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Users Manual for Nevada Test Site Database (NTS-DB) Software

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Technical Report

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13. ABSTRACT (Maximum 200 words)

The U.S. Army Engineer Waterways Experiment Station was actively involved in the development, testing, and fielding of a wide variety of grout and concrete mixtures in support of underground nuclear test programs at the Nevada Test Site. Detailed information on mixture designs, laboratory data such as unconfined compressive strength, sonic velocity, density, and modulus, and similar results for actual as-placed mixtures have been archived in a computerized database. There are 264 mixture designs included in the database that were fielded at 2,132 locations on 48 underground nuclear tests between February, 1970, and September, 1992. There are over 67,000 data entries in the database. The software, entitled NTS-DB, used to query this database is a user-friendly Windows-format code that provides almost unlimited flexibility in specifying a query criterion.

Also provided with the NTS-DB software and database is the Windows Help-like Grout Users Manual. The manual provides guidance to those who are not knowledgeable in the area of grout mixture proportioning, materials, mixing, and placing.

14 SUBJECT TERMS		15 NUMBER OF PAGES
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Concrete	Nevada Test Site	
Database	Grout Users Manual	16 PRICE CODE

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PREFACE

The work described in this user's manual was sponsored by the Field Command, Defense Special Weapons Agency (DSWA). Funding was provided under MIPRs HD1102-4-I24A01, dated 17 May, 1994, and HD1102-6-B45H02, dated 5 December, 1995. Dr. George Baladi was the DSWA Project Manager.

This study was conducted by the Geomechanics and Explosion Effects Division (GEED), Structures Laboratory (SL), U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. Dr. Howard G. White, GEED, was the principal investigator. Numerous persons assisted in various aspects of the software development. Those included Messrs. John Boa and Brian Green, Concrete and Materials Division, WES, who assembled data and provided technical assistance, respectively, and Mr. Jonathan Ashley, a contractor to the GEED, who populated the database. During this investigation, Dr. Jimmy P. Balsara was Chief, GEED, and Mr. Bryant Mather was Director, SL.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

The NTS DB software and accompanying database may be obtained by sending a written request to Director, USAE Waterways Experiment Station, ATTN: Engineering Computer Programs Library (CEWES-IM-DS), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

CONVERSION TABLE

Conversion factors for U.S. Customary to metric (SI) units of measurement.

MULTIPLY → TO GET	BY	TO GET
← DIVIDE	← BY	

angstrom	1.000 000 X E -10	meters (m)
atmosphere (normal)	1.013 25 X E +2	kilo pascal (kPa)
bar	1.000 000 X E +2	kilo pascal (kPa)
barn	1.000 000 X E -28	meter^2 (m^2)
British thermal unit (thermochemical)	1.054 350 X E +3	joule (J)
calorie (thermochemical)	4.184 000	joule (J)
cal (thermochemical/cm^2)	4.184 000 X E -2	mega joule/m^2 (MJ/m^2)
curie	3.700 000 X E +1	*giga becquerel (GBq)
degree (angle)	1.745 329 X E -2	radian (rad)
degree Fahrenheit	$t_k = (t°f + 459.67)/1.8$	degree kelvin (K)
electron volt	1.602 19 X E -19	joule (J)
erg	1.000 000 X E -7	joule (J)
erg/second	1.000 000 X E -7	watt (W)
foot	3.048 000 X E -1	meter (m)
foot-pound-force	1.355 818	joule (J)
gallon (U.S. liquid)	3.785 412 X E -3	meter^3 (m^3)
inch	2.540 000 X E -2	meter (m)
jerk	1.000 000 X E +9	joule (J)
joule/kilogram (J/kg) radiation dose absorbed	1.000 000	Gray (Gy)
kilotons	4.183	terajoules
kip (1000 lbf)	4.448 222 X E +3	newton (N)
kip/inch^2 (ksi)	6.894 757 X E +3	kilo pascal (kPa)
ktap	1.000 000 X E +2	newton-second/m^2 (N-s/m^2)
micron	1.000 000 X E -6	meter (m)
mil	2.540 000 X E -5	meter (m)
mile (international)	1.609 344 X E +3	meter (m)
ounce	2.834 952 X E -2	kilogram (kg)
pound-force (lbs avoirdupois)	4.448 222	newton (N)
pound-force inch	1.129 848 X E -1	newton-meter (N·m)
pound-force/inch	1.751 268 X E +2	newton/meter (N/m)
pound-force/foot^2	4.788 026 X E -2	kilo pascal (kPa)
pound-force/inch^2 (psi)	6.894 757	kilo pascal (kPa)
pound-mass (lbm avoirdupois)	4.535 924 X E -1	kilogram (kg)
pound-mass-foot^2 (moment of inertia)	4.214 011 X E -2	kilogram-meter^2 (kg·m^2)
pound-mass/foot^3	1.601 846 X E +1	kilogram/meter^3 (kg/m^3)
rad (radiation dose absorbed)	1.000 000 X E -2	**Gray (Gy)
roentgen	2.579 760 X E -4	coulomb/kilogram (C/kg)
shake	1.000 000 X E -8	second (s)
slug	1.459 390 X E +1	kilogram (kg)
torr (mm Hg, 0° C)	1.333 22 X E -1	kilo pascal (kPa)

*The becquerel (Bq) is the SI unit of radioactivity; 1 Bq = 1 event/s.
**The Gray (GY) is the SI unit of absorbed radiation.

TABLE OF CONTENTS

FIGURES

SECTION 1

INTRODUCTION

1.1 INTRODUCTION.

The Concrete and Materials Division of the U.S. Army Engineer Waterways Experiment Station developed, tested, and fielded a wide variety of concrete, grout, and groutcrete mixtures in support of underground nuclear weapons effects testing programs at the Nevada Test Site. Detailed information on mixture designs, laboratory data such as unconfined compressive strength, sonic velocity, density, and modulus, and similar results for actual as-placed mixtures have been archived in a user-friendly Windows-based computerized database.

