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16. Abstract <p>A tremendous amount of scour data already exists for the highway bridges monitored by the Louisiana Department of Transportation and Development (DOTD). More than one hundred and twenty bridges are being monitored at a frequency of one to several times per year and at various locations from the bridges centerlines.</p> <p>The scour data collected is still in the format of traditional paper files and there existed a need to develop ready-to-use computer software using modern database technology to perform scour data management. Such software was needed to speed plotting historical cross sections and to identify scour critical bridges.</p> <p>This report presents the manual of the software program developed for database management of scour data of the Louisiana highway bridges. The program has the capabilities of data retrieval of a specific bridge using a variety of data search routines. The program retrieves bridge information, survey plans, and soil boring data. It plots the cross-sections and longitudinal sections at any survey location and date. The program also displays contour plots at any selected date and historic plots of scour at any selected location.</p> <p>The database software can be installed on any DOTD computer having Microsoft Windows 95, 98 and NT systems. The database can be installed in any directory in the user's computer or can be accessed remotely from the DOTD server.</p>			
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**DEVELOPMENT OF A DATABASE FOR LOUISIANA
HIGHWAY BRIDGE SCOUR DATA**

A Program and Manual

by

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October 1999

ABSTRACT

A tremendous amount of scour data already exists for the highway bridges monitored by the Louisiana Department of Transportation and Development (DOTD). More than one hundred and twenty bridges are being monitored at a frequency of one to several times per year and at various locations from the bridges centerlines.

The scour data collected is in the format of traditional paper files and there existed a need to develop ready-to-use computer software using modern database technology to perform scour data management. Such software was needed to speed plotting historical cross sections and to identify scour critical bridges.

This report presents the manual of the software program developed for database management of scour data of the Louisiana highway bridges. The program has the capabilities of data retrieval of a specific bridge using a variety of data search routines. The program retrieves bridge information, survey plans, and soil boring data. It plots the cross-sections and longitudinal sections at any survey location and date. The program also displays contour plots at any selected date and historic plots of scour at any selected location.

The database software can be installed on any DOTD computer having Microsoft Windows 95, 98, and NT systems. The database can be installed in any directory in the user's computer or can be accessed remotely from the DOTD server.

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IMPLEMENTATION STATEMENT

The deliverable for this research project is a database management software package developed at LTRC for storage and retrieval of scour data of the Louisiana highway bridges. The system currently stores the data in a Microsoft Access database program. The database is placed on the road design server. A Visual Basic program is used as the front end of the software package to allow the user access to the database. The software program can be installed on any DOTD computer having Windows 95, 98, or NT systems. Any personnel having access to the road design server will thus be able to utilize the attributes of the program.

Manipulation of the database is only allowed with password access. Password access is provided to the hydraulic and location & survey personnel. Location and survey personnel will maintain and update the data as new information is obtained. Hydraulic personnel will be responsible for input of new bridges and bridge information. Hydraulic personnel will also be responsible for overall distribution of the program and control of password access codes.

Future implementation of the database will progress in two phases. Phase I is to transmit the database to the DB2 program and to network the database for users access through the DOTD intranet. Phase II of the implementation plan is to network the database into the DOTD GIS strategy. These two phases will be the responsibility of the information services section. Completion of these phases will allow a more global access to the program throughout DOTD.

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INTRODUCTION

Scour of highway bridges in Louisiana has been collected by the DOTD location and survey section and monitored by the hydraulics section, district offices, and contract companies since the 1970's. A tremendous amount of scour data already exists for these bridges. Approximately one hundred and twenty bridges are being monitored at a frequency of one to several times per year with an average of six cross sections for each bridge.

The scour data collected is in the format of traditional paper files. Manual and visual analysis of these data is tedious work and there existed a need to develop ready-to-use computer software using modern database technology to perform scour data management. Such software was needed to speed plotting historical cross sections and to identify scour critical bridges.

This manual presents the database management software developed at LTRC for storage and retrieval of scour data of the Louisiana highway bridges. The system stores scour data in a Microsoft Access database program. A Visual Basic (VB) computer program is used as a front end to allow the user to access the database. The VB program has the following capabilities:

- *Data Retrieval:* Scour data for a specific bridge can be searched and retrieved using one or a combination of the indices such as Bridge Number, State Project Number, Recall Number, District Code, Parish Code, River, and Route. The database software tabulates the basic bridge information, pier data, and the hydrographic data of the cross-sections and longitudinal sections at a specific location and time.
- *Data Visualization:* The software displays survey plans of the bridges. The plans show locations of bridges, piers distances, base lines stations of the hydrographic readings, and the locations of the monitored cross sections

along the river. The program also displays soil-boring data near the pier locations. The software plots the cross-sections, the longitudinal sections, and the contour plots of the hydrographic readings at the selected survey dates. Contour plots can also be exported for use in other graphical programs. The history of scour at specific location is plotted in the hydrographic–time plots. A printer can produce hard copies of these plots.

- *Database Update and Addition:* New scour data can be added to the existing bridges in the database. New bridges that do not exist in the database can also be added through the software. These operations are accessible to DOTD personnel with an authorized password.
- *Data Deletion:* Bridge and scour data can be modified or deleted from the database by authorized personnel. Warning messages are displayed to insure proper modification or deletion of key bridge data.
- *Accessibility:* The database software can be installed on any DOTD computer having Microsoft Windows 95, 98, and NT systems. The database can be installed in any directory in the user's computer or can be accessed remotely when installed in the DOTD sever.

The manual contains three chapters. The first chapter presents the structure of the database and computer program. Chapter Two presents the procedure for scour-data retrieval and graphical display. Chapter Three presents data editing and manipulation procedures.

CHAPTER 1

PROGRAM STRUCTURE AND INSTALLATION

INSTALLATION

The installation program contains two directories, **BridgeScour_Data** and **Installation_Programs**. The installation procedure consists of the following two steps.

1. The **BridgeScour_Data** is copied into any directory in the user's computer or to the network directory accessible to the user. The directory contains the following bridge scour data:
 - *DataBase_02.mdb*: the hydrographic database file in MS Access format.
 - *Plans*: a directory contains the survey plans of the bridges in the database
 - *SoilBorings*: a directory contains the soil boring plans of the bridges in the database.

The database file contains the Fathometer data (hydrographic data) and bridge data of the surveyed bridges in Louisiana.

Note: The access to the database files should be allowed to authorized personnel only. Installing the database on the user's directory is for the program demonstration purpose only. In order to prevent access to the database through the MS Access files, the database is installed in the network. The administrator should provide the necessary access security procedures.

2. Open the **Installation_Programs** directory. The directory contains the following files and directories:

- BridgeScour_02.CAB program files
- Support: directory containing the necessary system files, graphics support, and un-installation files
- DCOM95 executable program that installs the necessary database ADO, OLEDB, and ODBC communication components into the Windows 95 system directory
- DCOM98.exe executable program that upgrades the above components in the Windows 98 system
- SETUP.exe installation program
- SETUP.lst list file of the installation procedure

In order to install the program, run **SETUP.exe** and follow the setup instructions on the screen. The program first decompresses and copies **BridgeScour_02.CAB** files into a temporarily directory. The program then runs the installation procedure and prompts the user for the location of the directory to install the executable program. When installation is successful, the program prompts the user of complete installation.

In order to un-install the program, don't delete the files from the program directory. The installation procedure installs other system files in the Windows system directory. For correct un-installation procedure, run "Add/Remove Programs" from the "Control Panel" in Windows Setup. Select the program name from the Add/Remove list and select un-install.

Note: The program uses the last version of the Visual Basic 6.0 ADO remote database connectivity. When installing the program in older Windows 95 systems, a message may appear during installation indicating missing system files that handle the database components. In this case, exit the setup and run DCOM95 to install the necessary files. After completion, re-install the program using Setup.exe.

Note: Computers with Windows 98 and Windows NT systems usually have these system files already installed. No messages of missing system files should appear during installation in these systems and there is no need to run the DCOM programs.

Program Structure

The database is installed in a Microsoft Access 97 database program. Figure 1 shows the database tables. The relationships between the database tables are shown in figure 2. **Bridge Number** is the primary key that identifies the bridge in the database. The hydrographic data of each bridge are installed in separate tables. Bridge number identifies each hydrographic table in the database.

