the FWD data file to be analyzed. The remaining four screens consist of menus which allow the user to perform the various data analysis functions: statistical, subsection, outlier, and structural capacity analysis. Depending on the menu option selected in each of these screens, one or more input/output screens are generated by the program.

A complete summary of the **FWDCHECK** screens is provided, in sequential fashion, over the remainder of this section. When using the program, it is strongly recommended that the user follow the exact sequence of choices provided by the menus. For the purpose of this documentation, each major screen has been assigned a numeric code (1 through 6) and the screens associated with each menu choice a letter code (e.g., 3A, where the first number code corresponds to the major screen and the letter code to the menu choice).

In addition to the above referenced screens, the user should also become familiar with the various FUNCTION KEYS that are used during the execution of the program. These keys are listed in Table 1 along with a brief explanation of their function. Note that the various FUNCTION KEYS available to the user appear at the bottom of each screen.

Screen No. 1 - Title Screen (see Figure 2)

The first major screen, as noted earlier, is the title screen. Besides the program title, this screen also contains the program version number and copyright information. No input is required from the user.

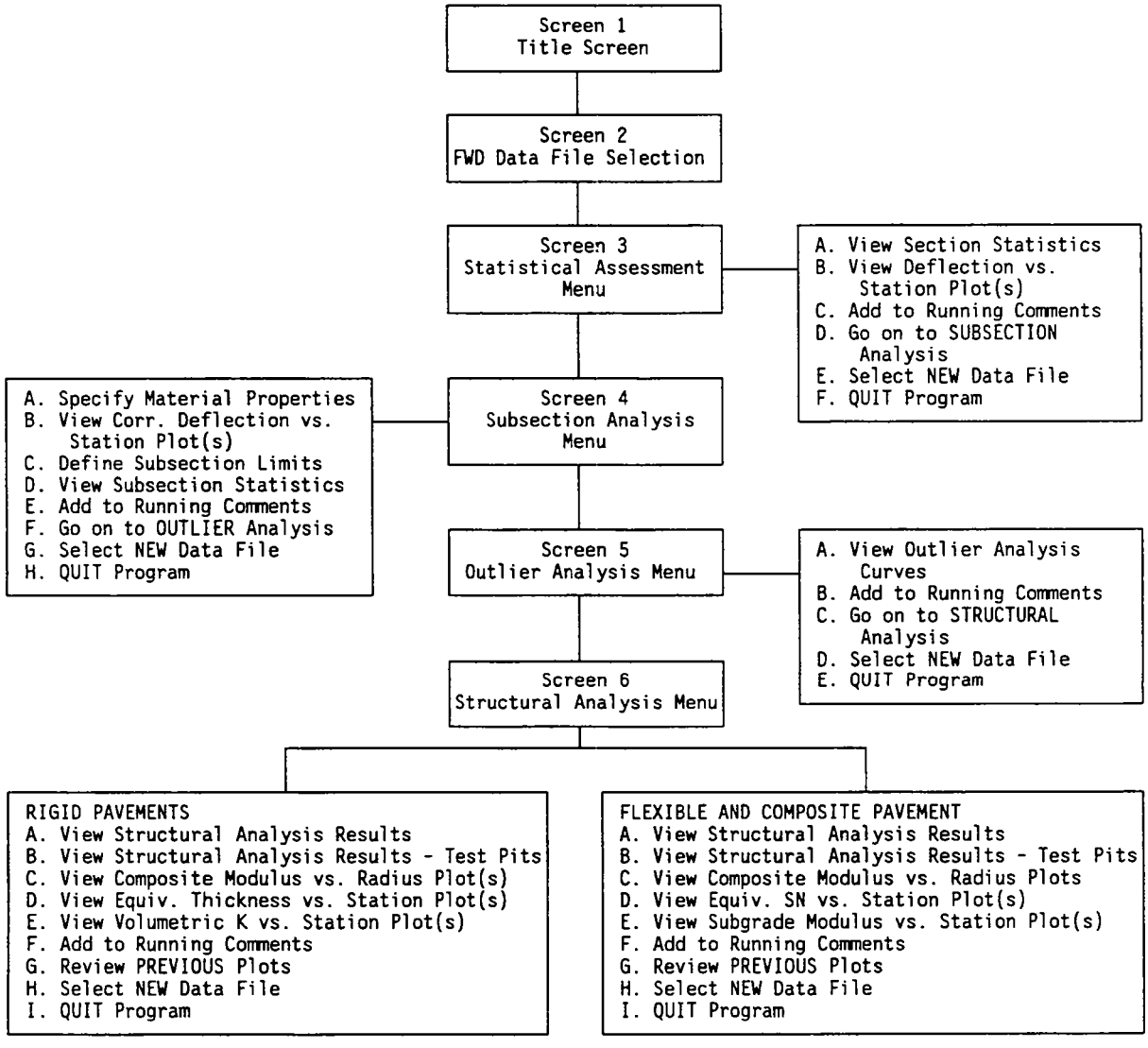

Figure 1 - FWDCHECK Program Screens

Table 1 - Summary of Function Keys

KEY(S)	FUNCTION
<F10>	EXIT/EXITPLOTS - the <F10> key is used to exit the current screen.
	QUIT - the <F10> key is used to quit the program from the data file selection screen.
<Esc>	ESCAPE - returns the user to field 2 from the file list without selecting a file. It also allows the user to exit the comment window WITHOUT saving any changes that may have been made.
<PgDn>,<PgUp>	PAGE DOWN - used to move to the next screen in the program's normal execution sequence.
	PAGE DOWN or PAGE UP - used in a list window if more than 20 items are present, to move from one page of the list to the next/previous page, where applicable.
<Ctrl-PgDn>, <Ctrl-PgUp>	CONTROL-PAGEDOWN or CONTROL-PAGEUP - used to move to the statistics for the previous/next subsection.
<↑>,<↓>,<←>,<→>	ARROW KEYS - these keys allow the user to move from one field to another on the data entry screens, as well as to move from item to item on a menu or in a list window. Also, when more than one page of items are available in a list window, pressing <DOWN> on the last row of the window places the cursor on the first row of the next page of the list. Pressing <UP> when on the top line of the second or subsequent page of the list of items will move the cursor to the bottom line of the previous page in the list. In addition, they allow the user to cycle from one graph to another as specified on each specific screen.
<Home>, <End>	HOME or END - these keys allow the user to quickly move to the first or last field within a data entry screen, as well as the first or last item in the current page of a list window.
<Space Bar>	SPACE BAR - the <Space Bar> key is used to exit the various warnings or errors that appear at the bottom of the data entry screen.
<CR>,<Enter>	CARRIAGE RETURN or ENTER - used to accept a data input value once it has been entered.

FWD Data Checking Software

Version 2.00

For EXCLUSIVE Use by the
Strategic Highway Research Program (SHRP)
and its contractors and sub-contractors.

Figure 2 - Screen No. 1 - Title Screen

Screen No. 2 - FWD Data File Selection (see Figure 3)

This particular screen contains the five (5) input fields required to setup the program and select an FWD data file for analysis. They are:

Field 1: Deflection analyst - the name (or initials, if desired) of the person performing the analysis of this data.

Field 2: Path to data files - the path to the desired FWD data files may be entered in this field by typing the full path (assumes default drive if no drive is specified) or by pressing <Return> for the current directory. The path does NOT require a backslash as the LAST character. If an error is detected when attempting to change to an invalid or nonexistent directory, an error message will appear on the screen.

Field 3: Show a list of files - a yes/no question that allows the user to select the file to be analyzed from the list of data files in the specified directory. If the response is YES, then the user is placed in the directory list and cursor keys are used to highlight a file in the list that can be selected by pressing <Return>. <PgUp> and <PgDn> can also be used to move backwards or forwards one page at a time, where such a quantity of files exists. <Esc> allows the user to exit the file list WITHOUT selecting one of the files.

Field 4: Data file name - if a file was picked from the list of files in the specified directory, that file's name appears in this field and the file will be analyzed when **<PgDn>** is pressed. If the field is blank, enter a valid MS-DOS filename, and press <PgDn> to scan the file. If the file does not exist, an error message will appear on the screen.

Field 5: Printer type - select the printer type desired for graphical screen dumps. The two supported types are HP Laserjet II and compatibles, and Epson/IBM Graphics Printers. Select the single character designation of the type attached to LPT1:.