The database file may be queried using the NTS-DB software. This software has been organized with two primary users in mind:

> Mixture designers: someone developing a mixture that has a certain requirement. For example, the mixture must attain 3000-4000 psi[1] (20.7-27.6 MPa) at 14 days and must contain steel fibers. The user would specify a Property/Component query (see Chapter 3).
>
> NTS experimenters: someone who would like information about a specific mixture or test. This user must know the name of the mixture or test, and would execute a Name query (see Chapter 3).

The available data are divided into two major categories:

> Laboratory Data: data obtained from specimens prepared in the lab. These data are unique for a given mixture, i.e., no matter how many different field tests used the mixture, only one set of laboratory data exists.
>
> Field Data: data obtained from specimens prepared in the field. A mixture may have been used on several tests. Data may be viewed for all tests using the mixture, for a single test, or for a single location on a single test.

There are 264 mixture designs included in the NTS-DB database that were fielded at 2,132 locations on 48 underground nuclear tests between February, 1970, and September, 1992. There are over 67,000 data entries in the database, including:

- 140 grouts, 48 concretes, 69 groutcretes, 7 unclassified materials.

---

[1] The English system of units is used in the NTS-DB software. This system was chosen at the sponsor's (DSWA) request and because the data were orginally recorded in the English system. SI units are provided in this manual for convenience.

- unconfined compressive strengths between 25 and 15,335 psi.
- sonic velocities between 1,220 and 16,330 ft/sec.
- densities between 54 and 130.2 lb/cu ft.

1.2 SCOPE.

This report documents the NTS-DB software and its use. Chapter 2 presents installation information and describes changes made to your computer system upon installation. Chapter 3 documents the NTS-DB software by providing general information on how to initiate a query and view the results. Chapter 4 states conclusions and recommendations.

SECTION 2

INSTALLING NTS-DB

2.1 SYSTEM REQUIREMENTS.

The minimum recommended system requirements for using NTS-DB are:

Computer: A 486 class processor. 8 MB RAM.
Disk Space: 10 Mbytes free disk space.
Monitor: VGA (640 x 480) graphics adapter.
Mouse: because some NTS-DB features are not accessible from the keyboard, a mouse is recommended.

2.2 INSTALLATION.

NTS-DB files are in compressed format on the distribution disks, therefore you must use the SETUP file included on Disk 1. To install NTS-DB on your hard disk,

1. Insert Disk 1 into drive A (or drive B).
2. Choose RUN from the FILE menu in the Windows Program Manager.
3. Type *a:setup* (or *b:setup*), then choose OK.
4. Accept the default, or type the location for SETUP to install NTS-DB, then choose OK.

2.3 CHANGES TO YOUR SYSTEM.

The files listed below, which require approximately 5.5 Mbytes disk space, are copied to your hard drive to the \WINDOWS\SYSTEM directory during the installation procedure. Many of these files may already reside on your hard drive. In these cases, the files are not recopied to your system.

The following files are copied to the \WINDOWS\SYSTEM directory:

CHART2FX.VBX	DOA2516.DLL	OLE2CONV.DLL	THREED16.OCX
COMDLG16.OCX	MSAJT200.DLL	OLE2DISP.DLL	TRUEGRID.VBX
COMPOBJ.DLL	MSJETERR.DLL	OLE2NLS.DLL	TYPELIB.DLL
CSCMD.VBX	MSJETINT.DLL	OLE2PROX.DLL	VAEN21.OLB
CSCOMBO.VBX	OC25.DLL	SCP.DLL	VB40016.DLL
CSTEXT.VBX	OLE2.DLL	STDOLE.TLB	VBAJET.DLL
CTL3DV2.DLL	OLE2.REG	STORAGE.DLL	VBDB16.DLL

The following files are copied to the \NTSDB directory. These files require approximately 4.3 Mbytes disk space:

Filename	Function
DATAPOP.MDB	Database of mixtures
NTSDB.EXE	NTSDB executable file
NTSDB.HLP	NTSDB online help file
GUM.HLP	Grout User's Manual

The file DATAPOP.MDB is in Microsoft Access format. The contents of this file cannot be changed with the NTS-DB software. However, it is possible to alter the data contained in the DATAPOP.MDB database using other database software, e.g., Microsoft Access. It is recommended that the data in DATAPOP.MDB *not* be altered. The USAE Waterways Experiment Station will maintain the database and provide periodic updates as additional data become available.

2.4 GROUT USER'S MANUAL.

The file GUM.HLP is a Windows Help-like document and is *not* required to run NTS-DB. The main purpose of the Grout User's Manual is to provide guidance to those who are not knowledgeable in the area of grout mixture proportioning, materials, mixing, and placing. It is intended to provide very basic, elementary information and to impart a working knowledge of what is important to insure a successful grout placement near instruments used to monitor explosive events.

The Grout User's Manual discusses the proportioning or designing of a mixture (how to make it), actual mixing (how to mix it) and placement (how to get it in place). These three phases are the backbone of a successful grouting operation. The information presented is neither limiting nor all inclusive but is intended primarily for familiarization. To access the Grout User's Manual, simply double-click the GUM icon in the NTS-DB program group.

2.5 TECHNICAL SUPPORT, BUG REPORTS, AND COMMENTS.

Every effort has been make to rid the NTS-DB software of bugs. Before reporting any suspected bugs, it is important that you be able to reproduce the circumstances that led to an error. Please include the full version number of the code in any correspondence. Attempt to recreate the error by performing the same functions that led to it previously. A full description of the circumstances leading to the error should be addressed to: USAE Waterways Experiment Station, ATTN: CEWES-SD-R (H. G. White), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199. Technical questions about mixture design or the data presented by NTS-DB should be addressed to USAE Waterways Experiment Station, ATTN: CEWES-SC-CA (B. H. Green), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199

SECTION 3

USER'S MANUAL FOR NTS-DB

3.1 GETTING STARTED.

To launch the NTS-DB software, open the NTS-DB Program Group within Windows and simply double-click the NTD-DB icon (a concrete truck). An alternative method of launching the software would be to:

1. Choose RUN from the FILE menu in the Windows Program Manager.
2. Type *path:\ntsdb* where *path*, is the location of the NTS-DB software on your hard drive, e.g., c:\ntsdb.
3. Click OK.