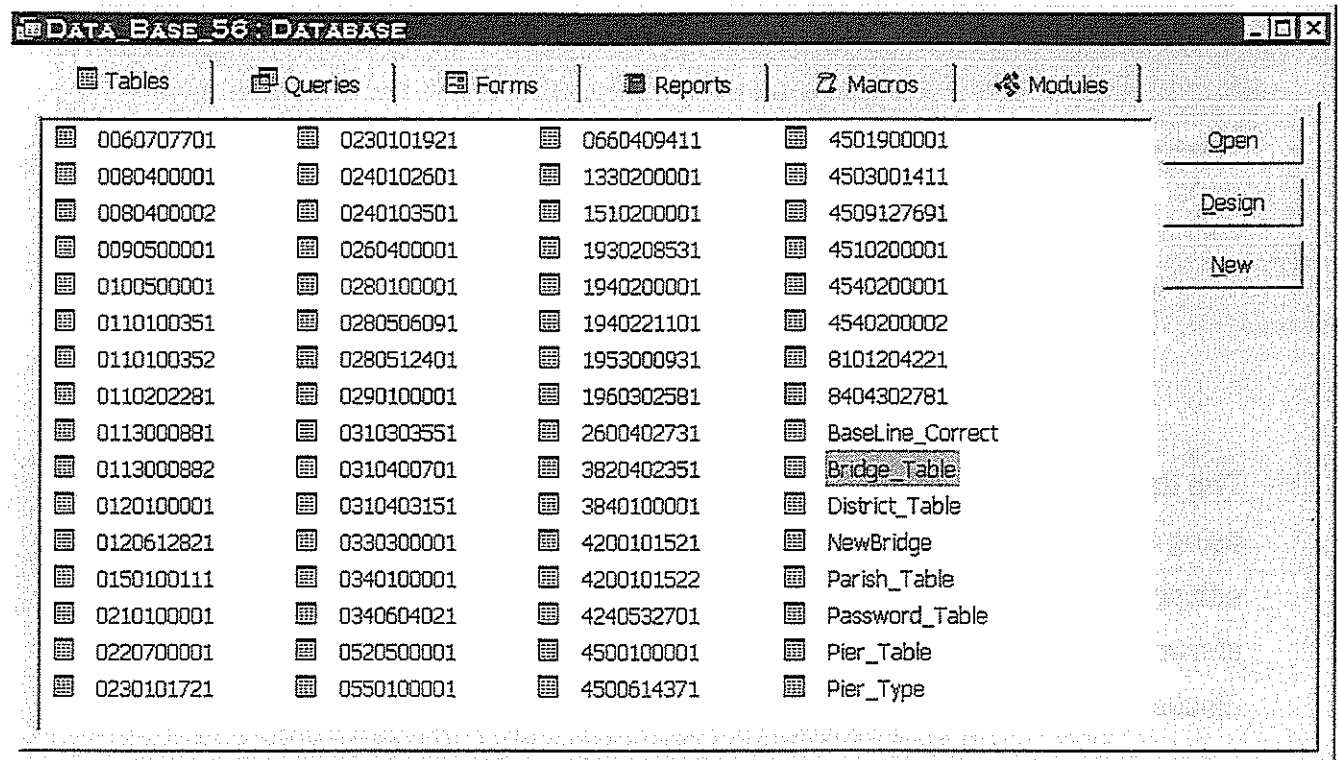


Figure 1
Bridge tables in the MS Access database

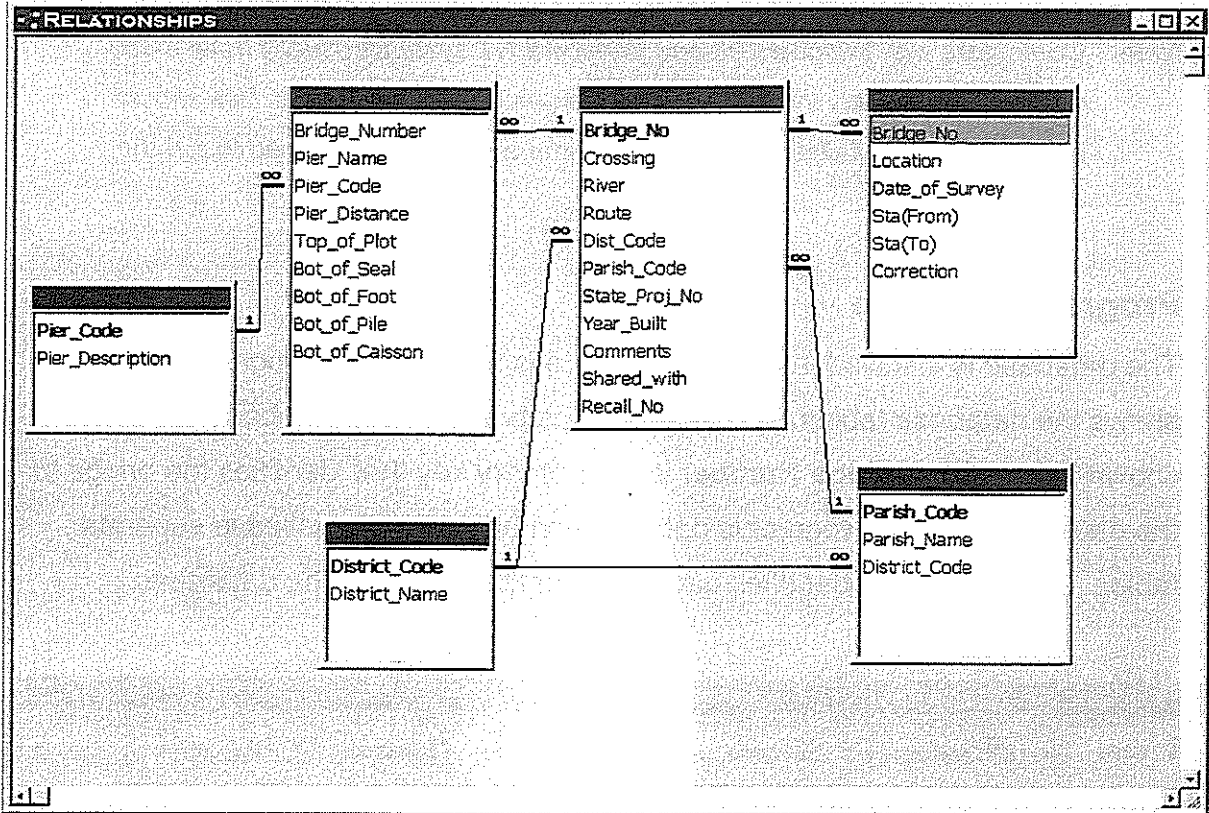


Figure 2
Relationship between the database tables

The database program is written in Visual Basic 6.0. It accesses the database using the ActiveX Database Connectivity "ADO." Data access, display, and editing are done through interactive forms. A layout of the program forms is shown in figure 3. The use of the program for data display and editing is discussed in detail in the following chapters.

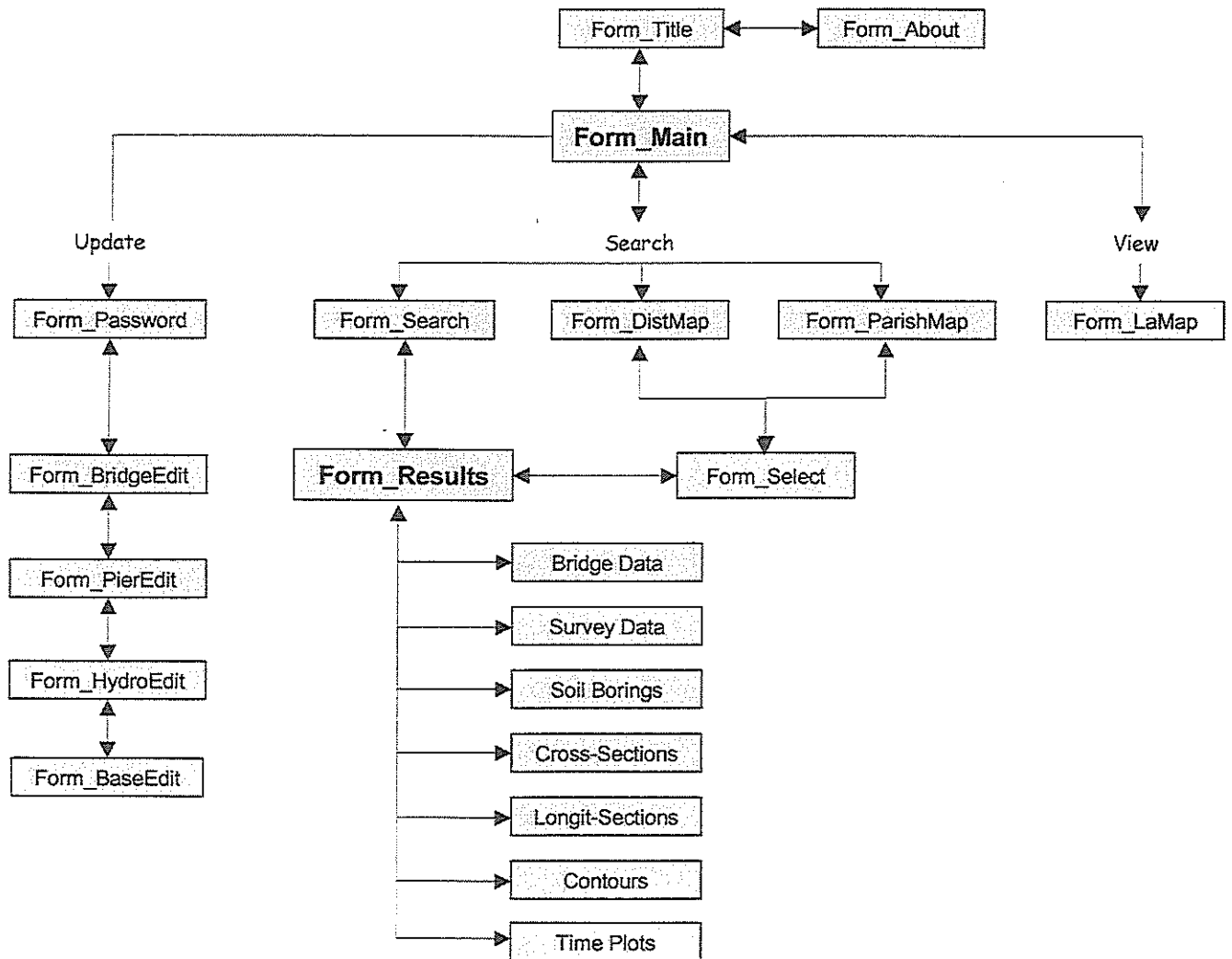


Figure 3
Layout of program forms

CHAPTER 2

SCOUR-DATA RETRIEVAL AND DISPLAY

Database Connection

The installation procedure places the program taskbar "BridgeScour_02" in the start up menu of the Windows system. Clicking on the taskbar starts the program and displays the startup form of the software (figure 4). Click **Start** in the top menu bar to go to the main program menu.

When the main program menu is initially displayed, all the selection buttons are disabled except the button: **Establish Database Connection**. The user should establish a connection with the database before he/she can proceed with the other options in the menu. Clicking on the button initiates a search for the database in the computer hard drives and remote network directories. The program searches for the default database name: **DataBase_2.mdb**.

Note: If the user fails to select the correct database file name, an error message is displayed: "DataBase2.mdb file not found. Please verify the correct filename was given."

Main Menu Form

Once a connection to the database is established, a displayed message confirms the connection and shows the number of bridges in the database (figure 5).

When the connection is established, the selection options in the main menu are enabled (figure 6). The **Next** button in the top menu bar is also enabled to allow the user to move to the next form.

Note: If the user clicks "Next" without selecting any option in the main menu, the program proceeds with "Search Using Bridge Database" as a default selection.