Screen No. 3 - Statistical Assessment Menu (see Figure 4)

The statistical assessment menu presents the user with six (6) functional choices to select from. They are:

A. **View Section Statistics** - used to display a tabular summary of the uncorrected normalized deflection statistics (mean, standard deviation and coefficient of variation) for the pavement section in question. An example of the information generated by this menu choice is given in Figure 5. As

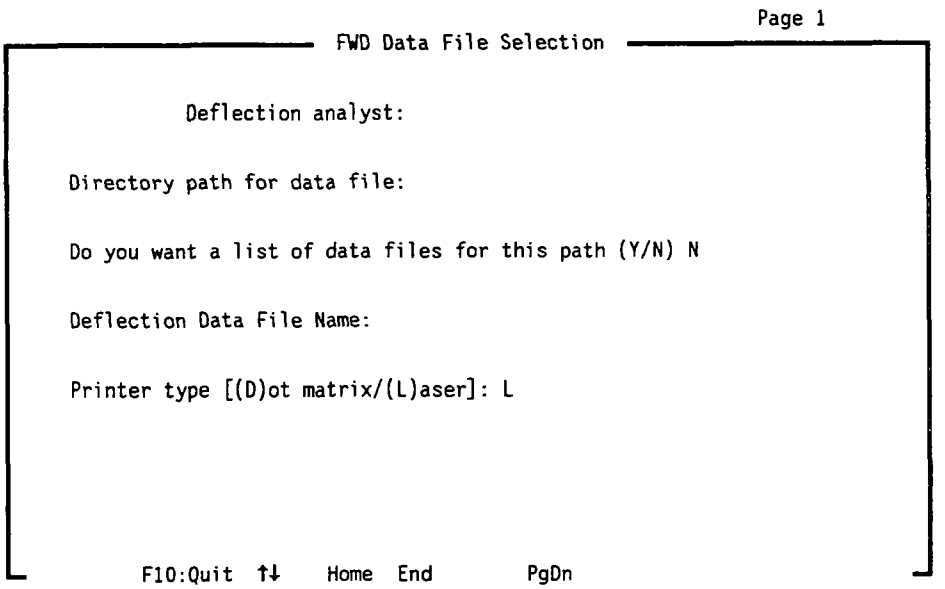

Figure 3 - Screen No. 2 - Setup and FWD Data File Selection

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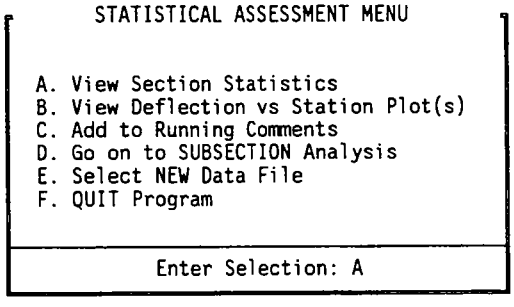

↑↓ Home End

Figure 4 - Screen No. 3 - Statistical Assessment Menu

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UNCORRECTED Deflection Statistics

Data for section 373807A Mean Values (mils/kip)

Test Loc.	Drop Ht	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6	Sensor 7
0	1	0.3076	0.2947	0.2754	0.2619	0.2414	0.1730	0.1279
	2	0.3325	0.3142	0.2964	0.2820	0.2596	0.1850	0.1379
	4	0.3652	0.3466	0.3267	0.3115	0.2887	0.2088	0.1505
1	1	0.2865	0.2745	0.2555	0.2396	0.2271	0.1634	0.1096
	2	0.3025	0.2878	0.2754	0.2641	0.2391	0.1705	0.1183
	4	0.3402	0.3236	0.3072	0.2941	0.2736	0.1975	0.1327

Standard Deviations

Test Loc.	Drop Ht	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6	Sensor 7
0	1	0.0236	0.0190	0.0110	0.0061	0.0076	0.0022	0.0166
	2	0.0227	0.0163	0.0140	0.0101	0.0046	0.0063	0.0173
	4	0.0116	0.0042	0.0021	0.0004	0.0027	0.0080	0.0160
1	1	0.0364	0.0353	0.0328	0.0286	0.0272	0.0155	0.0102
	2	0.0394	0.0380	0.0363	0.0340	0.0283	0.0161	0.0104
	4	0.0473	0.0450	0.0423	0.0394	0.0350	0.0212	0.0135

Coefficient of Variation

Test Loc.	Drop Ht	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6	Sensor 7
0	1	7.68%	6.44%	3.99%	2.31%	3.17%	1.27%	12.97%
	2	6.83%	5.20%	4.74%	3.57%	1.76%	3.38%	12.53%
	4	3.18%	1.22%	0.64%	0.11%	0.93%	3.82%	10.62%
1	1	12.69%	12.85%	12.85%	11.94%	11.96%	9.51%	9.34%
	2	13.02%	13.21%	13.17%	12.87%	11.85%	9.45%	8.80%
	4	13.91%	13.89%	13.78%	13.41%	12.78%	10.75%	10.17%

PgDn

Figure 5 - Sample Section Statistics

shown, statistics are generated for every combination of test location, drop height and sensor. This information, along with that generated under menu choice B in this screen and menu choice B in Screen No. 4 - "Subsection Analysis Menu," should be used to define subsection station boundaries, if any.

B. **View Deflection vs Station Plot(s)** - used to display plots of uncorrected normalized deflection versus station for the pavement section in question. An example of the plots generated by this menu choice is given in Figure 6. As shown, all seven geophones are superimposed on the same plot for any combination of test location and drop height. This information, along with that generated under menu choice A in this screen and menu choice B in Screen No. 4 - "Subsection Analysis Menu", should be used to define subsection station boundaries, if any.

C. **Add to Running Comments** - this menu choice allows the user to enter any comments based on his/her observations; e.g., location of possible subsection station boundaries, unusual data, etc. Accordingly, when this menu choice is selected, **Screen No. 3C - "Comment"** appears on the monitor (see Figure 7). A total of 23 lines of running comments are provided. The amount of information entered for the comment is only limited by the size of screen. Comments entered by the user can be viewed from any menu within the program. All user comments are included in the output file generated by the program.

D. **Go on to SUBSECTION Analysis** - on completion of the deflection statistical assessment, the user must select this menu choice in order to proceed with the subsection (i.e., section homogeneity) analysis.

E. **Select NEW Data File** - this menu choice allows the user to terminate the analysis of the current data file and to select a new data file. When this menu choice is selected, the program returns the user to Screen No. 2 - "FWD Data File Selection".

F. **QUIT Program** - this menu choice allows the user to terminate use of the program.

Screen No. 4 - Subsection Analysis Menu (see Figure 8)

The subsection analysis menu presents the user with eight (8) functional choices to select from. They are:

A. **Specify Material Properties** - before the user can proceed with the subsection analysis, he/she must first specify layer thickness and material type information. Accordingly, when this menu choice is selected, **Screen No. 4A1 - "Material Properties Control Information"** (see Figure 9) appears