The structure of the NTS-DB program is shown in Figure 3-1. The program begins by loading the Main Form (see Figure 3-2). The type of query is specified on the Main Form, i.e., either a Property/Component query or a Name query. Also, the About NTS-DB Form (see Figure 3-3) may be accessed by clicking the NTS-DB icon on the Main Form. *Hint*: the animation of the concrete truck may be stopped and started by right-clicking the icon.

3.2 BEGINNING A QUERY.

To begin a query:

1. Start on the Main Form (Figure 3-2).
2. Choose to **Query a Property and/or Component**[2], or **Query a Mixture Name or Test Name.**
3. The query process may be initialized at any time by clicking **Cancel.**

3.2.1 To Query on a Mixture Name or Test Name.

Clicking **Query a Mixture Name or Test Name** on the Main Form (Figure 3-2) immediately displays the Name Form (see Figure 3-4). Select a mixture name from the **Mixture Name List Box** or a test name from the **Test Name List Box.**

[2] Buttons/boxes available on various NTS-DB forms are shown in **bold face type** in this manual. Definitions of the buttons/boxes are contained in the Glossary at the end of this manual.

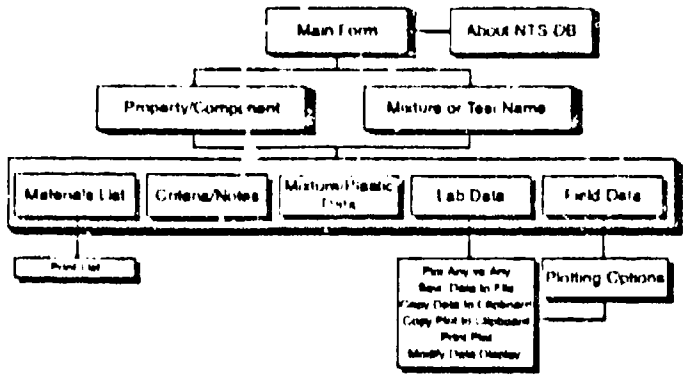

Figure 3-1. Organization of NTS-DB

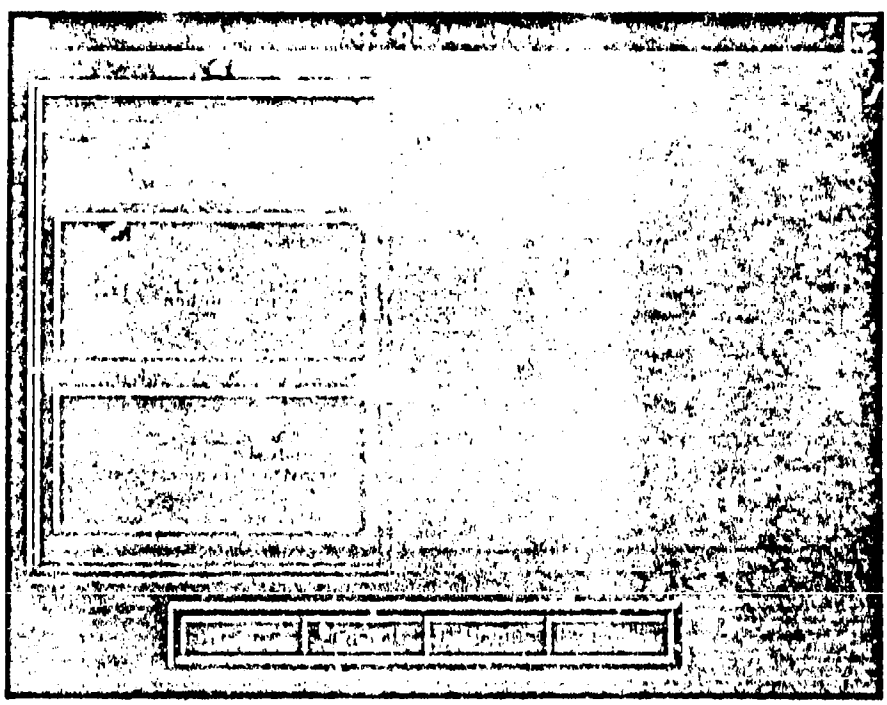

Figure 3-2. The Main Form is the initial form loaded by NTS-DB.

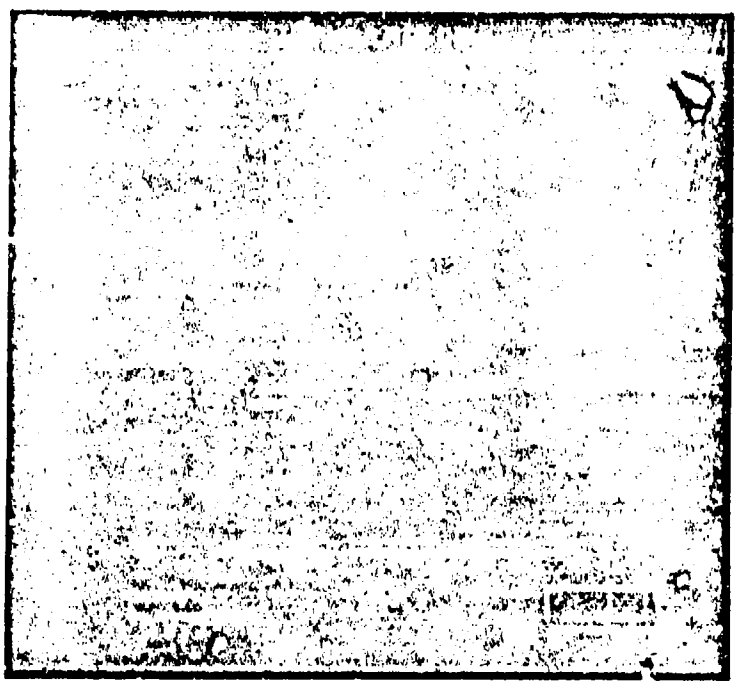

Figure 3-3. The About NTS-DB Form is accessed by clicking the NTS-DB icon, i.e., the concrete truck, on the Main Form.