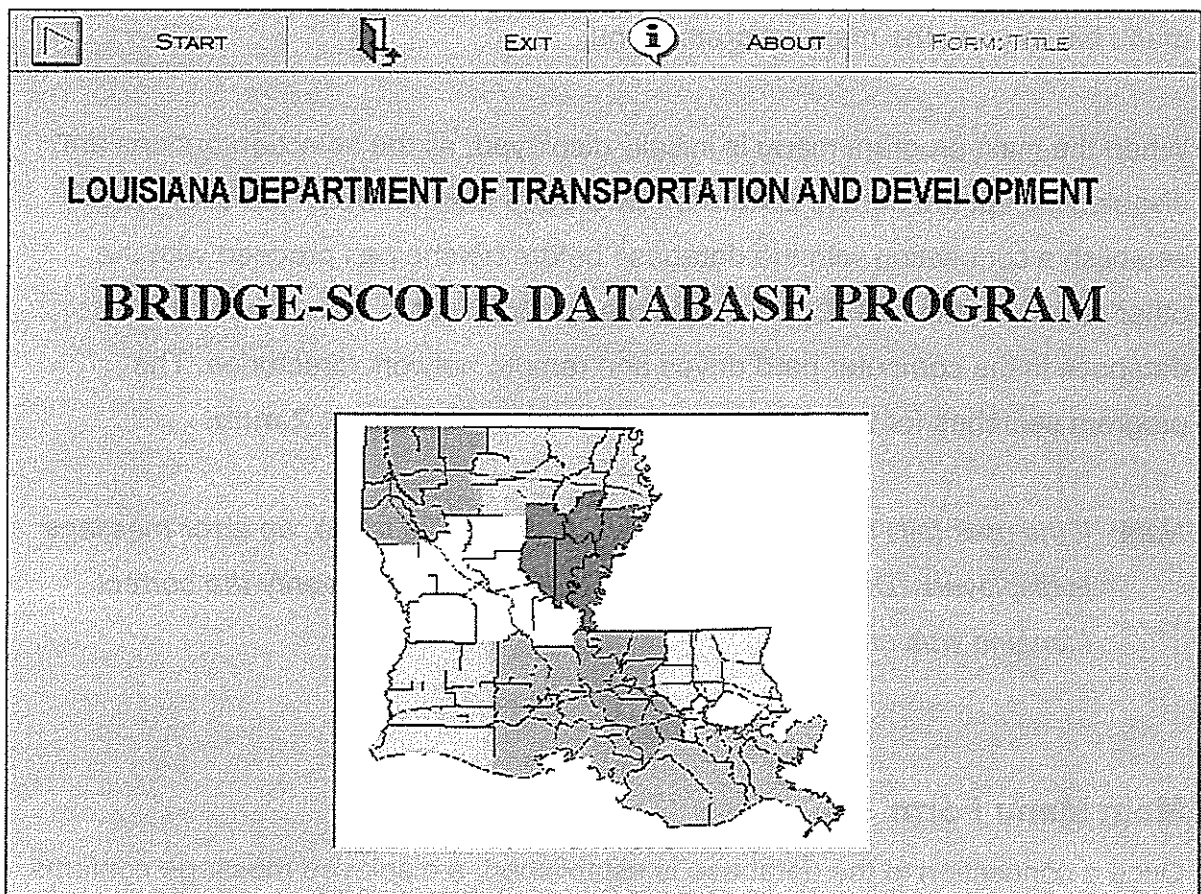


Figure 4
The program startup form

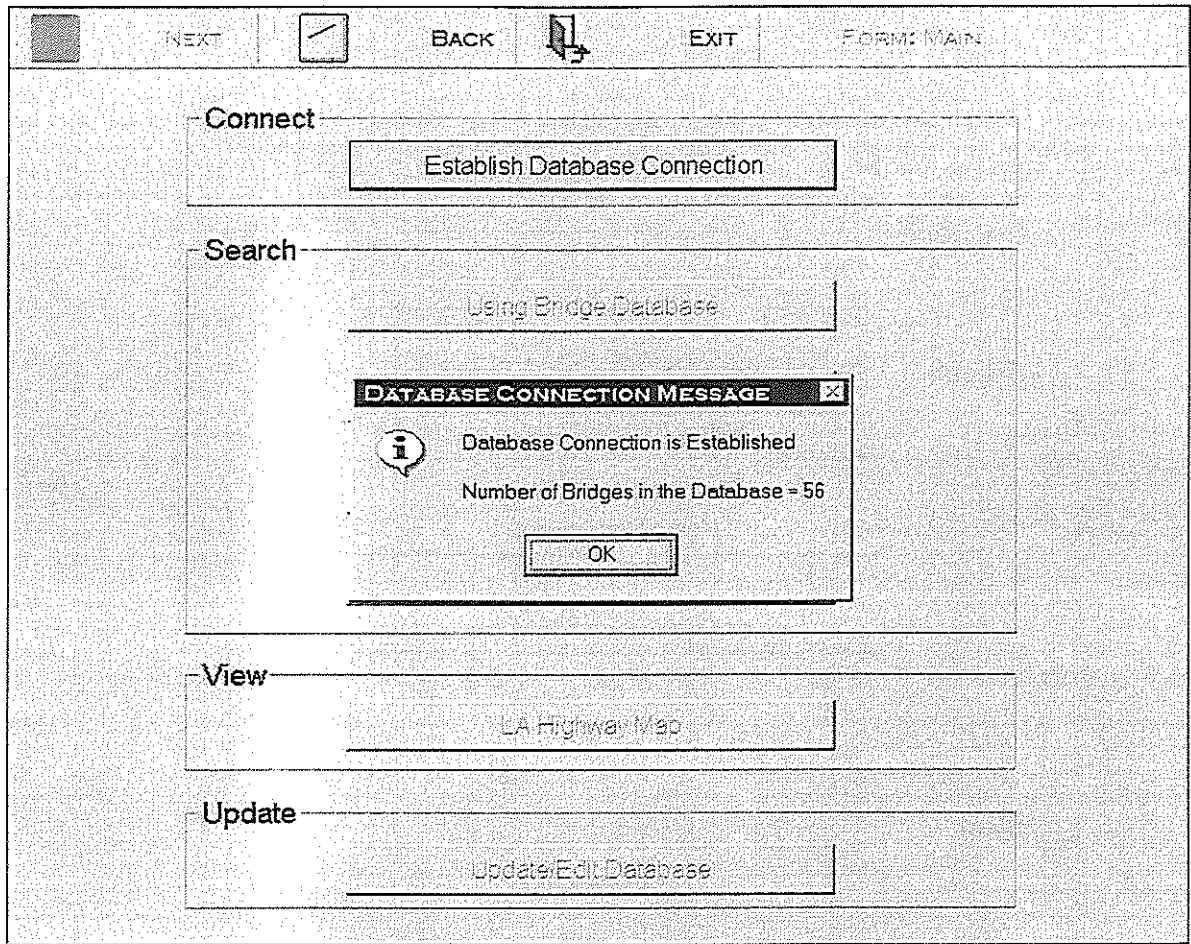


Figure 5
Database connection message

Navigation icons: [Home], [Next], [Back], [Mouse], [Exit]

FORM: MAIN

Connect

- Establish Database Connection

Search

- Using Bridge Database
- Using District Map
- Using Parish Map
- Scour Repair Data

View

- LA Highway Map

Update

- Update/Edit Database

Figure 6
The program main menu

Form Search, Using Bridge Database

This option is the default search routine if the user clicks "Next" in the main menu form. It enables the search using one of the options shown in the form (figure 7). The selection of one of the search options results in displaying a combo box with the data related to the selected search criteria. Figure 7 shows a list of bridge numbers in the database when the **Search Using: Bridge Number** was selected. Similarly, figure 8 shows a list of the rivers in the database when the **Search Using: River Name** button was selected.

FORM: SEARCH

NEXT BACK EXIT

Search Using

- Bridge Number
- River Name
- Route
- District Code
- Parish Code
- State Project Number
- Recall Number

Enter/Select Bridge Number

006-07-0770-1
006-07-0770-1
008-04-0000-1
008-04-0000-2
009-05-0000-1
010-05-0000-1
011-01-0035-1
011-01-0035-2
011-02-0228-1

Figure 7

The search form with "Search Using: Bridge Number"

FORM: SEARCH

NEXT BACK EXIT

Search Using

- Bridge Number
- River Name
- Route
- District Code
- Parish Code
- State Project Number
- Recall Number

Enter/Select River Name

- Atchafalaya
- 12 Mile Bayou
- Amite River
- Atchafalaya
- Atchafalaya River
- Bayou Choupique
- Bayou Toro
- Black River
- Calcasieu River

Figure 8

The search form with “Search Using: River Name”

The user can click to select the bridge number from the list. The user can also type the first numerical value of the bridge number in the combo box. This will toggle between all the bridge numbers that start with the typed numerical value. Click on **Next** to move to **Form Bridge Results** showing the information of the selected bridge. If the user selects other search options, the **Next** key will move to **Form Select Bridge** displaying a list of the bridges in the selected option.

Form Search, Using District Map

This option allows searching for bridges in a specific district. The user can either click on the district number in the map or select from the list in the box (figure 9). The **Search** button is enabled when the user selects a district number. Click on **Search** to move to the next form, **Form Select Bridge**, showing a list of bridges in the selected district.

Note: If the user clicks on a district number that does not have bridges in the database, an error message is displayed: "This district has no bridges in the database."

The screenshot shows a web application interface for searching bridges by district. At the top, there is a navigation bar with buttons for 'SEARCH', 'BACK', and 'EXIT', and a label 'FORM: DISTMAP'. Below this is the main title 'SEARCH USING DISTRICT MAP'. The central part of the interface features a map of Louisiana divided into numbered districts. To the right of the map is a dropdown menu labeled 'District:' with a list of numbers: 3, 4, 58, 62, 7, 8. The number 58 is currently selected in the dropdown. Above the dropdown, there is a text prompt: 'Click on Number in the Map, or Select from the List'.

Figure 9
The "Search Using District Map" form

Form Search, Using Parish Map

This option allows searching for bridges in a specific parish. A map is displayed in the form showing Louisiana parishes (figure 10). When the user selects a parish from the list in the box, the **Search** button is enabled. Click on **Search** to move to the next form, **Form Select Bridge**, showing a list of bridges in the selected parish.

Form Update/Edit Database

This option will be discussed in detail in Chapter 3.

The screenshot shows a web-based form titled "SEARCH USING PARISH MAP". At the top, there is a navigation bar with buttons for "SEARCH", "BACK", and "EXIT", along with a "FORM: PARISHMAP" label. The main content area is divided into three sections:

- Map:** A map of Louisiana parishes, each labeled with a number from 1 to 64. The map is oriented with North at the top.
- Parish List:** A list of 64 parishes, numbered 1 through 64, arranged in three columns. The list includes:
 1. ACADIA
 2. ALLEN
 3. ASSUMPTION
 4. AYOULET
 5. BEAUREGARD
 7. BIENVILLE
 8. BOSSIER
 9. CALDOO
 10. CALCASIEU
 11. CALDWELL
 12. CAMERON
 13. CATAHOULA
 14. CLATSOPNE
 15. CONCORDIA
 16. DESOTO
 17. E. BATON ROUGE
 18. EAST CARROLL
 19. EAST FELICIAN
 20. EVANGELINE
 21. FRANKLIN
 22. GRANT
 23. IBERIA
 24. IBERVILLE
 25. JACKSON
 26. JEFFERSON
 27. JEFFERSON PARISH
 28. LAFOURCHE
 29. LA SALLE
 30. LINCOLN
 31. LIVINGSTON
 32. MADISON
 33. MOREHOUSE
 34. NATCHITOCHE
 35. ORLEANS
 36. QUACHITA
 37. PLAQUEMINE
 38. PORTECOUPEE
 39. RAMBER
 40. REG RIVER
 41. RICHLAND
 42. SARINE
 43. ST. BERNARD
 44. ST. CHARLES
 45. ST. HELENA
 46. ST. JAMES
 47. ST. JOHN THE BAPTIST
 48. ST. LANDRY
 49. ST. MARTIN
 50. ST. MARY
 51. ST. TAMMANY
 52. TANGIPAHOA
 53. TERREBONNE
 54. TERRYBINE
 55. VERMILION
 56. WASHINGTON
 57. WEST CARROLL
 58. WEST FELICIAN
 59. WINN
- Select From the List:** A dropdown menu labeled "SELECT FROM THE LIST:" with the text "Parish:" followed by a list of numbers from 01 to 13. The number "06" is currently selected and highlighted.




Figure 10

The "Search Using Parish Map" form

Form Select Bridge

This form displays the results when the user uses the options of search using district map, parish map, or the options in the main menu form. The form displays bridge names and other bridge information for the selection (figure 11). Use the mouse to select a bridge from the list. Click **Next** in the top menu bar to move to **Form Bridge Results**.

Note: If the user clicks "Next" without selecting any bridge from the list, the program proceeds with the first bridge in the list as a default selection.