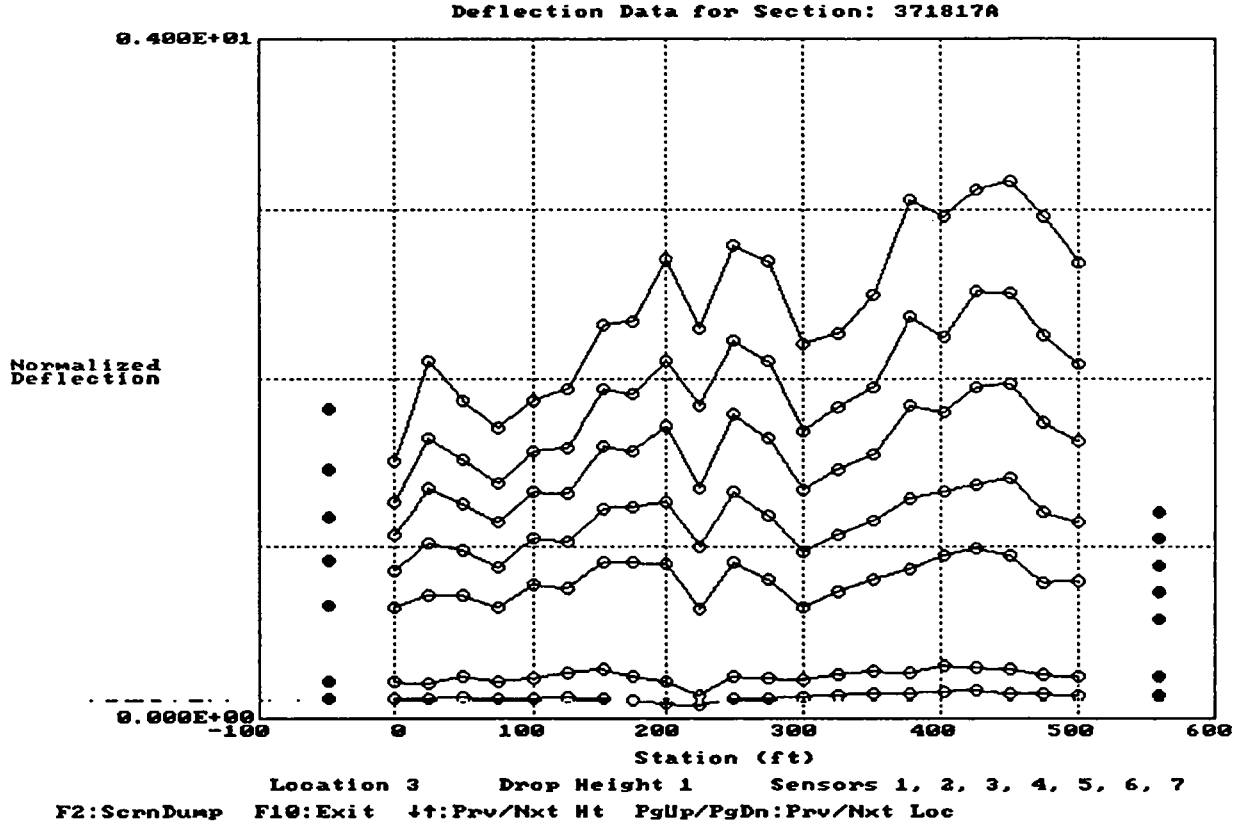


Figure 6 - Sample Deflection versus Station Plot

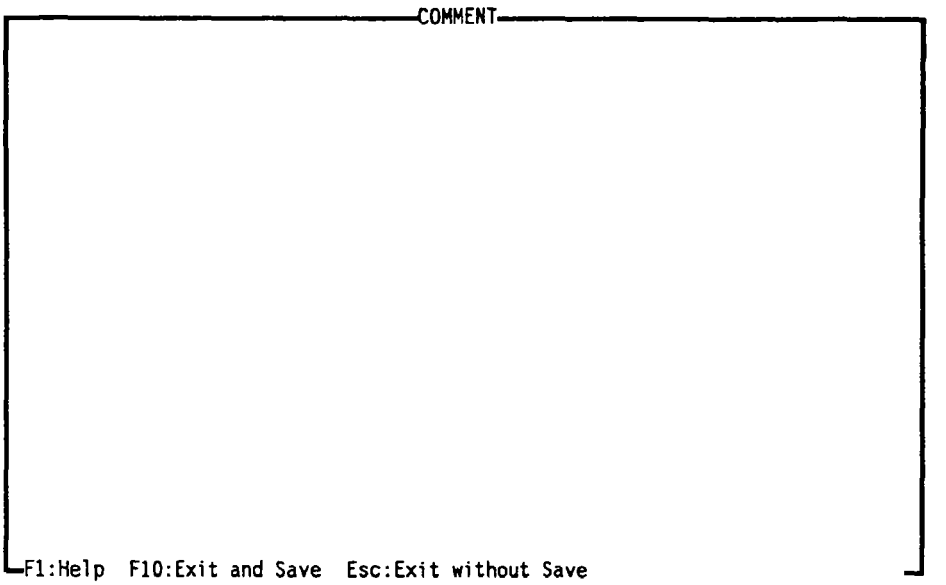
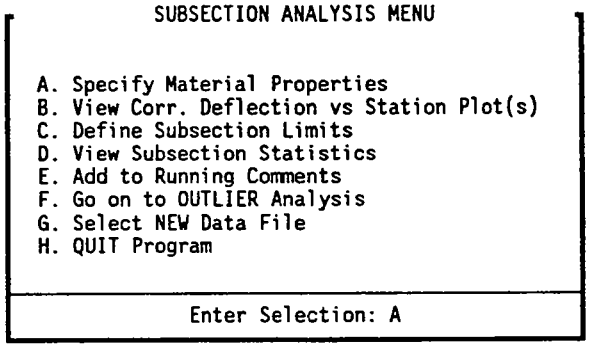


Figure 7 - Screen No. 3C - Comment

373 807



↑↓ Home End

Figure 8 - Screen No. 4 - Subsection Analysis Menu

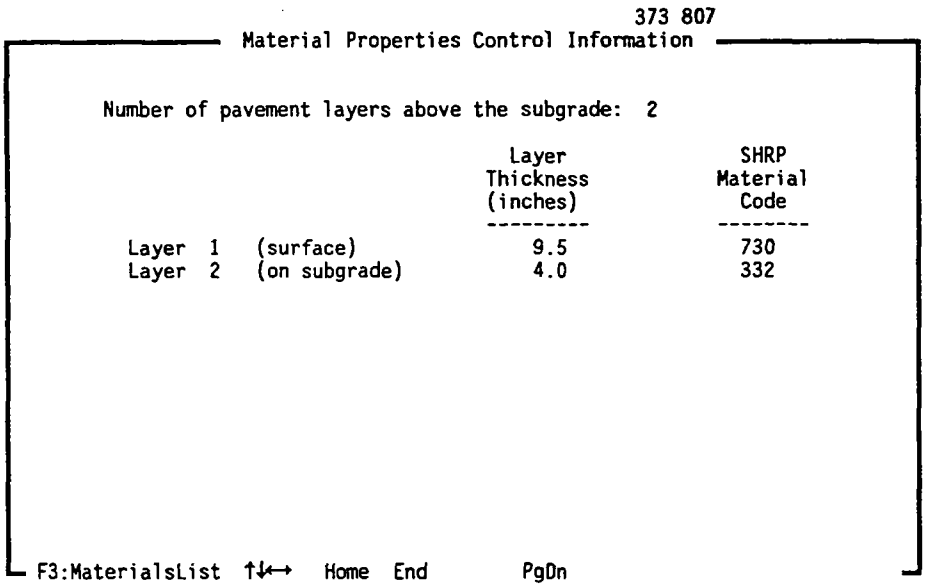


Figure 9 - Screen No. 4A1 - Material Properties Control Information

on the monitor. This screen contains the three (3) input fields required to define a pavement structure. They are:

Field 1: Number of pavement layers above the subgrade - user must specify the number of pavement layers above the subgrade. A maximum limit of ten (10) layers has been implemented in the program.

Field 2: Layer Thickness (inches) - user must specify the thickness of each pavement layer, in inches. Layers are ordered from top (surface) to bottom (subgrade).

Field 3: SHRP Material Code - user must specify the material type of each pavement layer, in terms of the SHRP material codes. A two-page list of available codes appears when the cursor is on this input field and the user presses the F3 key. Using the cursor keys, the user must select the appropriate material code and press the <Return> key to accept it. The <PgUp> and <PgDn> keys can also be used to move between the first and second page of codes. Note that this field is critical in terms of both the temperature correction of deflection data as well as the structural capacity analysis.

If Material Code 700 (Asphalt Concrete Surface) is specified for the surface layer of the pavement, **Screen No. 4A2 - "Asphalt Surfaced Pavement Temperature Gradient Control Data"** (see Figure 10) and **Screen No. 4A3 -"Asphalt Surfaced Pavement Temperature Gradient Data"** (see Figure 11) appear on the monitor. Screen 4A2 contains the input fields required to define the temperature gradient control data. They are:

Field 1: Number of depths for temperature at each time - user must specify the number of depths where temperatures were measured during testing.

Field 2: Number of times temperature measured first area - user must specify how many sets of temperatures were measured at the holes drilled at station 0-05 (approx).

Field 3: Number of times temperature measured second area - user must specify how many sets of temperatures were measured at the holes drilled at station 5+05 (approx).

There are an additional number of fields for the measurement times corresponding to the number of times specified in fields 2 and 3. Screen 4A3 appears twice with a small matrix of fields allowing the user to enter the

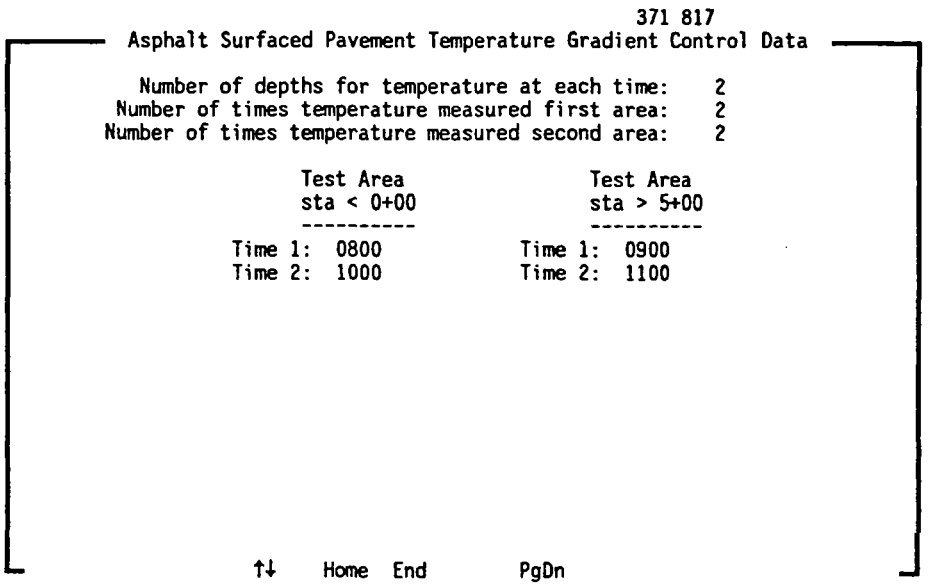


Figure 10 - Screen No. 4A2 - Asphalt Surfaced Pavement Temperature Gradient Control Data