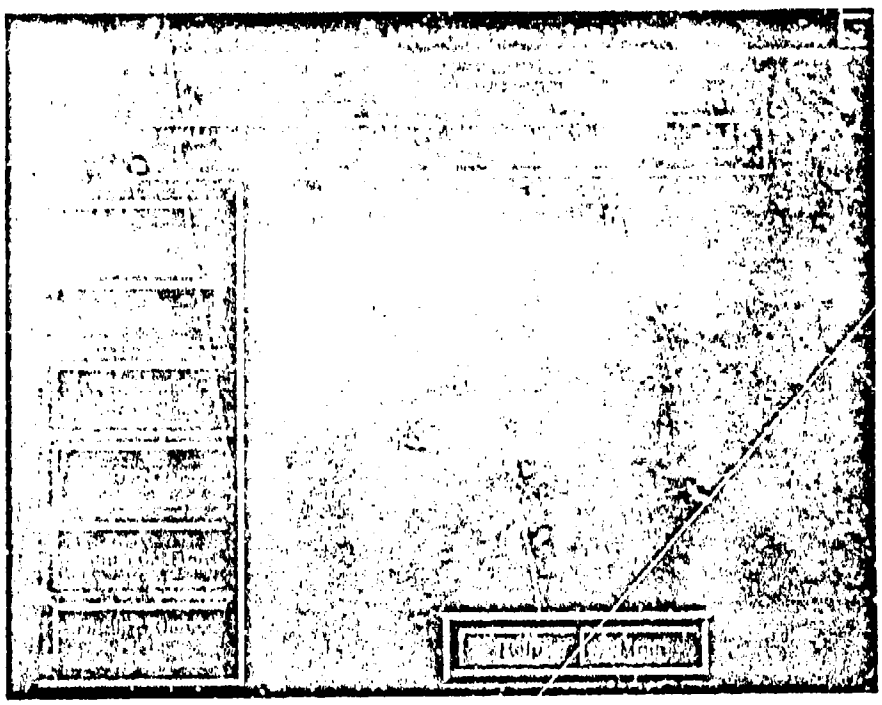

Figure 3-4. The Name Form is displayed in response to a query on a Mixture Name or a Test Name.

3.2.2 To Query on Properties and/or Components

Clicking **Query a Property and/or Component** on the Main Form (Figure 3-2) changes the display of the Main Form so that a query may be initiated. Presented in Figure 3-5 is an example of the Main Form for a query on Properties and/or Components.

Several properties of a mixture may be queried. These include Strength, Velocity, Density, Static Modulus, Dynamic Modulus, Expansion, Mixture Class, and Slump (laboratory data only). Also, the user may choose to search either field data or laboratory data. Refer to the Glossary at the end of this manual for definitions of each of these terms.

The components used in the various mixtures contained in the database have been grouped into six categories. These include Fine Aggregates, Coarse Aggregates, Cementitious Materials, Chemical Admixtures, Mineral Admixtures, and Others. Any one component from each category may be included in a query.

To specify a query criterion:

1. If querying on properties, choose to query either **Field Data** or **Laboratory Data**. If laboratory data are chosen, Slump may be included in the query. The default is field data.

2. Choose any combination of properties on which to query by entering lower and/or upper bounds for the property. You may select suggested bounds by clicking the arrow adjacent to the lower and upper bound list boxes for each property and then clicking the desired value. A more specific bound may be entered by clicking in the appropriate list box and simply typing the value. Note: Age may be selected only in combination with another property.

3. If querying on components, the choices for a category are shown by clicking the arrow adjacent to the associated list box. Then click the component to be queried. To clear a component from a query, click the blank line at the top of the list of choices in the appropriate list box. All categories may be queried; however, only one component per category may be selected.

4. Click **Continue** to proceed with the query. If no mixtures meet the specified criterion, NTS-DB will display a message box indicating a null search, otherwise the Property/ Component Form will be displayed.

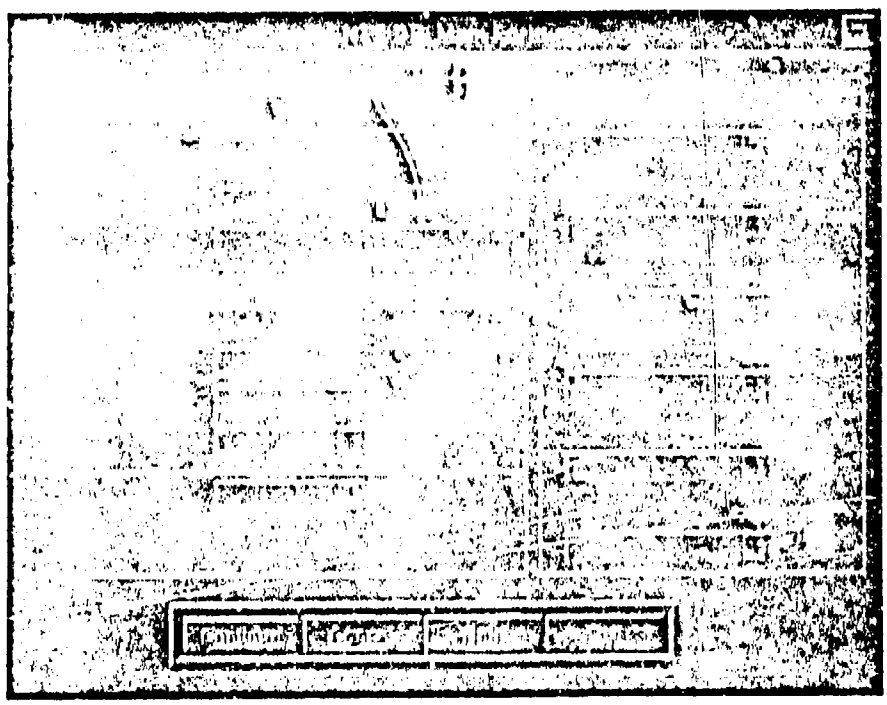

Figure 3-5. The Main Form, Property/Component Query is used to develop a query criterion by allowing the user to specify bounds on properties and/or to select components to be included in the query.

