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<td>October 1999</td>
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<td>Mark Morvant, P.E.</td>
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Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. 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 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.

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.

17. Key Words
Bridge scour, database, fathometers, hydrographs, computer programming

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DEVELOPMENT OF A DATABASE FOR LOUISIANA

HIGHWAY BRIDGE S Cour DATA

A Program and Manual

by

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and

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Louisiana Department of Transportation and Development
Louisiana Transportation Research Center

in cooperation with

U.S. Department of Transportation
Federal Highway Administration

The contents of this report reflect the opinion of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or the policies of the state, the Louisiana Department of Transportation and Development, the Louisiana Transportation Research Center, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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.

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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.
ACKNOWLEDGEMENTS

The development of the database program for Louisiana highway bridge scour was supported by the Louisiana Transportation Research Center (LTRC) and the Louisiana Department of Transportation and Development (DOTD). The financial support and cooperation provided by these agencies is gratefully appreciated.

The direction and support from the following project review committee members is also appreciated: Tony Ducote, Eric Jeansonne, Gil Gautreau, Steve Lee, Josh Gilbert, Frank Grabski, Kim Price, Mike Gusky, and Babak Naghavi.

Special appreciation is extended to Karen Jarreau and Karen Lemoine for their help throughout this project. The bridge scour data entry could not have been completed without the meticulous efforts of several undergraduate students.
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 server.

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.

![Database Table Structure](image)

**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
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.

![Search Using Bridge Number](image)

Figure 7
The search form with "Search Using: Bridge Number"
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."

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.

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.

<table>
<thead>
<tr>
<th>Bridge No</th>
<th>Crossing</th>
<th>River</th>
<th>Route</th>
<th>District</th>
<th>Parish</th>
</tr>
</thead>
<tbody>
<tr>
<td>012-06-1282-1</td>
<td>Calcasieu River @ Kinder</td>
<td>Calcasieu River</td>
<td>US 190</td>
<td>7</td>
<td>02</td>
</tr>
<tr>
<td>024-01-0350-1</td>
<td>Calcasieu River @ Moss Bluff</td>
<td>Calcasieu River</td>
<td>US 171</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>028-05-1240-1</td>
<td>Calcasieu River near Oberlin</td>
<td>Calcasieu River</td>
<td>LA 26</td>
<td>7</td>
<td>02</td>
</tr>
<tr>
<td>056-04-0941-1</td>
<td>Calcasieu River @ Oakdale</td>
<td>Calcasieu River</td>
<td>LA 10</td>
<td>7</td>
<td>02</td>
</tr>
<tr>
<td>450-30-0141-1</td>
<td>Calcasieu Ship Channel @ Lake Charles</td>
<td>Calcasieu River</td>
<td>I-210</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>450-91-2789-1</td>
<td>Calcasieu River @ Lake Charles</td>
<td>Calcasieu River</td>
<td>I-10</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>810-12-0422-1</td>
<td>West Fork Calcasieu River</td>
<td>Calcasieu River</td>
<td>LA 378</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

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.*
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.

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.*
### Table of Hydrograph Data

<table>
<thead>
<tr>
<th>Date_of_Survey</th>
<th>Position</th>
<th>Dist_from_Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/18/98</td>
<td>up</td>
<td>22</td>
</tr>
<tr>
<td>9/18/98</td>
<td>up</td>
<td>100</td>
</tr>
<tr>
<td>9/18/98</td>
<td>up</td>
<td>200</td>
</tr>
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<td>6/17/99</td>
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<td>up</td>
<td>100</td>
</tr>
<tr>
<td>6/17/99</td>
<td>up</td>
<td>200</td>
</tr>
</tbody>
</table>

Total Number of Records = 132

---

### Cross-section data folder

**Figure 15**

- Double-Click on the box next to the record to select it for plotting.
- Click on the box next to the record in order to un-select it.

---

**Plot**
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 “Chart 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 on 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 form 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](image)

**Figure 21**

The time plot folder
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.
Figure 23
The password 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
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](image)

**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.
Figure 27
Pier edit form

Table 1

Pier codes and the corresponding coordinate entries

<table>
<thead>
<tr>
<th>Pier Code</th>
<th>Pier Description</th>
<th>Bottom of Footing</th>
<th>Bottom of Seal</th>
<th>Bottom of Pile</th>
<th>Bottom of Caisson</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pile bent</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pier with footing and pile</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pier with footing, seal and pile</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Pier with footing, no piles</td>
<td></td>
<td>Yes</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Caissons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**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.

<table>
<thead>
<tr>
<th>Date_of_Survey</th>
<th>Position</th>
<th>Dist_from_Center</th>
<th>Orig_Dist</th>
<th>Corr_Dist</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>79</td>
<td>79</td>
<td>92.1</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>95</td>
<td>95</td>
<td>82.7</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>112</td>
<td>112</td>
<td>79.1</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>129</td>
<td>129</td>
<td>72</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>145</td>
<td>145</td>
<td>88.4</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>162</td>
<td>162</td>
<td>87.7</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>179</td>
<td>179</td>
<td>88.8</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>195</td>
<td>195</td>
<td>88.4</td>
</tr>
<tr>
<td>9/30/99</td>
<td>up</td>
<td>200</td>
<td>212</td>
<td>212</td>
<td>72.7</td>
</tr>
</tbody>
</table>

Date of Survey (mm/dd/yy): 9/30/99  
Record: 1297 of 1299

Position: Upstream  
Distance from Bridge C.L: 200
Distance from Baseline: 229
Elevation: 81.3

Add New Data  
Delete Data  
Edit  
Save  
Undo  
Next [Baseline]  
Exit the Program

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 floe 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
Figure 30
Baseline correction data form
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