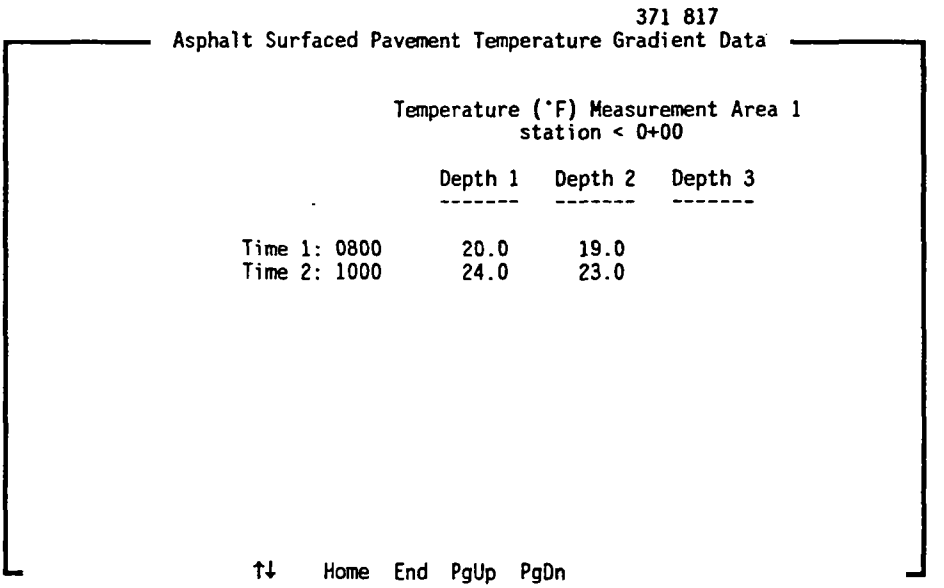


Figure 11 - Screen No. 4A3 - Asphalt Surfaced Pavement Temperature Gradient Data

temperature for each time and depth combination in each of the two measurement areas.

B. **View Corr. Deflection vs Station Plot(s)** - used to display plots of temperature corrected normalized deflection versus station for the pavement section/subsections in question. An example of the plots generated by this menu choice is given in Figure 12. As shown, only geophones number 1 and 7 are superimposed on the same plot for any combination of test location and drop height. It should also be noted here that only geophone number 1 is corrected. Geophone number 7 is shown for reference purposes only. This information, along with that generated under menu choices A and B in Screen No. 3 - "Statistical Assessment Menu", should be used to define subsection station boundaries, if any.

C. **Define Subsection Limits** - after reviewing the information generated under menu choices A and B under Screen No. 3 - "Statistical Assessment" as well as menu choice B on this screen, the user must specify the limits of all subsections. Accordingly, when this menu choice is selected, **Screen No. 4C - "Subsection Boundary Definition"** (see Figure 13) appears on the monitor. This screen contains the two (2) input fields required to define pavement subsections. They are:

Field 1: Number of subsections - user must specify the number of possible subsections. Each subsection must contain at least four (4) stations.

Field 2: Station for end of each Subsection - user must specify the station, in feet, corresponding to the end of each subsection. If the station selected should be exactly the same as one of the test locations, that test location will be part of the subsection the falls after the boundary. A status field is provided to the right of each input field warning the user whether or not each subsection satisfies the minimum requirement of four (4) stations. All status fields must show "ok" in order to continue with the analysis.

Note that before proceeding with the program (i.e., Outlier Analysis), the user can look at any combination(s) of station boundaries. However, the information sent to the output file and the ensuing program analyses are based solely on the results generated for the last set of station boundaries investigated.

D. **View Subsection Statistics** - used to display a tabular summary of the temperature corrected normalized deflection statistics (mean, standard deviation and coefficient of variation) for the pavement section/subsections

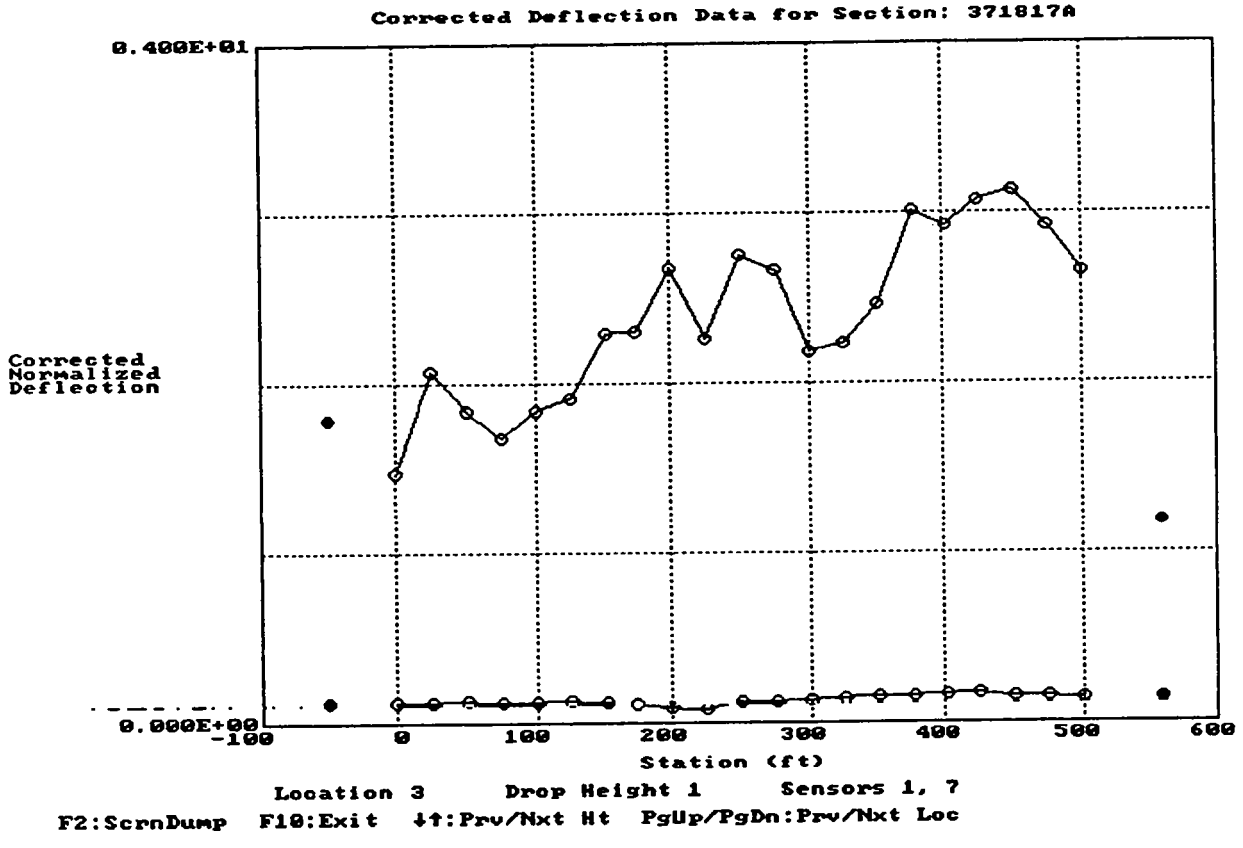


Figure 12 - Sample Corrected Deflection versus Station Plot

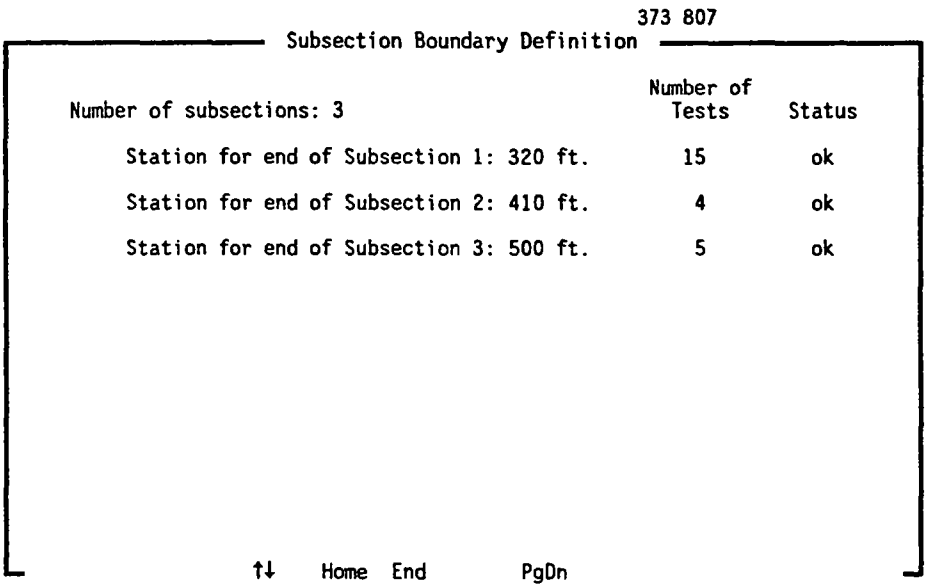


Figure 13 - Screen No. 4C - Subsection Boundary Definition

in question. An example of the information generated by this menu choice is given in Figure 14. As shown, statistics are generated for every combination of test location, drop height and sensor.