3.3 COMMON FEATURES OF THE PROPERTY/COMPONENT FORM AND NAME FORM.

The Property/Component Form (see Figure 3-6) and Name Form (see Figure 3-4) have similar formats. At the top of each form are list boxes that are used to display mixture names and test names. Along the left edge of the form are command buttons that allow the user to view information about the mixture selected or to begin a new query. At the bottom of the form are command buttons that invoke NTS-DB online help or return the user to the Main Form. The operation of NTS-DB in response to user actions on these forms is described below.

3.3.1 List Boxes.

3.3.1.1 Property/Component Form. When the user specifies a query on a Property and/or Component on the Main Form and clicks **Continue**, NTS-DB searches the database to find all mixtures that meet the specified criterion. If no mixtures meet the criterion, NTS-DB will display a message box indicating a null search, otherwise the Property/Component Form will be displayed. The results of the query are listed in the **Mixture Name List Box** (see the top of Figure 3-6). Click the list box to display the mixture names. Once a mixture is selected, NTS-DB searches the database to find all tests which used the mixture. The results of the search are displayed in the **Test Name List Box.**

3.3.1.2 Name Form. If the user specifies a query on a Mixture Name or Test Name on the Main Form, NTS-DB immediately displays the Name Form. NTS-DB searches the database to find all mixture names and test names and displays the results in the **Mixture Name List Box** and **Test Name List Box**, respectively. These list boxes are shown at the top of Figure 3-4.

The user may select either a mixture name or test name from one of the list boxes. If the user selects a mixture name, NTS-DB searches the database for all tests which used the mixture. Click on the **Test Name List Box** to see the results of the search. If the user selects a test name, NTS-DB searches the database for all mixtures used on the test. Click on the **Mixture Name List Box** to see the results of the search.

Each time the mixture name or test name is changed in one of the list boxes, NTS-DB updates the other list box to reflect the results of the search. To initialize the query, the user may select the first item in either of the list boxes, "Initialize Lists", or click **Initialize Query Lists** (described below).

3.3.2 Command Buttons.

Several command buttons are included on the Property/ Component Form and Name Form (see Figures 3-6 and 3-4, respectively. The operation of NTS-DB in response to user actions is described below.

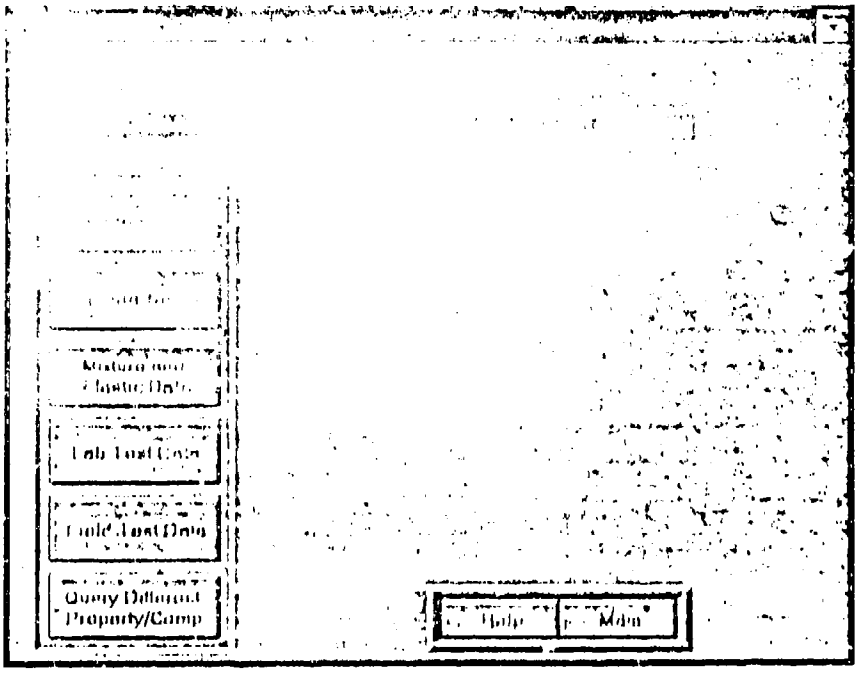

Figure 3-6. The Property/Component Form is displayed in response to a query on properties and/or components.

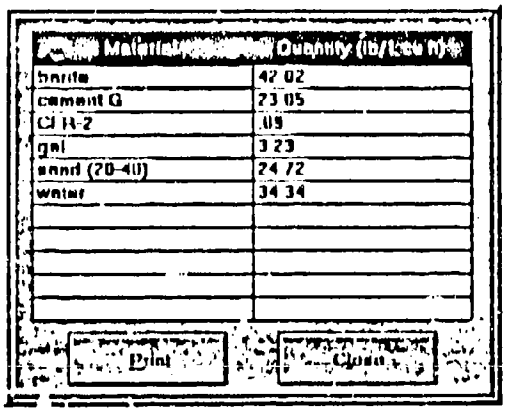

Figure 3-7. The list of materials (or components) used in the mixture is displayed after clicking the Materials List command button on the Property/Component Form or Name Form.

Button	Action
Materials List	View the list of materials used to prepare the mixture (see Figure 3-7). Two additional command buttons, **Print** and **Close**, are displayed with the materials list.
Print	Print a hard-copy of the materials list. Available after clicking **Materials List**.
Close	Close the materials list display. Available after clicking **Materials List**.
Criteria/Notes	View the original criteria for the mixture (if specified) and any notes recorded.
Mixture and Plastic Data	Display the Mixture and Plastic Data Form (see Figure 3-8).
Lab Test Data	Display the Laboratory Data Form. If this button is shaded then no data are available to plot.
Field Test Data	Display the Field Data Plotting Options Form. If this button is shaded then no data are available to plot
Query Different Property/Comp	Available only on the Property/ Component Form, click this button to return to the Main Form, where the query may be modified (see Figure 3-6).
Initialize Query Lists	Available only on the Name Form, click this button to list all mixture names and test names in the list boxes (see Figure 3-4).
Help	Invoke NTS-DB online help.
Main	Return to the Main Form.