	NEXT		BACK		EXIT	FORM: SELECT
---	------	---	------	---	------	--------------

RESULTS OF BRIDGE SEARCH USING : River

Bridges with River = Calcasieu River

Bridge No	Crossing	River	Route	District	Parish
012-06-1282-1	Calcasieu River @ Kinder	Calcasieu River	US 190	7	02
▶ 024-01-0350-1	Calcasieu River @ Moss Bluff	Calcasieu River	US 171	7	10
028-05-1240-1	Calcasieu River near Oberlin	Calcasieu River	LA 26	7	02
066-04-0941-1	Calcasieu River @ Oakdale	Calcasieu River	LA 10	7	02
450-30-0141-1	Calcasieu Ship Channel @ Lake Charles	Calcasieu River	I-210	7	10
450-91-2769-1	Calcasieu River @ Lake Charles	Calcasieu River	I-10	7	10
810-12-0422-1	West Fork Calcasieu River	Calcasieu River	LA 378	7	10

Figure 11
The "Select Bridge" form

Form Bridge Results

The form displays bridge information and hydrographic data for the selected bridge. Click on any label in the form (figure 12) to display the information in this folder. No editing is enabled in any of the folders in this form. The default folder in the form is **Bridge Information** folder. The folders in this form are:

- a. **Bridge Information Folder:** This folder displays bridge and pier information in the database.
- b. **Survey Map Folder:** This folder shows a schematic of the bridge plan (figure 13). It also displays pier names, pier locations, baseline stations, and the locations of survey sections on the river. It should be noted that the locations of survey sections might be different in some survey dates. For bridges that don't have a survey map in the database, a message "*No Survey Map is found for this Bridge*" is displayed.
- c. **Soil Boring Data Folder:** This folder displays the soil borings close to the locations of the piers (figure 14). For bridges that don't have a survey map in the database, a message "*No Soil Borings are found for this Bridge*" is displayed.

*Note: In order to print the graphs displayed in "Survey Map" and "Soil Boring Data," the user can click on the **Print Screen** key on the keyboard. The figure is then copied to the system clipboard. The user can past the figure in the Windows program Paint or any other graphics utility program.*

BRIDGESCOUR DATABASE PROGRAM

MAIN FORM BACK EXIT FORM: RESULTS

Search Results for Bridge Number : 012-01-0000-1

Bridge Information | Survey Map | Soil-Boring Data | Cross-Sections | Contours \ Longit. Plots | Time-Plot

Bridge Number: 012-01-0000-1 State Project No.: 1909

Crossing: Sabine River @ Starks

River: Sabine River Bridge Recall No.: 031530

Route: LA 12 Shared with: Texas

Year Built: 1938

District Code: 7

Parish Code: 10

Comments

PIER DATA

Name	Code	Distance	Bot_of_Foot	Bot_of_Seal	Bot_of_Pile	Bot_of_Caisson
Bent 3	1	121			-24.37	
Pier 3	3	162	-8.1	-15.1	-41.6	
Pier 2	3	243	-8.06	-15.06	-46.56	
Pier 1	3	324	-8.1	-15.1	-41.6	

Figure 12
Bridge information folder

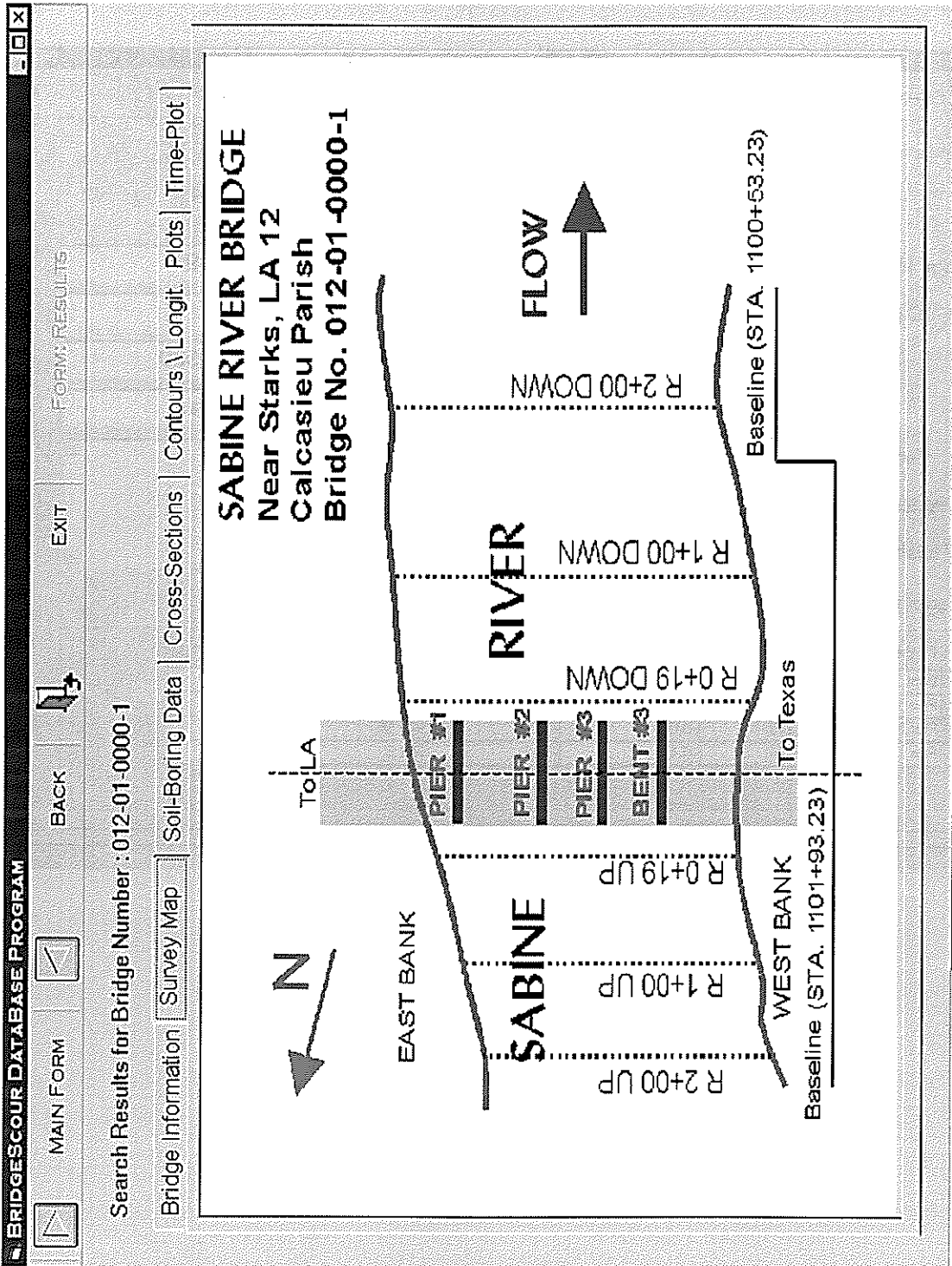


Figure 13
Bridge survey data folder

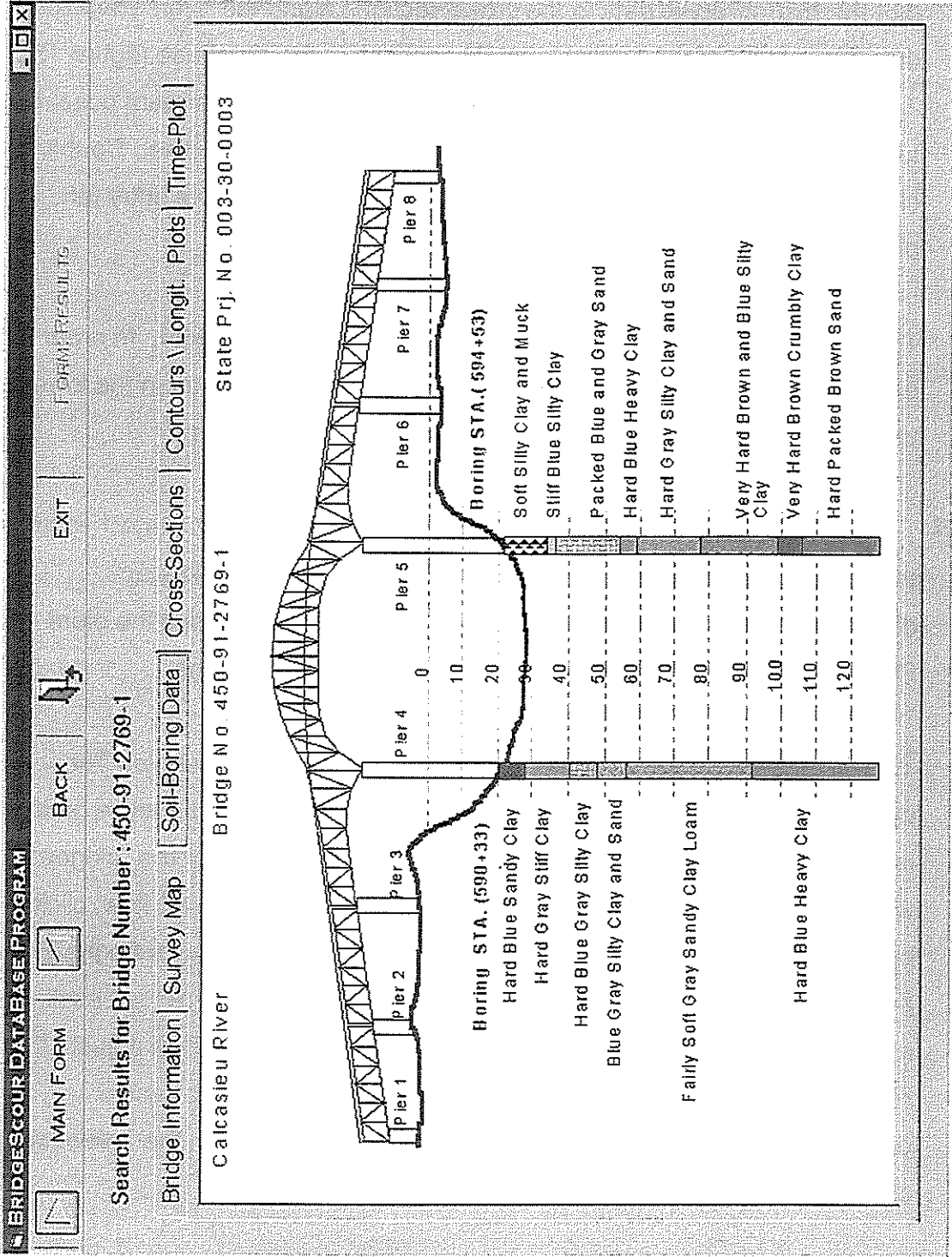


Figure 14
Bridge soil boring folder

- d. **Cross-Sections Folder:** One of the major functions of the software is to plot the hydrographic data in the cross-sections along the river. The folder displays a table of the available cross-sections in the database (figure 15). The table shows the date of survey, the upstream or downstream position, and the distance of the cross-section from the bridge centerline. Double-click on the blank box next to the date of survey to select this entry for plotting.

The selected entries are shown on the lower table in the folder. In order to deselect an entry in the box, click on the box next to the entry in the lower table. Click on the **Plot** button to display the cross-sections.

Plot

The cross-section plots of the selected entries are displayed when the user clicks on this button. A maximum number of five plots are displayed at the figure. Click on **Plot Pier Data** in order to plot the piers. Figure 16 shows the cross sections and pier plots of a bridge.

The distance from the baseline is plotted on the x-axis of the plot. The positive value of the x-axis present cross-sections with the baseline on the left side of the graph when looking toward the river flow. For the bridges where the baseline is on the right side with respect to the river flow, click on **Flip Horiz. Axis** in order to display the cross-sections accordingly. The points in the x-axis are based on the distance from the reference baseline at the bridge centerline. If various baselines exist, the program adjusts the reading at each baseline to the one at the centerline (the corrected distance). Baseline corrections will be discussed in detail in the following chapter.