E. **Add to Running Comments** - this menu choice allows the user to enter any comments based on his/her observations; e.g., unusual data, section/ subsection requiring a more detailed analysis, etc. Accordingly, when this menu choice is selected, **Screen No. 4E - "Comment"** appears on the monitor (same as Screen No. 3C, see Figure 7). A total of 23 lines of running comments are provided.

   The amount of information entered for the comment is only limited by the size of screen. Comments entered by the user can be viewed from any menu within the program. All user comments are included in the output file generated by the program.

F. **Go on to OUTLIER Analysis** - on completion of the subsection analysis, the user must select this menu choice in order to proceed with the outlier (i.e., non-representative data) analysis.

G. **Select NEW Data File** - this menu choice allows the user to terminate the analysis of the current data file and to select a new data file. If this menu choice is selected, the program returns the user to Screen No. 2 - "FWD Data File Selection".

H. **QUIT Program** - this menu choice allows the user to terminate use of the program.

Screen No. 5 - Outlier Analysis Menu (see Figure 15)

The outlier analysis menu presents the user with five (5) functional choices to select from. They are:

A. **View Outlier Analysis Curves** - used to display plots of deflection standard deviation versus station for the pavement section/ subsections in question. An example of the plots generated by this menu choice is given in Figure 16.

B. **Add to Running Comments** - this menu choice allows the user to enter any comments based on his/her observations; e.g., unusual data, section/ subsection requiring a more detailed analysis, etc. Accordingly, when this menu choice is selected, **Screen No. 5B - "Comment"** appears on the monitor (same as Screen No. 3C, see Figure 7). A total of 23 lines of running comments are provided. The amount of information entered for the comment is only limited by the size of screen. Comments entered by

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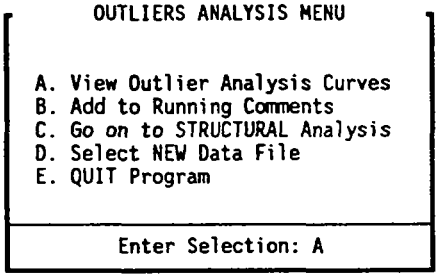


↑↓ Home End

Figure 14 - Screen No. 5 - Outlier Analysis Menu

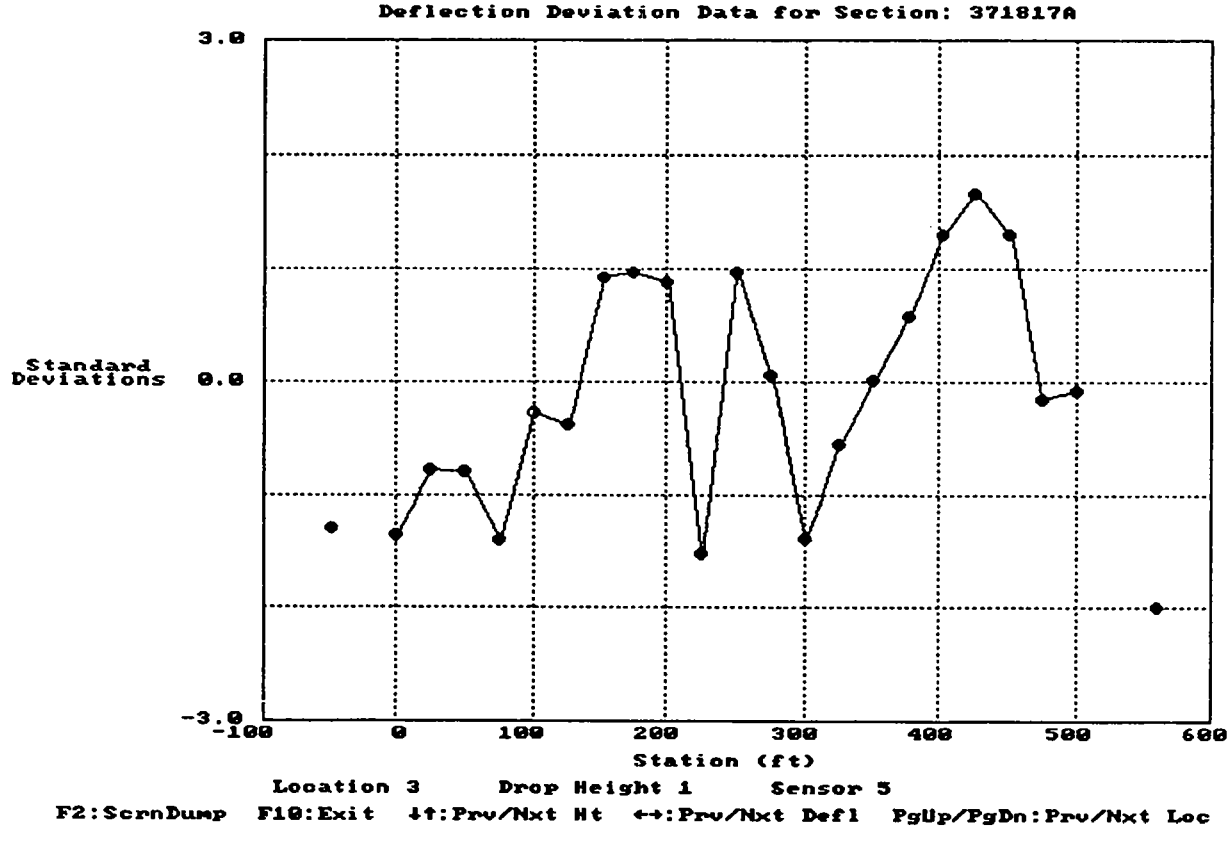


Figure 15 - Sample Outlier Analysis Curve

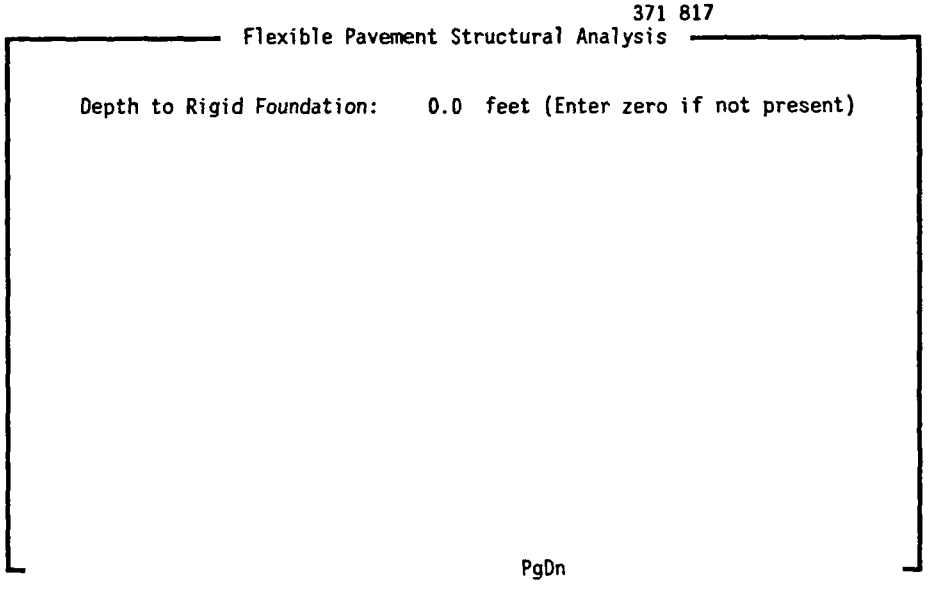


Figure 16 - Screen No. 5C - Flexible Pavement Structural Analysis

the user can be viewed from any menu within the program. All user comments are included in the output file generated by the program.

C. **Go on to STRUCTURAL Analysis** - on completion of the outlier analysis, the user must select this menu choice in order to proceed with the structural capacity analysis. In the case of asphaltic concrete surfaced pavements only, **Screen No. 5C - "Flexible Pavement Structural Analysis"** (see Figure 17) appears on the monitor when this menu choice is selected. This screen contains the following single (1) input field required for the structural analysis of asphaltic concrete pavements:

   Field 1: Depth to rigid foundation - user must specify the depth to rigid foundation (i.e., stiff layer), in feet. If unknown or if none is present, press the <Return> key to accept the default value of zero; the program assumes a depth of 100 feet in this case.

D. **Select NEW Data File** - this menu choice allows the user to terminate the analysis of the current data file and to select a new data file. If this menu choice is selected, the program returns the user to Screen No. 2 - "FWD Data File Selection".