3.4 GENERAL INFO FOR DISPLAYING PROPERTY DATA

Property Data is displayed using the Field Data Form and the Laboratory Data Form. Prior to displaying the Field Data Form, the Field Data Plotting Options Form is displayed, allowing the user to specify the data to be plotted.

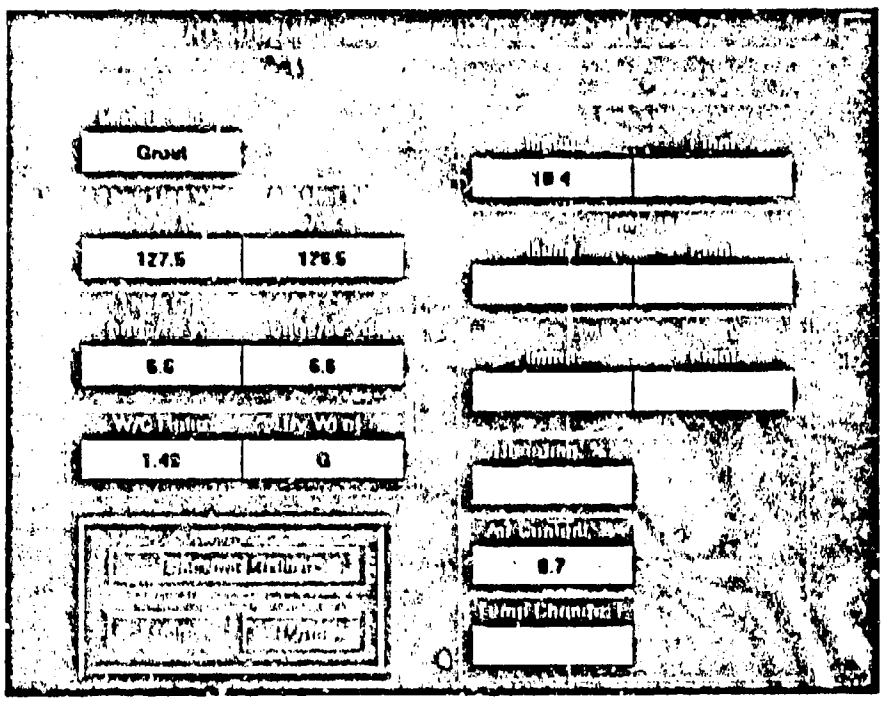

Figure 3-8. The Mixture and Plastic Data Form is used to display various mixture data determined in the laboratory.

3.4.1 Field Data Plotting Options Form.

The Field Data Plotting Options Form (see Figure 3-9) is displayed in response to the user clicking **Field Test Data** on either the Property/Component Form or Name Form. This form is displayed prior to the Field Data Form and allows the user to select which field data to plot. This form is also used to display information specific to a mixture placement at a given location on a field test.

The user has the following options:

Select a Field Test: This list box contains the names of all field tests which included the selected mixture. A single test may be selected from the list or the first entry in the list, "View data from all field tests", may be selected to view all the data from applicable field tests. If the mixture was used on only one field test then the test name is automatically placed in the list box.

Select a Location: Available if a single test is selected in the Select a Field Test List Box. Select the location on a field test to view. A single location may be selected from the list or the first entry in the list, "View data from all locations", may be selected to view all data from a single field test. If the mixture was placed at only one location for the selected test then the location name is automatically placed in the list box. After a field location is selected, the Date Cast, Temperature Change, and Notes for the location are presented (when available)

Select Data to View: The field test data is divided into two distinct categories, **Prior to Shot Day** and **Shot Day**. Property data determined prior to the date on which a field test was conducted has an associated Age, i.e., the age at which the specimen was tested is known. On the contrary, the age at Shot Day is unknown. Therefore, for a history of a property, choose to plot Prior to Shot Day, because Shot Day data can not be plotted versus time.

Several command buttons are included on the Field Data Plotting Options Form. The operation of NTS-DB in response to user actions is described below.

Button	Action
Continue	Display the Field Data Form.
Different Mixture	Return to the Property/Component or Name Form (depending on the type of query being performed).
Help	Invoke NTS-DB online help.
Main	Return to the Main Form.

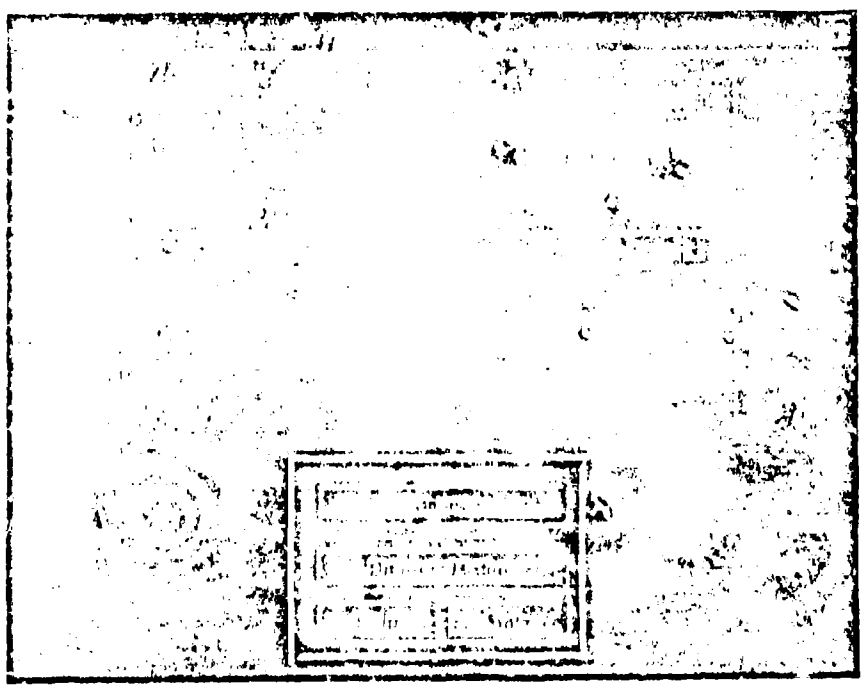

Figure 3-9. The Field Data Plotting Options Form allows the user to choose which field data to view. This form is also used to display field notes pertinent to a given placement of the mixture on a field test

3.4.2 Field Data Form and Laboratory Data Form.

The Field Data Form (see Figure 3-10) and Laboratory Data Form (see Figure 3-11) have a similar format. Option buttons allow the user to choose the property to be plotted on both the x- and y-axes. Any two properties may be plotted against one another, with the following exceptions:

1. Age may not be plotted on the y-axis.
2. A property may not be plotted against itself.
3. If no data are available for a given property, the option button is disabled (appearing gray), preventing the user from selecting it.