Note: Click on the right mouse button at any point on the graph lines in order to display the coordinates of that point.

Search Results for Bridge Number : 012-06-1282-1

Bridge Information | Survey Map | Soil-Boring Data | Cross-Sections | Contours \ Longjt. Plots | Time-Plot

Note: Double-Click on the box next to the record to select it for plotting ..

Table of Hydrograph Data		
Date_of_Survey	Position	Dist_from_Center
9/18/98	up	22
9/18/98	up	100
9/18/98	up	200
6/17/99	dn	22
6/17/99	dn	100
6/17/99	dn	200
6/17/99	up	22
6/17/99	up	100
6/17/99	up	200

Total Number of Records = 132

Note: Click on the box next to the record in order to un-select it ..

Date of Survey	Position	Distance from CL
6/17/99	up	200
9/18/98	up	200
7/10/97	up	200
8/29/96	up	200
10/19/95	up	200

Plot

Figure 15
Cross-section data folder

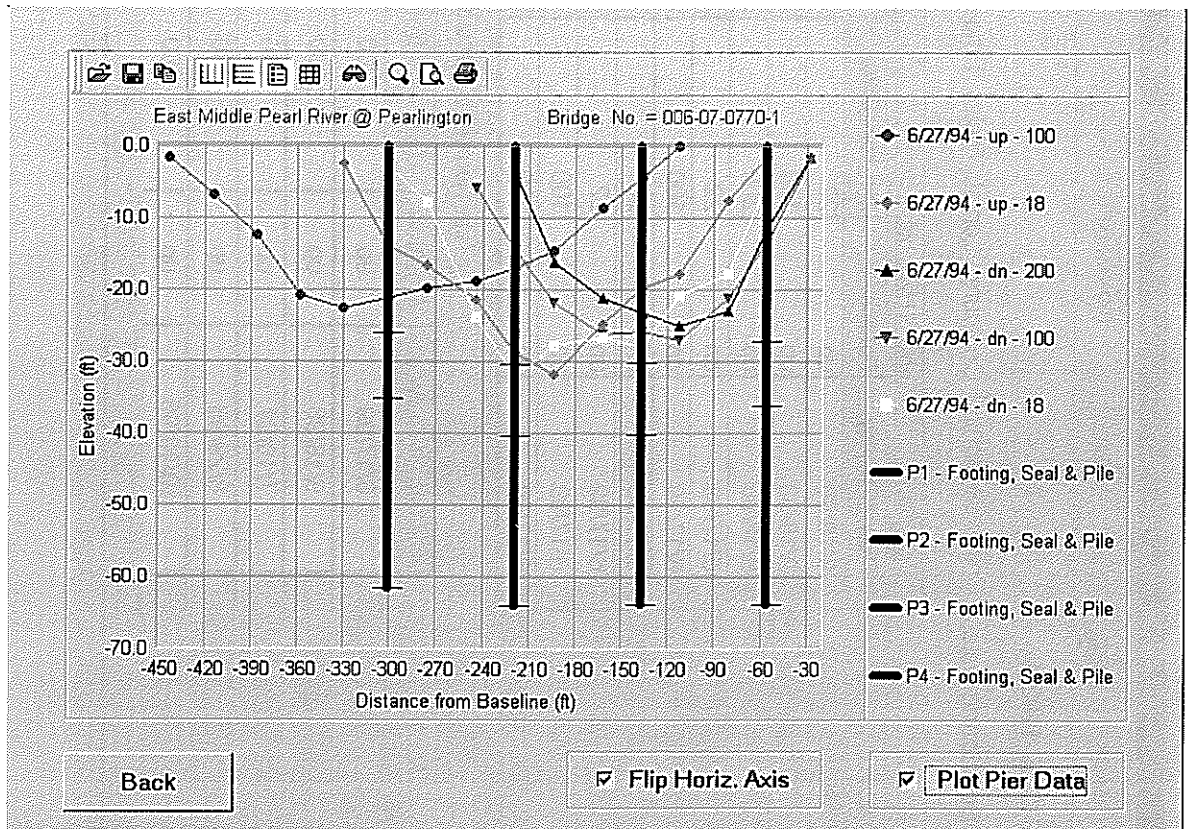


Figure 16
Cross-sections and pier plots of the bridge

The menu bar on the top of the cross-sections plot has the following keys:



Open a previously saved chart. It opens the charts saved in the program format "Chard FX98" file formats



Save the chart in the following formats:

- the program format : "Chart FX98" to be re-opened in the program
- text file format (data only)
- Metafile format
- Bitmap format



Copy the chart data to the Windows system in the following formats:

- bitmap format
- metafile format
- text (data only)
- OLE object



Display **Vertical Grid** lines



Display **Horizontal Grid** lines



Display **Legend** box



Display **Data Table**



Zoom. Use the mouse to select the zooming zone in the figure.



Print Preview



Print the plot. The printer selection and configuration are performed through Windows system.

- e. **Contour and Longitudinal Plots:** This form contains a combo box that lists the survey dates in the database (figure 17). Two buttons for contour plot and longitudinal plot are enabled when the user selects a date.

Contour Plot

The contour of the hydrographic data at the selected date is plotted when the user clicks on this button. The distance from the bridge centerlines is plotted on the x-axis. The distance from the baseline is plotted on the y-axis. Figure 18 shows an example of contour plot.

The elevations are displayed at the left-hand side of each measured point in the figure. The contour plot groups the points within a selected range (contour spacing) in one color group. Contour spacing, minimum elevation, and maximum elevation are listed in the figures.

The menu bar of the contour plot has the same standard buttons as the one in the cross section plots.

Note: Some bridges have more than one baseline for hydrographic measurements. An example of multi-baselines is shown in the bridge plan in figure 13. In such cases, a reference baseline is used for plotting the cross sections and contour plots. This reference baseline is the baseline station at the centerline of the bridge. The program calculates the offset of the other baseline stations and corrects the hydrographic points to correspond to the reference line. Baseline correction is discussed in detail in the data entry chapter.

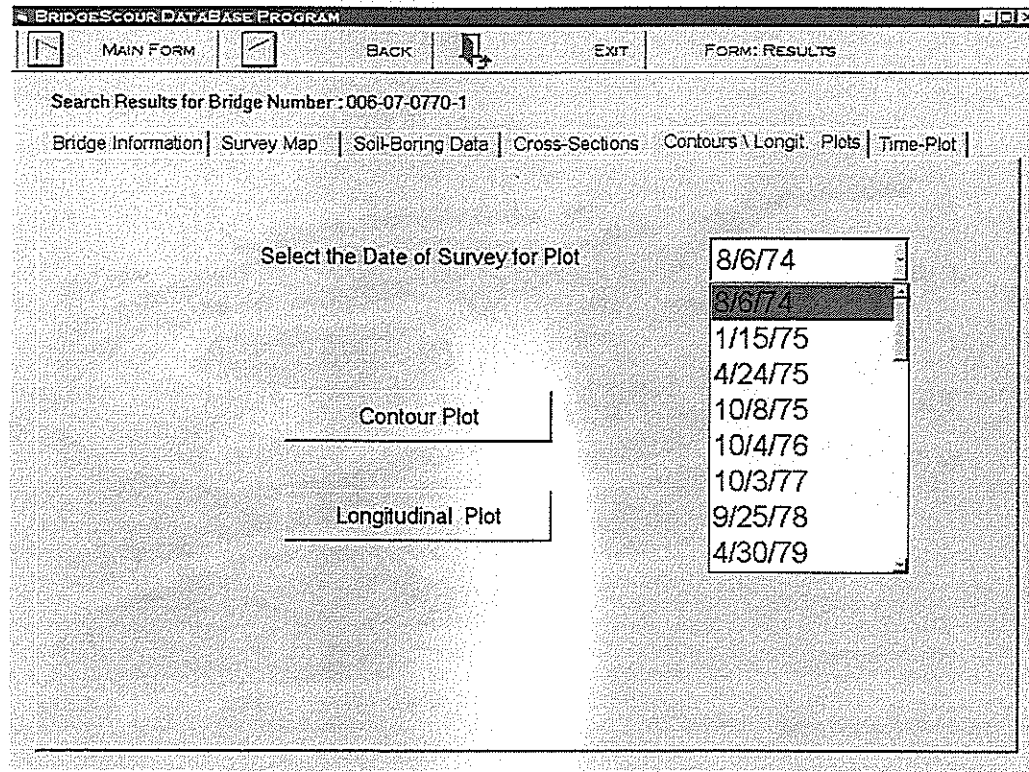


Figure 17

The contours and longitudinal plots folder

In some survey dates, the number of points is not sufficient to establish a complete contour plot. Missing data result in gray areas inside the plot (figure 19). For such reason, contour plots should be used only to establish a general visual idea about the river bottom at this date. Detailed measurements of elevations should then be obtained from the cross-section plots.