E. **QUIT Program** - this menu choice allows the user to terminate use of the program.

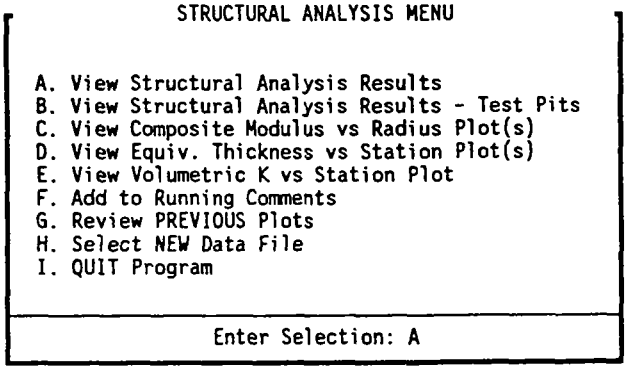
Screen No. 6 - Structural Analysis Menu (see Figure 18 for rigid pavements and Figure 19 for flexible and composite pavements)

The structural analysis menu presents the user with nine (9) functional choices to select from. The specific choice, however, depends in some cases on the pavement type. The menu choices are as follows:

For all pavement types:

A. **View Structural Analysis Results** - used to display tabular summaries of the structural analysis results for the pavement section/subsections in question. In the case of rigid pavements, the display includes point-by-point and statistical summaries of the composite modulus of subgrade reaction (K) and effective thickness values for all drop height and subsection combinations. A partial example of the tabular summaries generated by this menu choice for rigid pavements is given in Figure 20. For flexible and composite pavements, similar tabular summaries are generated for the subgrade modulus and structural number (SN) values. Figure 21 shows a partial example of these tabular summaries for flexible and composite pavements.

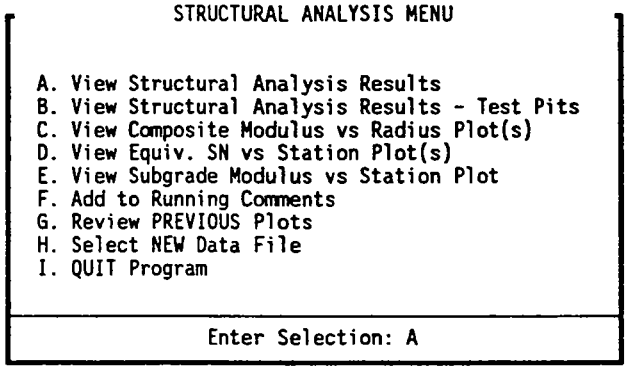
373 807



↑↓ Home End

Figure 17 - Screen No. 6 - Structural Analysis Menu: Rigid Pavements

371 817



↑↓ Home End

Figure 18 - Screen No. 6 - Structural Analysis Menu: Flexible and Composite Pavements

373 807

RIGID Pavement Thickness Statistics

Data for section 373807A
Subsection 1
Drop height 1

Station	Volumetric k	Effective Thickness
15	354	12.50
43	361	12.50
62	306	10.25
77	325	10.63
98	329	10.63
124	373	10.25
144	346	10.63
164	327	10.63
185	356	11.00
208	288	9.88
228	323	9.88
244	371	10.63
261	317	10.25
280	348	10.63
305	373	11.00
Overall Mean:	340	10.75
Standard Deviation:	26	0.78
Coeff Of Variation:	7.59%	7.30%

PgUp PgDn

Figure 19 - Sample Structural Analysis Results - Rigid

371 817

FLEXIBLE Pavement Thickness Statistics

Data for section 371817A
Subsection 2
Drop height 2

Station	Subgrade Modulus	Effective SN
175	8039	3.10
200	7923	2.85
225	12706	2.80
250	8252	2.80
275	9107	2.70
300	13018	2.80
325	11299	2.85
351	10162	2.80
Overall Mean:	10063	2.84
Standard Deviation:	2074	0.12
Coeff Of Variation:	20.61%	4.08%

PgUp PgDn

Figure 20 - Sample Structural Analysis Results - Flexible

373 807

RIGID Pavement Thickness Statistics - Test Pits

Data for section 373807A

Height	Station	Volumetric k	Effective Thickness
1	-50	327	10.25
	566	315	11.00
2	-50	307	9.88
	566	292	10.63
4	-50	278	9.88
	566	261	10.25

PgDn

Figure 21 - Sample Structural Analysis Results
(Rigid Pavement Test Pits)

B. **View Structural Analysis Results - Test Pits** - used to display a tabular summary of the structural analysis results for the test pits in question, if analyzed. For rigid pavements, the display includes a summary of the K and effective thickness values at each test pit for all drop heights. An example of the tabular summary generated by this menu choice for rigid pavements is given in Figure 22. For flexible and composite pavements, a similar display is generated for the subgrade modulus and structural number (SN) values. Figure 23 shows an example of the tabular summary for flexible and composite pavements.

C. **View Composite Modulus vs. Radius Plot(s)** - used to display plots of composite modulus versus radial distance for all drop heights at any given or all stations. An typical example of the plots generated by this menu choice is given in Figure 24.

For rigid pavements:

D. **View Equiv. Thickness vs. Station Plot(s)** - used to display plots of effective thickness versus station for the rigid pavement section/subsections in question. An example of the plot generated by this menu choice is given in Figure 25. As shown, superimposed on this plot are the expected thickness range (dashed horizontal lines) and specified thickness (solid horizontal line).

E. **View Volumetric K vs. Station Plot(s)** - used to display a plot of K versus station for the rigid pavement section/subsections in question. An example of the plot generated by this menu choice is given in Figure 26.

For flexible and composite pavements:

D. **View Equiv. SN vs. Station Plot(s)** - used to display plots of effective SN versus station for the flexible or composite pavement section/subsections in question. An example of the plot generated by this menu choice is given in Figure 27. As shown, superimposed on this plot are the expected SN range (dashed horizontal lines).

E. **View Subgrade Modulus vs. Station Plot(s)** - used to display a plot of subgrade modulus versus station for the flexible or composite pavement section/subsections in question. An example of the plot generated by this menu choice is given in Figure 28.

For all pavement types:

F. **Add to Running Comments** - this menu choice allows the user to enter any comments based on his/her observations; e.g., unusual data, section/

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FLEXIBLE Pavement Thickness Statistics - Test Pits

Data for section 371817A

Height	Station	Subgrade Modulus	Effective SN
1	-50	15708	3.15
	560	19113	3.75
2	-50	14008	3.15
	560	16745	3.75
3	-50	12599	3.15
	560	15026	3.70
4	-50	11954	3.15
	560	14111	3.60

PgDn

Figure 22 - Sample Structural Analysis Results
(Flexible Pavement Test Pits)