The user may choose from the following properties (when available): strength, velocity, density, static modulus, dynamic modulus, expansion, and age (x-axis only). The default selections are Strength versus Age.

Several command buttons are included on the Field Data Form and Laboratory Data Form. The operation of NTS-DB in response to user actions is described below.

Button	Action
Plot Data	Display a scatter plot of the specified data.
Different Mixture	Return to the Property/Component or Name Form (depending on the type of query being performed).
Different Options	Available only on the Field Data Form. Click Different Options to return to the Field Data Plotting Options Form (described above).
Help	Invoke NTS-DB online help.
Main	Return to the Main Form.

Once the data are displayed, a button bar is presented that allows the user to alter the display and export the data and/or graph. Exporting options include:

1. Saving the data values to a file.
2. Copying the plot image to the clipboard.
3. Copying the data values to the clipboard.
4. Printing a hard copy of the plot image.

The appearance of the display may be altered to:

1. Switch between 2-D and 3-D views of the graph (limited usefulness).

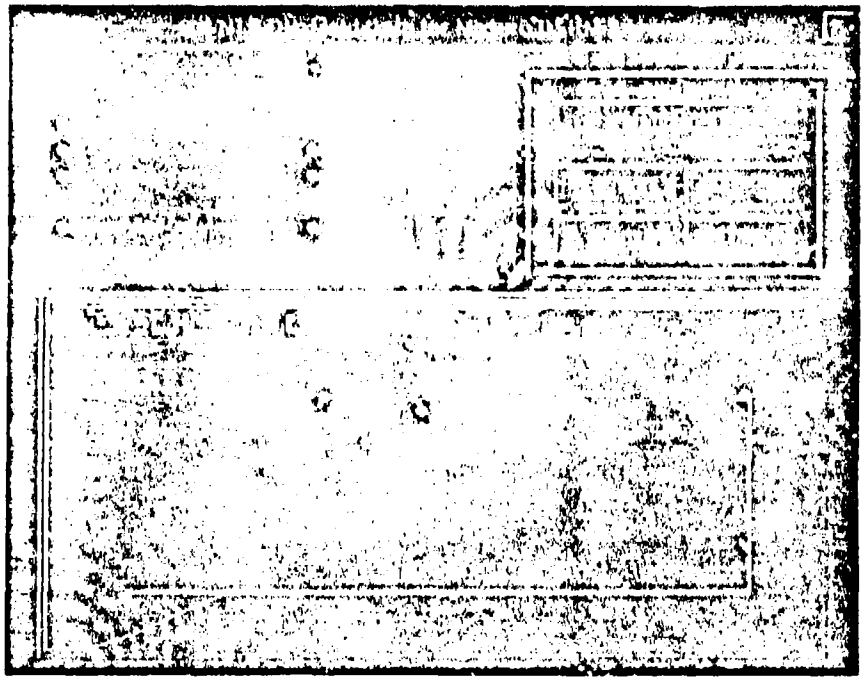

Figure 3-10. The Field Data Form is used to the display property data selected by the user from the Field Data Plotting Options Form.

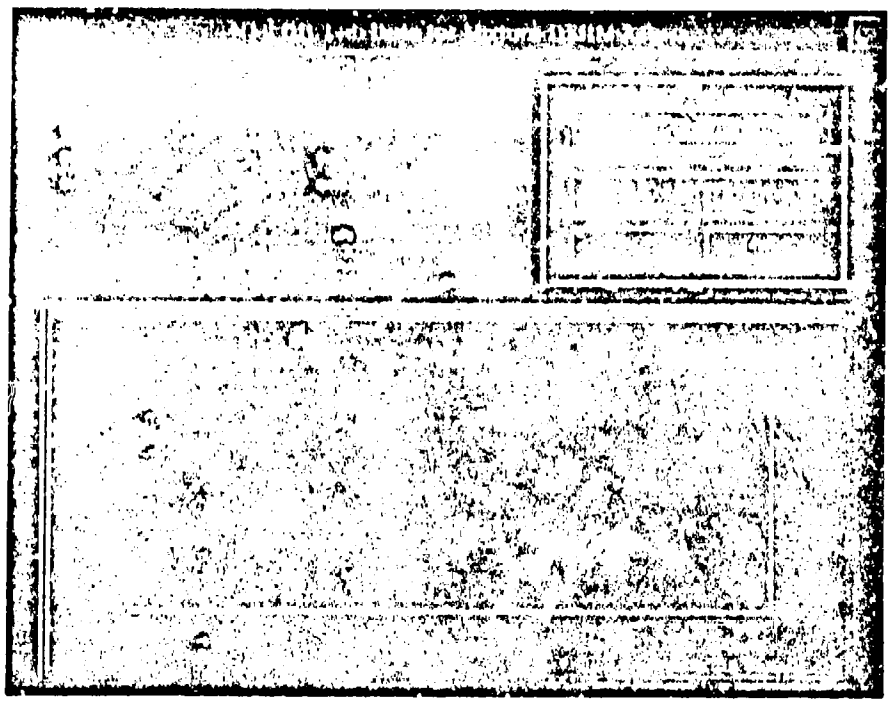

Figure 3-11. The Laboratory Data Form is used to display property data determined in the laboratory.

2. Rotate the 3-D image of the graph (3-D only, limited usefulness).
3. Spread the individual data series along the z-axis (3-D only, limited usefulness).
4. Zoom-in on an area of the plot. Note: the axes are not visible in the zoom mode.
5. Display a legend of the series names (Field Data only).
6. Display vertical grid lines.
7. Display horizontal grid lines.
8. Change the text displayed.
9. Change the font of the titles.
10. Change the colors and/or patterns of the display, view the y-values of the data.
11. Open a toolbox that allows the user many options for altering the display.