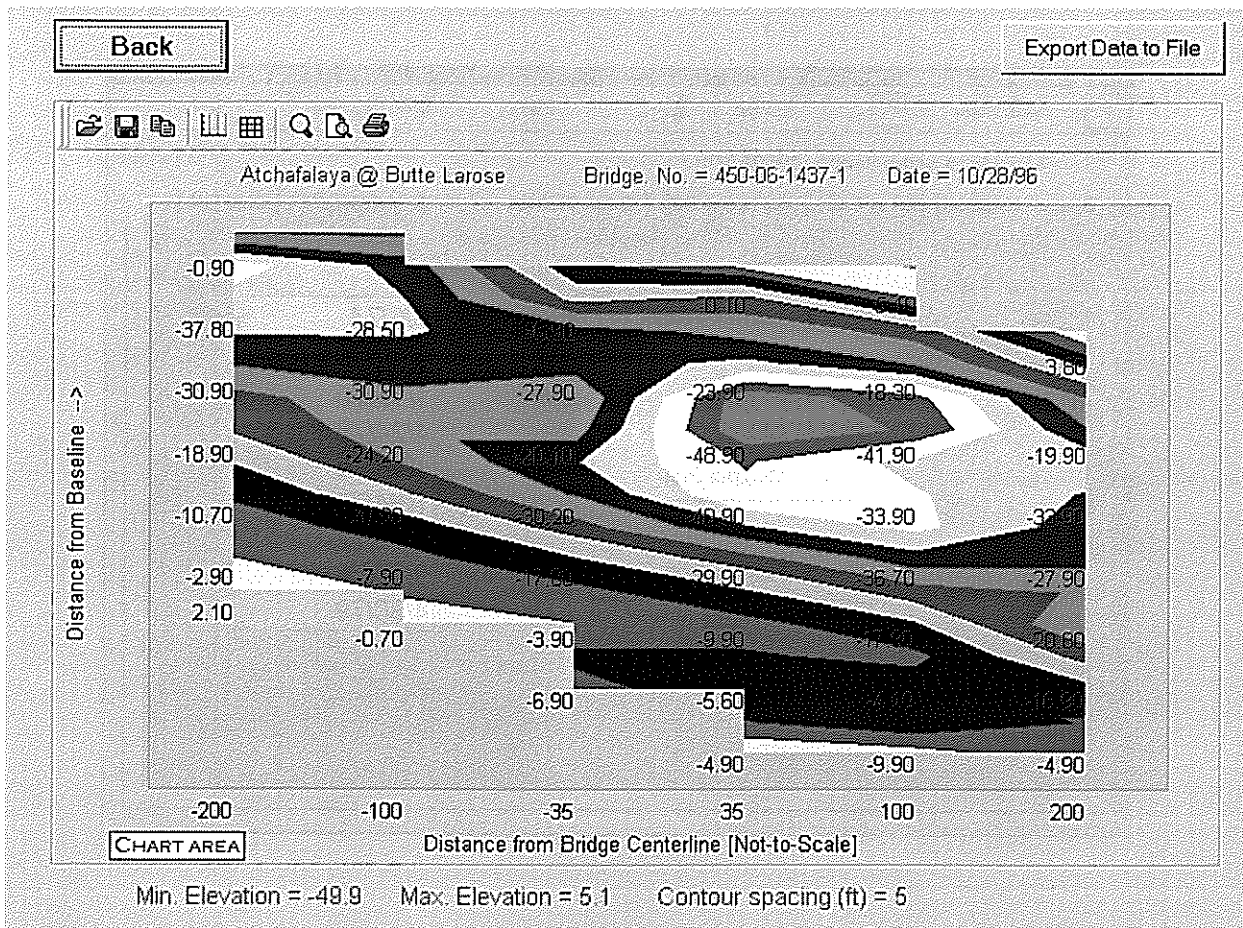


Figure 18
A typical contour plot

Export Data to File

This button is located at the top right of the contour plot. Clicking this button exports the contour data to a text file. The data are saved in columns format that can be exported to other contour plotting programs. The program displays a menu for the text file name. The user can select or change the location of the file and the default name "contour.txt."

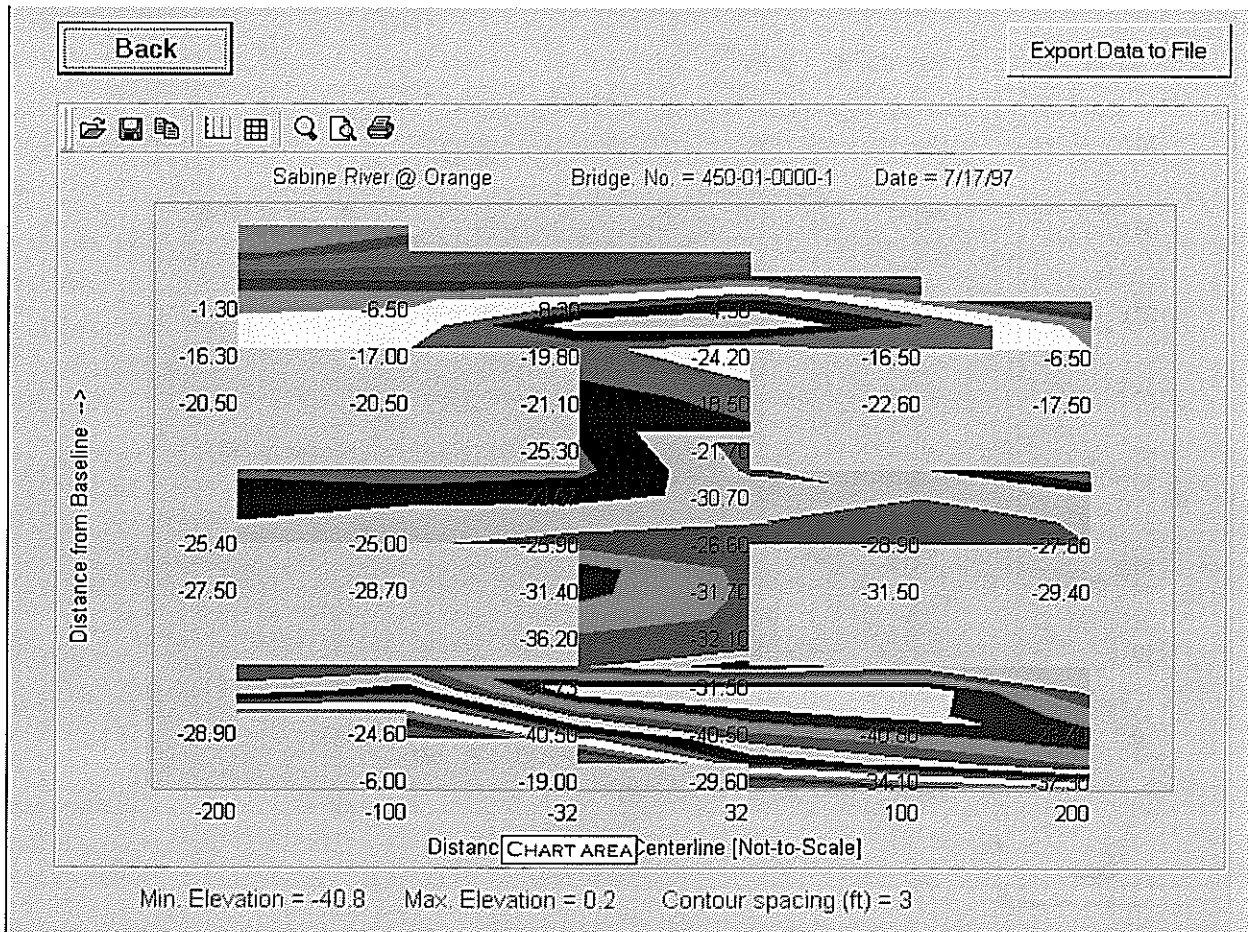


Figure 19
Contour plots with missing data points

Longitudinal Plots

These plots show the elevations at a longitudinal section parallel to the reference baseline. Longitudinal sections are plotted at pier locations only (figure 20). For bridges with multi-baselines, the distance from baselines is corrected to the reference baseline. Refer to the note in "Contour Plot" section for plots with multi-baselines.

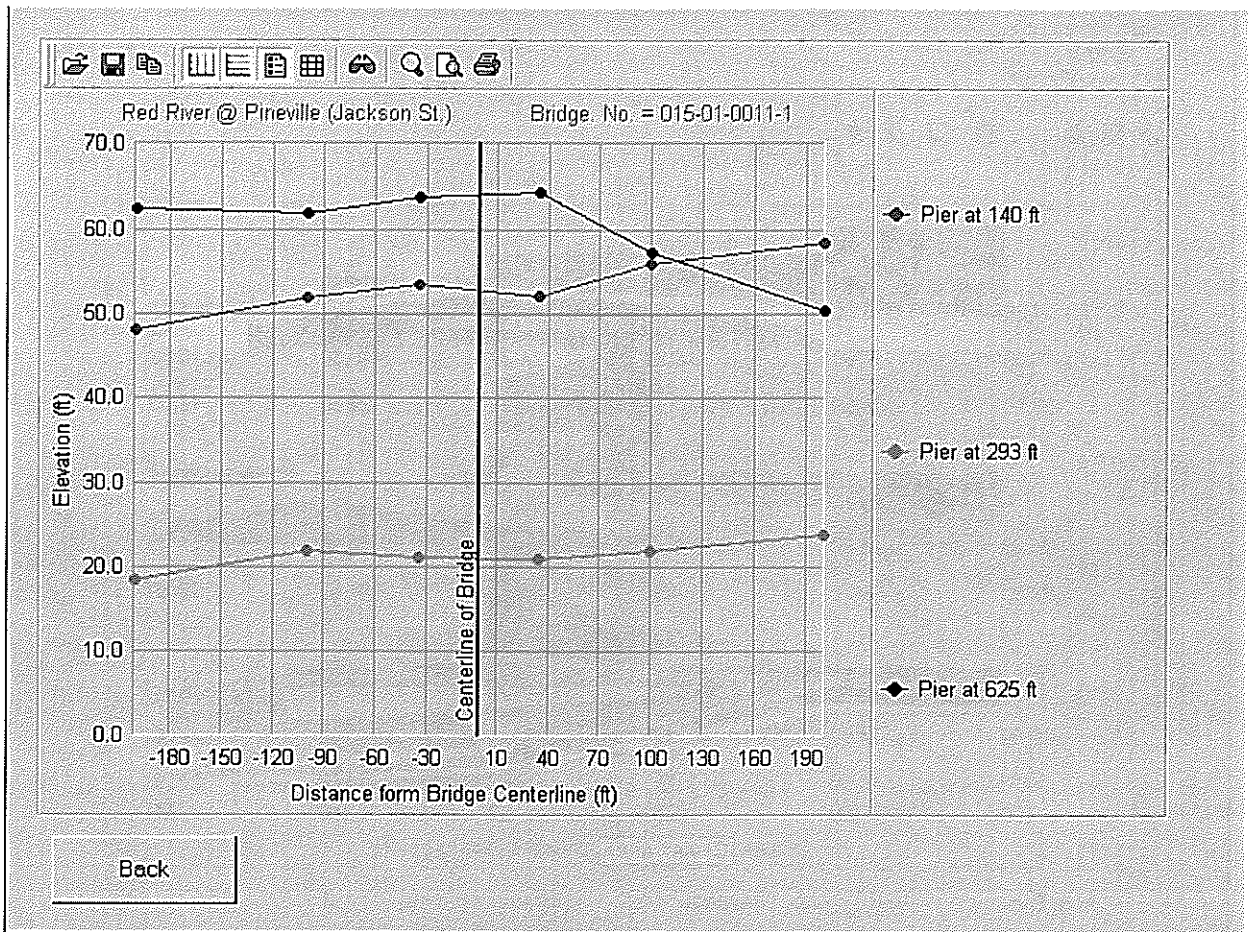


Figure 20
Example of longitudinal plot at the location of piers

- f. **Time Plots:** The change of hydrographic elevations with time are plotted in this folder. The selection table in the folder (figure 21) shows the available survey points at the upstream and downstream sections close to the bridge centerlines. Double-click on the selected locations for the plots. The selection is displayed in the lower box in the folder. Click on **Plot** to display the graph. For time-plots at the locations of the piers, obtain pier distances from pier table at the "Bridge Information" folder and select this distance from the selection table. Figure 22 shows time plots at the locations of the piers.