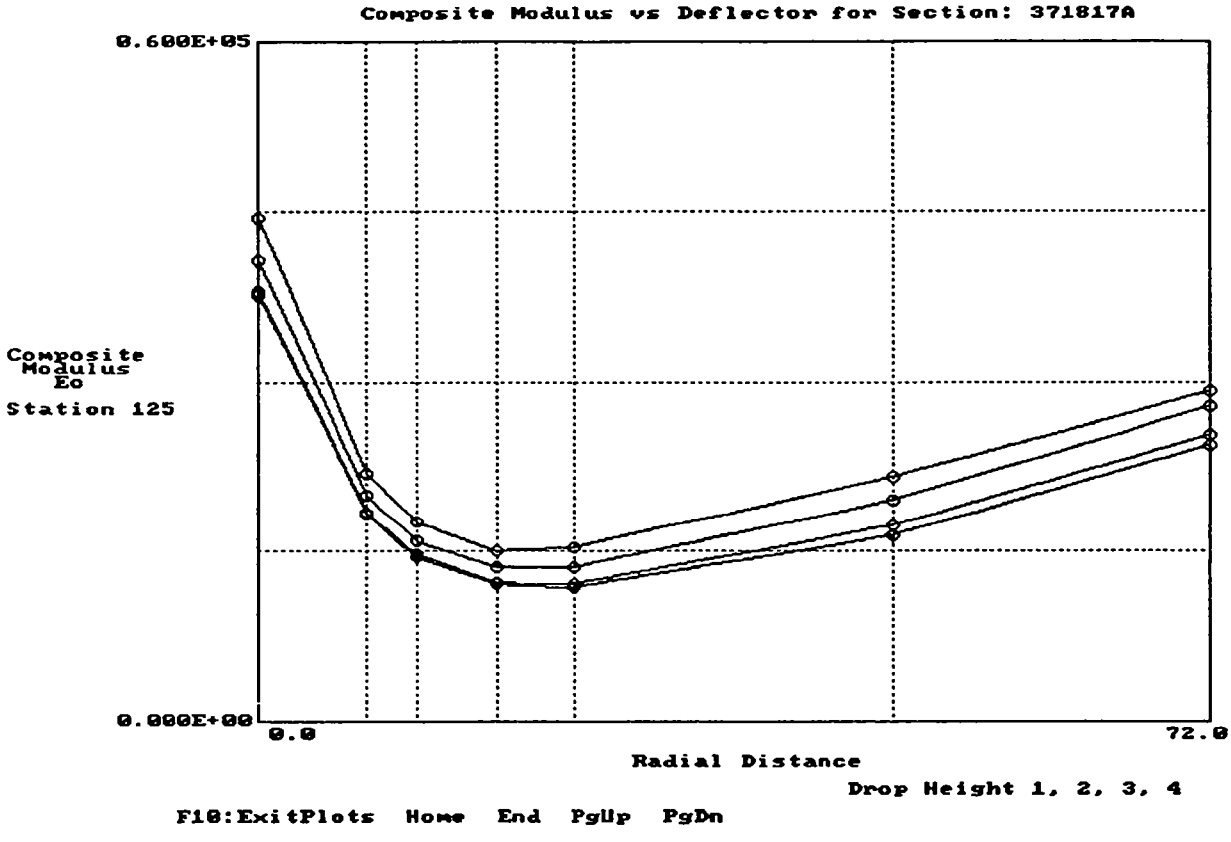


Figure 23 - Sample Composite Modulus Plot

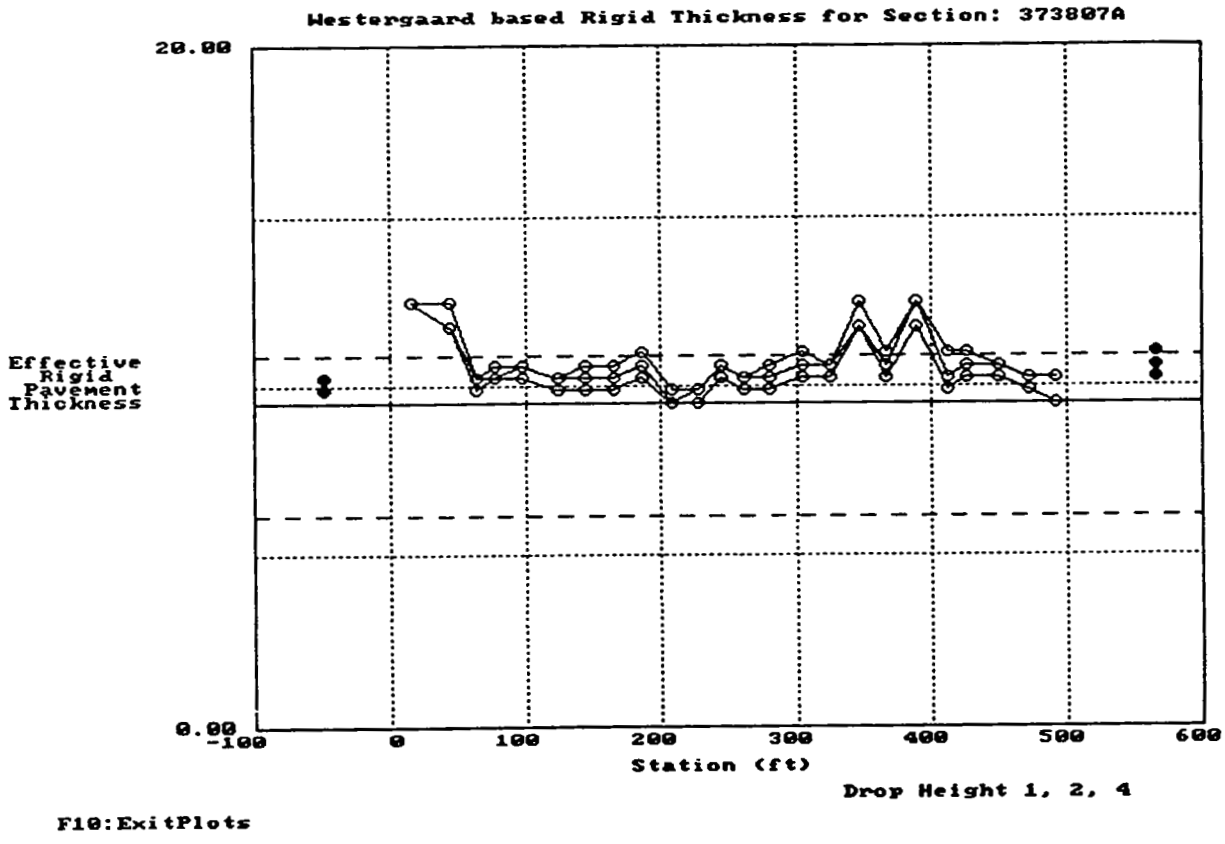


Figure 24 - Sample Equivalent Thickness Plot

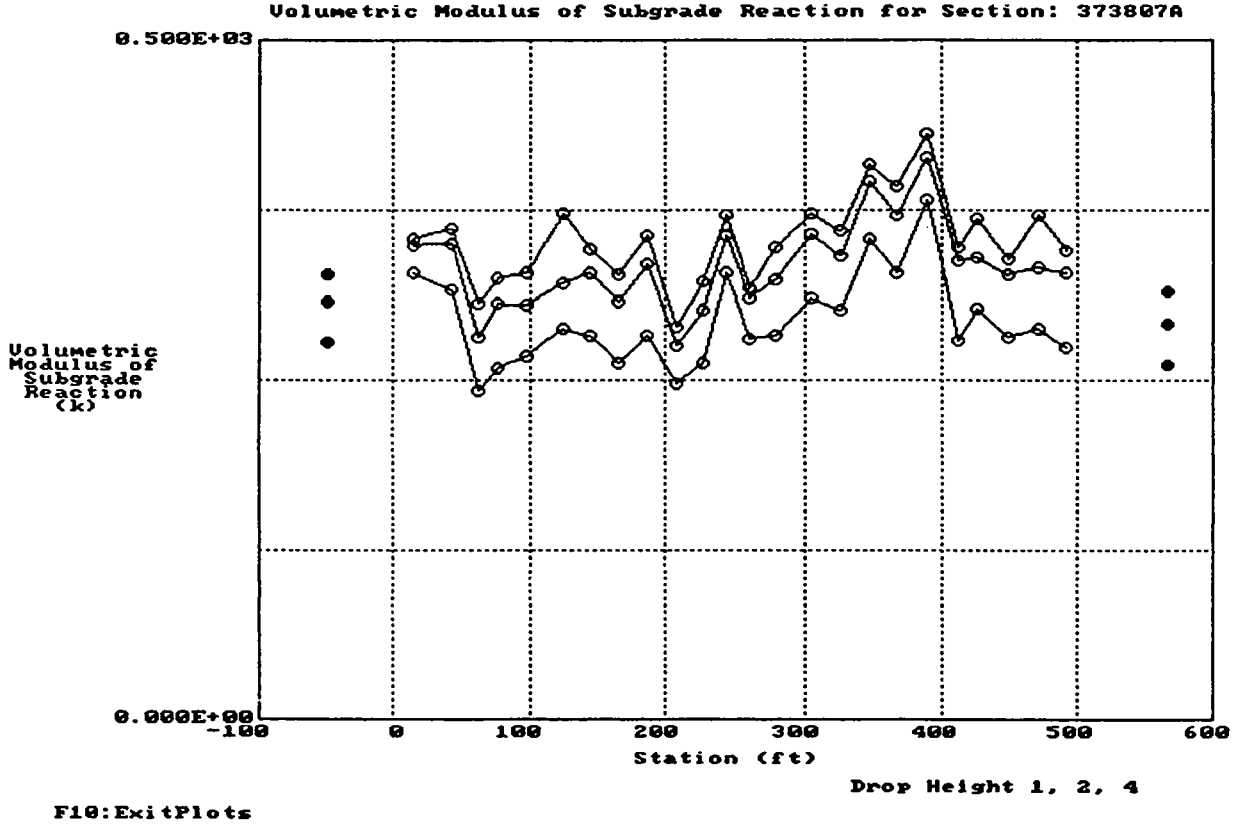


Figure 25 - Sample Volumetric K Plot

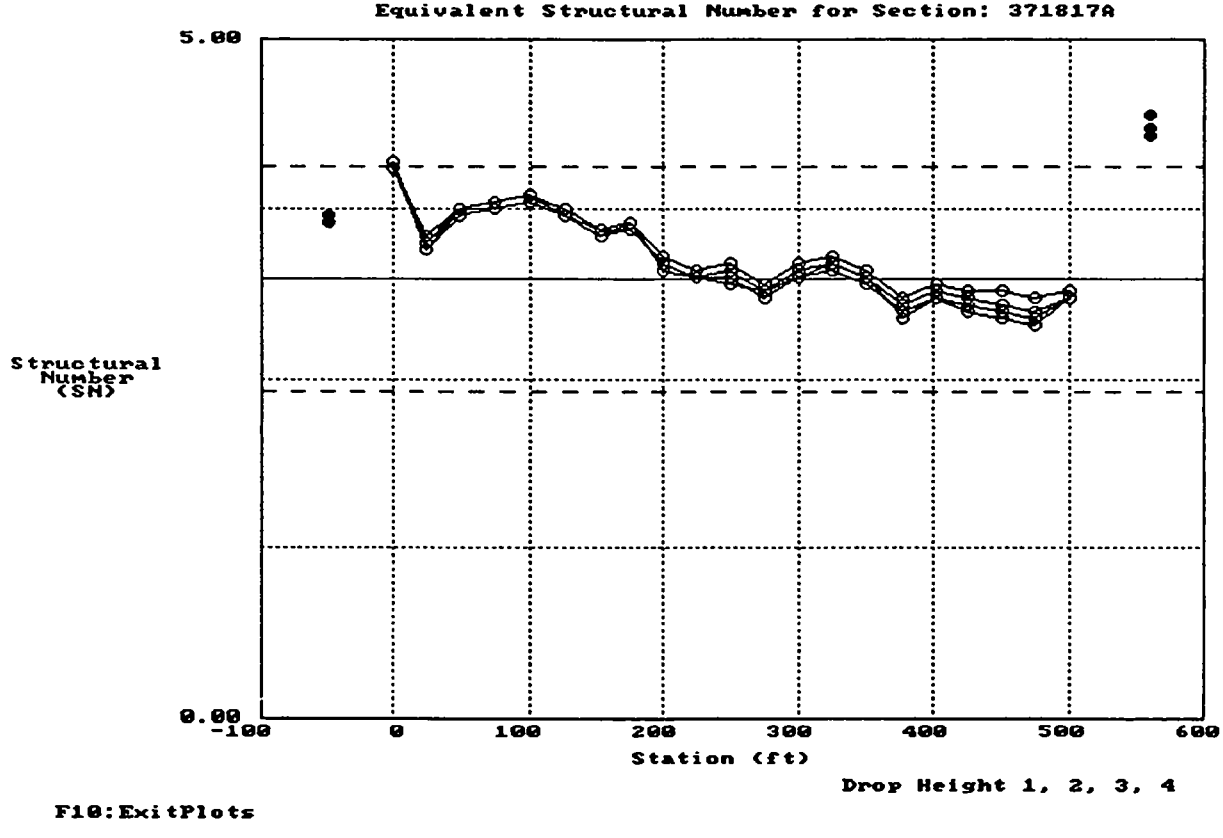


Figure 26 - Sample Effective Structural Number Plot

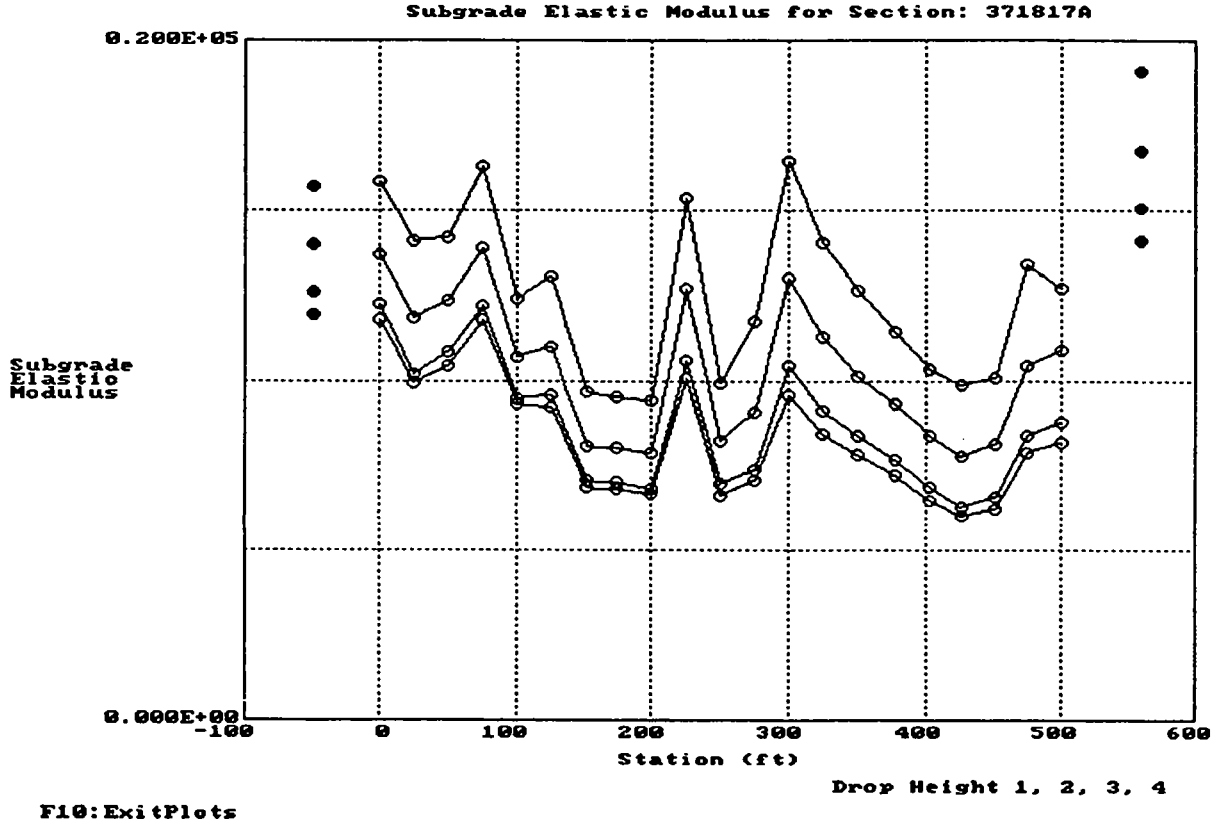
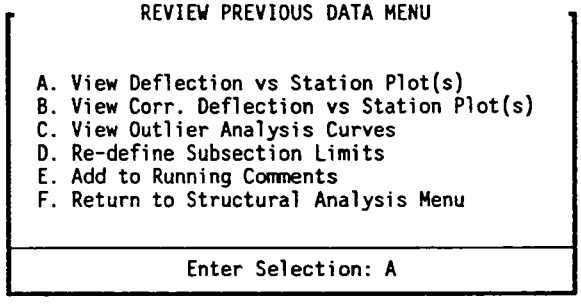


Figure 27 - Sample Subgrade Elastic Modulus Plot

371 817



↑↓ Home End

Figure 28 - Screen No. 6G - Review Previous Plots Menu

subsection requiring a more detailed analysis, etc. Accordingly, when this menu choice is selected, **Screen No. 6F - "Comment"** appears on the monitor (same as Screen No. 3C, see Figure 7). A total of 23 lines of running comments are provided. The amount of information entered for the comment is only limited by the size of screen. Comments entered by the user can be viewed from any menu within the program. All user comments are included in the output file generated by the program.

G. **Review PREVIOUS Plots** - this menu choice allows the user to review all previously viewable plots via a menu (Screen No. 6G - "Review PREVIOUS Plots", see Figure 29), and to re-define subsection boundaries based on the structural analysis, if so desired. All of the menu items found on this screen have been described previously.

H. **Select NEW Data File** - this menu choice allows the user to terminate the analysis of the current data file and to select a new data file. If this menu choice is selected, the program returns the user to Screen No. 2 - "FWD Data File Selection".

I. **QUIT Program** - this menu choice allows the user to terminate use of the program.

OTHER CONSIDERATIONS

In addition to what has been discussed so far, there are a number of other important considerations the user must be aware of. They are:

1. Output File - the output file generated by **FWDCHECK** is named according to the following scheme: "XXXXXXXX.RES", where "XXXXXXXX" is the SHRP GPS section identification, as specified by the user, and "RES" is the output file extension; e.g., 133071A1.RES. The file is generated in ASCII format and can be viewed using the DOS line editor (EDLIN) or any number of word processors commercially available.

2. Review of Output File - the user should <u>always</u> look at the output file after completion of the analysis and prior to uploading the deflection data to the National Pavement Performance Data Base (NPPDB). The last page of the output file contains a summary of the results of the programs' analysis. Numerous text messages summarize the various phases of the analysis.

   The first set of messages is based on section uniformity results and indicates whether or not subsections have been identified by the user. The second group of messages indicates whether or not deflections measured at the test pits are representative of deflections measured within the test section. Similarly, the

third set of messages indicates whether there are any data outliers present within the bounds of the section (or any of the identified subsections). The fourth set of messages indicates whether or not the structural capacity results for the test pits fall within the range of expected values for the section as a whole. Similarly, the next group of messages indicate whether or not the structural capacity results for locations within the section boundaries are within the expected range of values. The final set of messages for flexible pavements indicate the type of subgrade response found for this section. This information is not available for rigid pavement sections. All of these summary messages are to be included in the NPPDB.

3. Computational Time - while the structural analysis of rigid pavements is quite fast, that of flexible and composite pavements is not; it takes approximately 10 minutes to complete using the RCO workstations. The reason for this is that both the stiff layer and non-linearity analyses make extensive use of the Chevron N-layer code as part of the solution. All other program analyses - Statistical Assessment, Section Homogeneity, and Non-Representative Data - are very fast, regardless of pavement type.

Finally, it is important to emphasize once again that **FWDCHECK** has not been developed to eliminate "bad" deflection data, but rather to assess the quality of the data and, if necessary, generate warning messages alerting RCO personnel of possible "bad" data.

TECHNICAL ASSISTANCE

If further technical assistance is required in the usage of this program, please contact PCS/Law Engineering, Beltsville, Maryland at 301-604-5105.

REVISION NOTES

Version 2.10 - September 1992
- minor bug fixes
- enhanced to allow for testing both before and after midnight

Version 2.00 - January 1991
- substantial changes based primarily on comments received during the October 1990 workshop, and from comments received based on subsequent review by the SHRP Regional Coordination Offices.

Version 1.00 - September 1990
- initial release

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