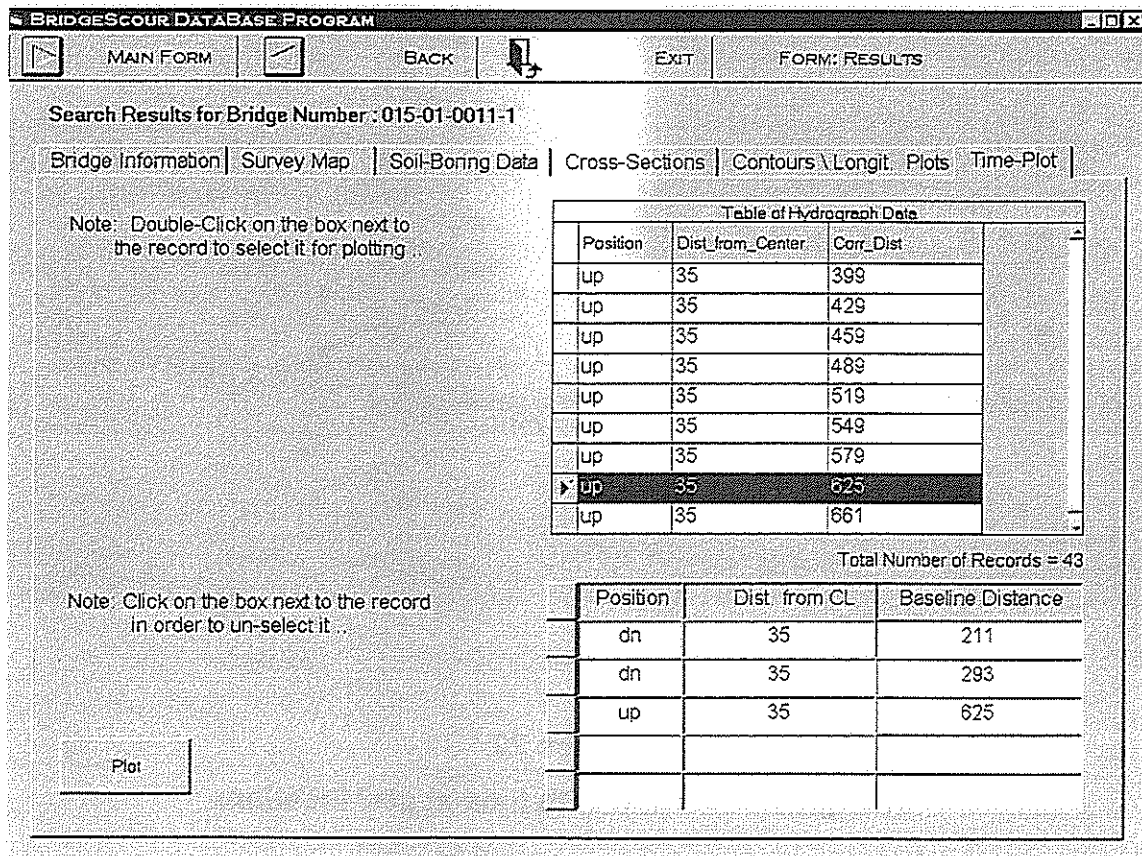
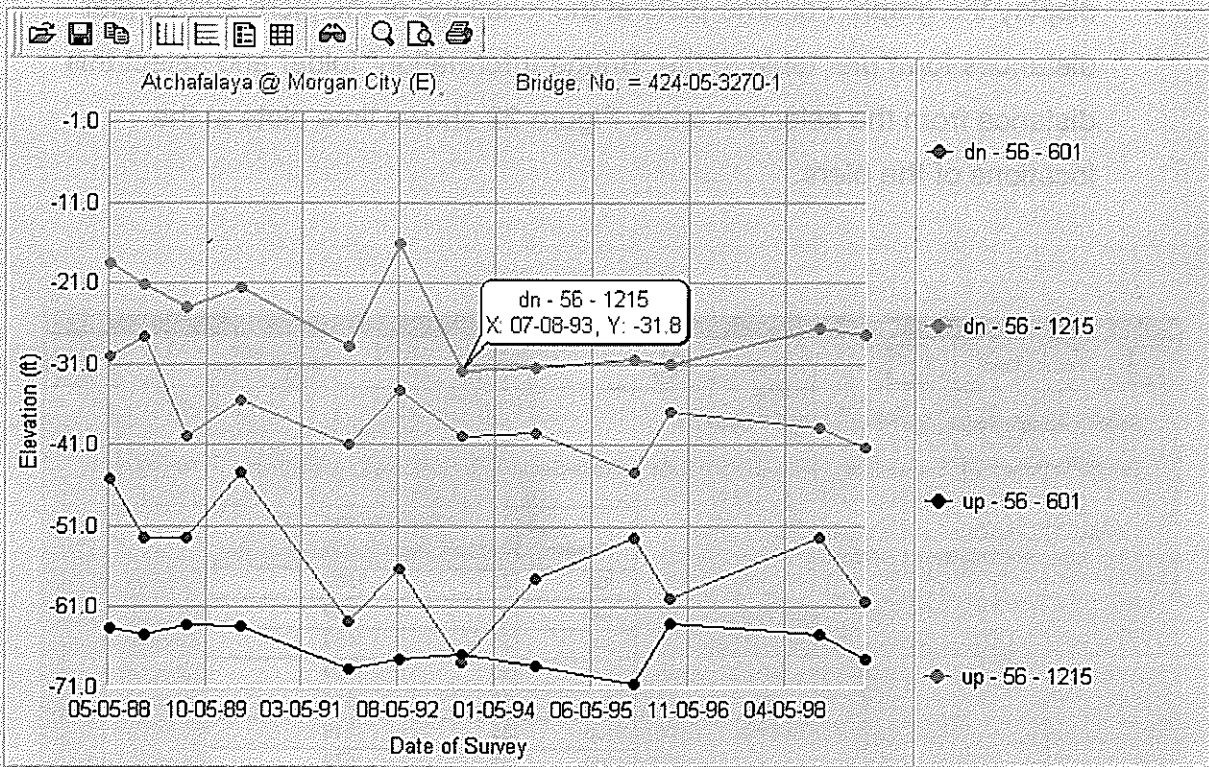


Figure 21
The time plot folder



Back

Figure 22
Change of elevation with time at pier locations

CHAPTER 3

DATA EDITING AND UPDATING

Password

A password is required to access the database update and edit section. User names and passwords are stored in table "Password" in the database file: "Database_2.mdb." Password management is administered by information services at the DOTD.

The user enters the password assigned to him/her in the form "Password" shown in figure 23. The entry is not case sensitive, so the password can be entered in either lowercase or uppercase. The **Clear** button clears the data entry and the **Cancel** button returns the user to the main menu.

NOTE: If the user enters an incorrect password, an error message: "Your password is not a valid one. Please re-enter."

Bridge Data Form

The first form in the data editing and update section is the "Bridge Data Form" (figure 24). This form contains the general information about the bridges. The user can scroll through the bridges using the arrow keys in the bottom of the form. The notations of these keys are shown in figure 25. Record number and the total number of bridge records in the database are shown in the top right of the form.

The user has the option of selecting any of the enabled buttons in the form. The buttons **Save** and **Undo** are only enabled in the adding and editing modes.

The image shows a graphical user interface window titled "FORM: MAIN". At the top, there is a navigation bar with four buttons: "NEXT" (with a right-pointing arrow icon), "BACK" (with a left-pointing arrow icon), "EXIT" (with a downward-pointing arrow icon), and "FORM: MAIN".

The main content area is divided into four sections, each with a label on the left and a button on the right:

- Connect:** A button labeled "Establish Database Connection".
- Search:** A sub-panel containing the text "Enter Password" followed by a text input field. Below the input field are three buttons: "Clear", "Cancel", and "Enter".
- View:** A button labeled "LA Highway Map".
- Update:** A button labeled "Update/Edit Database".

Figure 23
The password form

Bridge Number Record 4 of 56

Crossing

River State Project No.

Route Bridge Recall No.

Year Built Shared with

District Code

Parish Code

Comments

- Bridge added on [2/20/00]
- Last survey date [9/30/99]

Search

Add New Bridge Undo

Edit Back : Main Form

|<< << >> >>|

Figure 24
Bridge data form

- Move forward one record
- Move forward to last record
- Move backward one record
- Move backward to first record

Figure 25
Notation for the arrow key in the bridge data form

Search

The search button displays a list of the bridge numbers in the database (figure 26). Use this option for direct access to the required bridge information.

Add New Bridge

Use this button to add a new bridge to the database. A red note: "Adding a New Record" is displayed on the top of the form when the user is in this mode. When starting the add mode, all the buttons in the form are disabled except the **Undo** button. The **Save** button is displayed when the required entries are completed in the form. The user can move between the boxes using the mouse, [Tab] key, or [Enter] key.

The first required entry in this form is the "Bridge Number." Bridge numbers are numerical values 10 characters in length separated by "-" signs. The markers "# " in the entry box indicate the locations of the numerical values in the entry. Only numerical keys from 0 to 9 are enabled in the keyboard when the cursor is in this data entry box.

Enter/Select Bridge Number

010-05-0000-1
010-05-0000-1
011-01-0035-1
011-01-0035-2
011-02-0228-1
011-30-0088-1
011-30-0088-2
012-01-0000-1
012-06-1282-1

Total Number of Records = 56

Enter Cancel

Figure 26

Search menu in the bridge data form

Note: If the user moves the cursor to another entry box before completing the 10 required numerical values of the bridge number, a warning message is displayed: "Bridge code is less than 10 numbers. Please re-enter."

Note: If the user enters a bridge number that already exists in the database, an error message is displayed: "Bridge number already exists in the database. Please re-enter."

The formats of the next data entry boxes are as follows:

- **Crossing:** a string with maximum length 50 characters
- **River:** a string with maximum length 20 characters
- **Route:** a string with maximum length 8 characters
- **Year:** a numeric entry with maximum length 4 characters
- **District Code:** a numeric entry with maximum length 2 characters
- **Parish Code:** a numeric entry with maximum length 2 characters
- **State Project:** a string with maximum length 15 characters
- **Bridge Recall Number:** a string with maximum length 15 characters
- **Shared With:** a string with maximum length 11 characters
- **Comments:** a string with open length format. Press [Ctrl] + [Enter] to move to the next line in the "Comments" box.

Note: "District Code" and "Parish Code" are required entries. An attempt to have a void entry or to enter a district code or a parish code that are not in the database tables will result in the error messages: " District code (or parish code) is not a valid one. Please re-enter."

Edit

This button is used to change bridge information. A red note, **Editing the Record**, is displayed on the top of the form when the user is in the edit mode. Entry boxes that the user can edit are highlighted in yellow color. The user cannot edit the bridge number in this form. The formats of the data entry boxes are the same as in the "Add" mode.

Save

This button is enabled only in the “Add” and “Edit” modes when the required entries, “Bridge Number,” “District Code,” and “Parish Code,” are completed. Other data entries are optional and can be entered to the database later. A search for the bridge will be unsuccessful if the search criterion is blank in the bridge data form.

Delete Bridge

This button is used to erase the bridge information from the database. Since this option is critical and rarely used, a warning message is displayed before proceeding. Furthermore, the operation will not be successful without first deleting all other related data from the database tables. Such procedure will require going through all the bridge forms in this section and deleting the related bridge data before proceeding with deleting the bridge in this form.

Note: An attempt to delete a bridge that has other pier and/or hydrographic data residing in the database will result in displaying the error message: “The record cannot be deleted because other tables include related records.”

Undo

This button is enabled only in the “Add” and “Edit” modes. It cancels the add/edit entries in the text boxes and returns the form to its normal unedited mode.

The other buttons in the form are self-explanatory. They move back to the main menu form, exit the program, and move to the next form, the pier form.

*Note: In the “Add” mode, if the user clicks “Undo” when required entries “Bridge Number,” “District Code,” and “Parish Code” are not completed, a warning message will still be displayed. The user can then press **OK** and then press the “Undo” button.*

Pier Form

This is the second form in the data editing and update section. It displays data, names, codes, and coordinates of the piers of the selected bridge (figure 27).

Pier codes are defined in the table **List of Pier Types** in the form. The buttons in this form have the same format as in the bridge data form.

Add New Pier

Use this button to add a new pier to the bridge. A red note, **Adding a New Pier**, is displayed on the top of the form when the user is in this mode. Only the **Undo** button is enabled when first starting the data entries. The **Save** button is enabled when the required entries are completed in the boxes.

Four boxes are initially displayed in the form for data entries. The user can move between the boxes using the mouse, [*Tab*] key, or [*Enter*] key. The formats for the data entry in these boxes are as follows:

Name of Pier: A required alphanumeric entry with maximum length 8 characters.

Pier Code: A required numeric entry of one character length. Alphabetical keys are not enabled in this box. Pier codes in the "List of Pier Types" are the correct entries in this box. The entry in this box controls display of the corresponding coordinate boxes. Table 1 shows pier coordinates for every pier type.

Pier Data for Bridge Number : 009-05-0000-1 Editing Mode..

Bridge	Name	Code	Distance	Top_of_Plot	Bot_of_Foot	Bot_of_Seal	Bot_of_Pile	Bot_of_Caisson
009-05-0000-1	Bent 2	1	45	100	0	0	58	0
009-05-0000-1	Bent 3	1	95	100	0	0	43	0
009-05-0000-1	Bent 4	1	145	100	0	0	48	0
009-05-0000-1	Bent 5	1	195	100	0	0	63	0

List of Pier Types	
Pier Code	Pier Description
1	Pile Bent
2	Piers with Footing and Piles
3	Piers with Footing, Seal, and Piles
4	Piers with Footing without Piles
5	Caisson

Note: * Use this list when editing 'Pier Code' ..
 * 'Name of Pier' and 'Pier Code' are required entries

Name of Pier:
 Pier Code:
 Distance from Baseline (ft):
 Top of Plot (ft):
 Bottom of Pile (ft):

Figure 27
Pier edit form

Table 1
Pier codes and the corresponding coordinate entries

Pier Code	Pier Description	Bottom of Footing	Bottom Of Seal	Bottom of Pile	Bottom of Caisson
1	Pile bent			Yes	
2	Pier with footing and pile	Yes		Yes	
3	Pier with footing, seal and pile	Yes	Yes	Yes	
4	Pier with footing, no piles	Yes			
5	Caissons				Yes

*Note: The **Save** button is enabled only when the two required entries, "Name of Pier" and "Pier Code" are correctly entered. Other pier information can be entered later by the user. However, piers will not appear in the graphs if their coordinate data are missing.*

Distance from Baseline: A numerical entry for the pier distance from the baseline in feet. Alphabetical keys are not enabled in this box. The user should not enter a negative value since all the distances from baseline have positive values.

Top of plot: A numerical value for the coordinate of the top of pier. This entry is for plotting the pier in the cross-section plots. A value close to the highest elevation in the cross-section is usually entered.

The "Yes" entries in table 1 denote the boxes displayed according to the value entered in the pier code. The data of these boxes are in numerical format.

*Note: If the user inputs unacceptable numerical entry that contains more than one decimal point or more than one negative sign in any of the coordinates' boxes (e.g. (2.6.8) or (-12-6), an error message is displayed, "Error number [****], error occurred."*

Hydrographic Data Form

This is the third form in the edit and update section. The form displays the hydrographic survey data and allows editing and adding new data. The control buttons in this form function the same as in the other forms in this section. Figure 28 shows the form in the editing mode.

Hydrograph Data for Bridge Number : 009-05-0000-1

Date_of_Survey	Position	Dist_from_Center	Orig_Dist	Corr_Dist	Elevation
9/30/99	up	200	79	79	92.1
9/30/99	up	200	95	95	82.7
9/30/99	up	200	112	112	79.1
9/30/99	up	200	129	129	72
9/30/99	up	200	145	145	68.4
9/30/99	up	200	162	162	67.7
9/30/99	up	200	179	179	66.8
9/30/99	up	200	195	195	69.4
9/30/99	up	200	212	212	72.7
9/30/99	up	200	229	229	81.3
9/30/99	up	200	245	245	90.2
9/30/99	up	200	248	248	94.7

Date of Survey (mm/dd/yy) Record 1297 of 1299

Position Upstream Downstream

Distance from Bridge C.L.: Editing Mode..

Distance from Baseline:

Elevation:

Figure 28
Hydrograph edit form

Add New Data

Click on this button to display the entry boxes and to add new hydrographs to the database. A red note, **Adding New Data**, is displayed on the form when the user is in this mode. When starting the "Add" mode, all the buttons in the form are disabled except the **Undo** and the **Save** buttons. The user can move between the boxes using the mouse, [Tab] key, or [Enter] key. The entry boxes are as follows:

Date of Survey: Enter dates in the formats mm/dd/yy or mm/dd/yyyy. Alphabetical keys are not enabled in this box.

Position: This entry denotes the position of the hydrograph line with respect to the bridge centerline. It is a two-character string entry which is either "up" for upstream or "dn" for downstream.

Distance from Centerline: This is a positive integer entry for the distance of the hydrograph line from the bridge centerline.

Distance from Baseline: This is a positive integer entry for the measured distance from the baseline. The entry is stored in column "Original Distance" (Orig_Dist) in the database table. The program calculates the values of the column "Corrected Distance" (Corr_Dist) for any offset in the baseline. The calculation of the **Corr_Dist** is based on the last date entry of the offset in the baseline table. The baseline-correction procedure is discussed in detail in the next section.

*Notes: If the user clicks **Save** before completing the entries in the boxes, an error message will appear: "Data is missing in one or more boxes."*

If entry in the "Position" box is different than "up" or "dn," an error message will appear: "Enter 'up' or 'dn' only."

*If the entry in the "Date of Survey" box is not in date format, or the entry in the distance boxes are not in a correct numerical form, an error message will be displayed: "Error number [****], error occurred."*

The remaining entry boxes follow the same procedure and format as in previous entry forms.

Baseline Data Form

The baseline-offset data is an optional entry if there is only one baseline for the bridge. Baseline adjustment is required when multi-baselines exist for a single bridge. A schematic of the baseline adjustment is shown in figure 29. In case (A), one baseline exists for the bridge. In this case, the program inputs the value of the corrected distance, "Corr_Dist," in the hydrograph table as equal to the original distance, "Orig_Dist."

In case of multi-baselines (case B), the user should input baseline offset in the baseline data form. The computer uses this value to calculate the corrected distance, "Corr_Dist," in the hydrograph table.

If the user inputs new data in the hydrograph table, the program automatically inputs the "Corr_Dist" according the information available in the baseline table. The calculation of the corrected distance is based on the last date entered in the baseline table.

Notes: If the user inputs hydrograph data with dates older than the last date in the baseline table, the program will direct the user to run baseline correction from the baseline table. A warning message will be displayed: "You are modifying an older date than the last date in Baseline table. Please use Adjust Baseline table to modify for offset."

*If the user changes the baseline offset data after the hydrographs have been entered, he/she should recalculate the "Corr_Dist" by pressing on the button **Adjust for Baseline Offset**.*

The data entry boxes in this form are shown in figure 30 and are as follows:

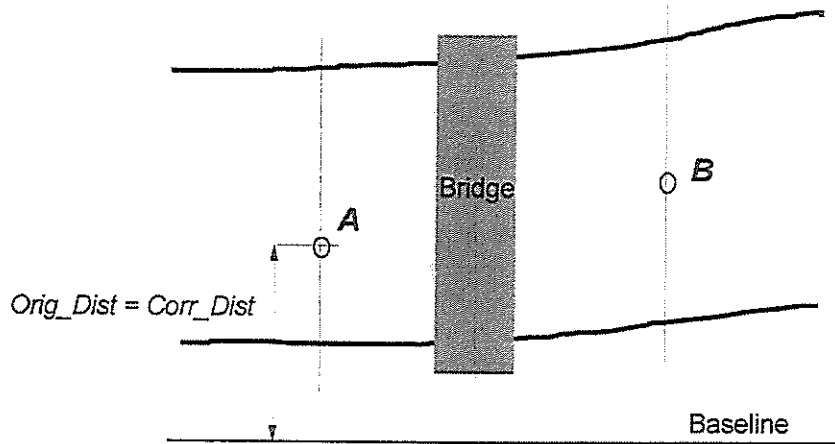
Baseline Location: One character string in the form **L** for left of water flow or **R** for right of water flow.

Date of Survey: The user should select the date when baseline-offset started. Otherwise, select the first date of survey from the list.

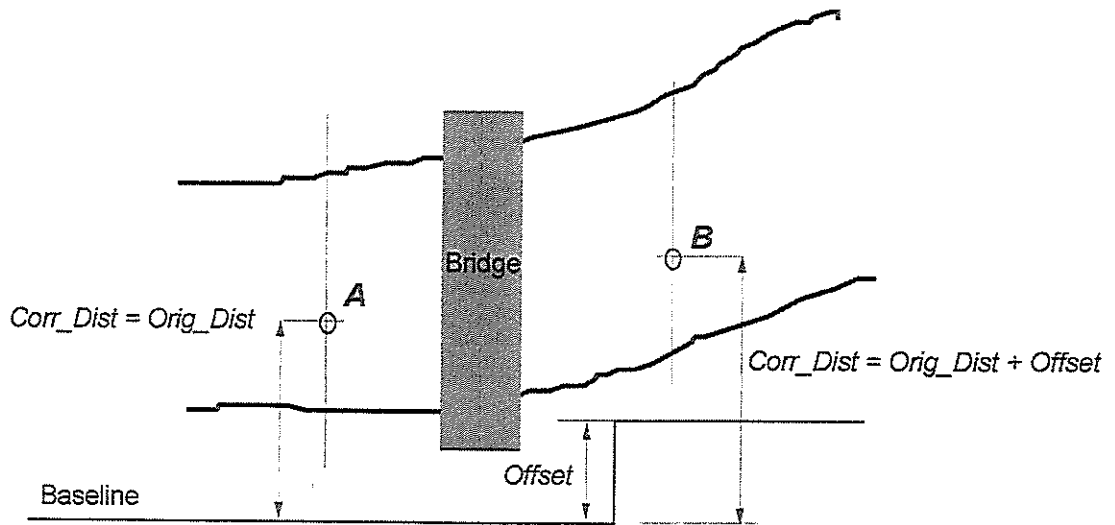
Station (from): The station where the offset in the base line starts

Station (to): The station where the offset ends

Baseline offset (ft): The offset between the two baselines in feet. The reference baseline is always the one where the bridge centerline exists.



A) One Baseline Case - No correction required



B) Multi-Baseline Case - Offset correction required

Figure 29
Schematic of baseline cases for bridge survey

BaseLine-Offset Data for Bridge Number : 009-05-0000-1

Bridge_No	Location	Date_of_Survey	Sta(From)	Sta(To)	Correction
▶ 009-05-0000-1	L	7/16/92	-600	600	0

Baseline Location L = Left of water flow, R = Right of flow

Date of Survey Select Date: Editing Mode..

Station (From)

Station (To)

Baseline Offset (ft)

- 7/16/92
- 12/10/92
- 4/22/93
- 8/19/93
- 1/20/94
- 4/28/94
- 7/28/94
- 12/8/94

Figure 30
Baseline correction data form

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