Hints:

1. Double-click on a data point to see its (x,y) data values and series name (Field Data only).
2. Experiment with the data display using the buttons presented on the button bar. The user cannot alter the data contained in the database. To restore the display defaults simply click **Different Mixture** or **Different Options** and then return once again to the Field Data Form or Laboratory Data Form.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS.

The U.S. Army Engineer Waterways Experiment Station was actively involved in the development, testing, and fielding of a wide variety of grout and concrete mixtures in support of underground nuclear weapons effects testing programs at the Nevada Test Site. Detailed information on mixture designs, laboratory data such as unconfined compressive strength, sonic velocity, density, and modulus, and similar results for actual as-placed mixtures have been archived in a computerized database. The software, entitled NTS-DB (Nevada Test Site - Database), used to query this database is a user-friendly Windows-format code that provides almost unlimited flexibility in specifying a query criterion.

Also provided with the NTS-DB software and database is the Windows Help-like Grout User's Manual. The manual provides guidance to those who are not knowledgeable in the area of grout mixture proportioning, materials, mixing, and placing. It presents very basic, elementary information in order to impart a working knowledge of what is important to insure a successful grout placement near instruments used to monitor explosive events.

4.2 RECOMMENDATIONS.

The expertise developed by WES over the many years of service at NTS has enabled WES to better serve other sponsors as well. The Generic Grout Families study, conducted for the Corps of Engineers, drew heavily upon the experience gained from WES's participation on the underground nuclear tests at NTS. The mixtures developed for use at NTS typically contain several exotic ingredients. Those special ingredients were used to meet a specific requirement for a particular placement of a given mixture. It was thought that mixtures based on generic/common ingredients would be useful as less complex points-of-departure for future mixtures. Under this study 13 families of grouts were identified. Each family was categorized based on the ingredients in the mixture, e.g., Family 1 is cement and water; Family 2 is cement, water, and bentonite; and Family 7 is cement, water, sand, and fly ash. The result of this study is a comprehensive matrix of mixtures that can be used by the layman mixture designer.

It is recommended that the Generic Grout Families database be coupled with the NTS-DB software. The inclusion of the database could be manifested in one of two ways. One method would be to create a stand-alone query code, similar to NTS-DB. The preferred method for including the additional data would be to modify the NTS-DB software by simply adding an option to query the generic families data. A form similar

to that available for a Property/Component query could be used to develop a criterion for querying the generic families database.

APPENDIX

GLOSSARY OF TERMS

Age
Time, in days, at which a specimen was tested.

Air Content
The volume of air voids in cement paste, exclusive of pore space in aggregate particles, expressed as a percentage of total volume of the mixture; determined according to ASTM C 231 or COE CRD C 41. Available for laboratory data only.

Presented on the Mixture and Plastic Data Form

Bleeding
The autogenous flow of mixing water within, or its emergence from a newly placed mixture; caused by the settlement of the solid materials within the mass; determined according to ASTM C 940 (grouts) or COE CRD C 613. Available for laboratory data only.

Presented on the Mixture and Plastic Data Form.

By Weight Of
A listing of the cementitious materials used to calculate the water/cement ratio. Available for laboratory data only

Presented on the Mixture and Plastic Data Form.

Hint: Click the Materials List command button for a list of materials used in the mixture.

Cancel
Click Cancel to cancel the specified query.

Available on the Main Form.

Cementitious Factor
A measure of cementitious materials in the mixture, expressed as bags/cu yd. Available for laboratory data only.

Presented on the Mixture and Plastic Data Form.

Close
Click Close to close the Materials List display for a mixture.

Available on the Property/Component and Name Forms after the Materials List button is clicked.

Component
A material used in the design of a mixture.

Continue, Field Data Plotting Options Form
Click Continue to display the Field Data Form.

Continue, Main Form
Click Continue to execute the specified query.

Criteria/Notes
Click Criteria/Notes to view the original criteria for the mixture (if specified) and any notes recorded.

Available on the Property/Component and Name Forms.

Date Cast
The date the mixture was placed at a location on a field test.

Presented on the Field Data Plotting Options Form (when available) after selecting an item from the Select a Location List Box.

Density
Mass per unit volume of the mixture, expressed as lb/cu ft; determined according to ASTM C 642.

Different Mixture
Click Different Mixture to return to the Property/Component or Name Form (depending on the type of query being performed).

Different Options
Click Different Options to return to the Field Data Plotting Options Form.

Available on the Field Data Form.

Dynamic Modulus
The modulus of elasticity computed from the size, weight, shape, and fundamental frequency of vibration of a specimen, or from pulse velocity, according to ASTM C 215.

Exit
Click Exit to quit NTS-DB.

Available on the Main Form.

Expansion
Material property determined according to ASTM C 878 and C 490. Positive expansion indicates an increase in volume. Negative expansion indicates a decrease in volume, i.e., shrinkage.

Field Data
Data obtained from specimens prepared in the field (Nevada Test Site). A query of field data searches all the field data and returns mixtures which meet the specified criterion.

Field Test Data
Click Field Test Data to display the Field Data Plotting Options Form. This item is disabled if there are no data available to plot.

Available on the Property/Component and Name Forms.

Flow
A measure of the consistency of a grout in which a predetermined volume is permitted to escape through a precisely sized orifice, the time of efflux being used as the indication of consistency; determined according to ASTM C 939. Available for laboratory data only.

Presented on the Mixture and Plastic Data Form.

Groutcrete
A mixture that exhibits properties generally between those typical for grouts or concretes; similar to mortar.

Help
Click Help to invoke NTS-DB online help.

Initialize Query Lists
Click Initialize Query Lists to list all mixture names and test names in the list boxes.

Available on the Name Form.

Lab Test Data
Click Lab Test Data to display the Laboratory Data Form. This item is disabled if there are no data available to plot.

Available on the Property/Component and Name Forms.

Laboratory Data
Data obtained from specimens prepared in the laboratory. A query of laboratory data searches all the laboratory data and returns mixtures which meet the specified criterion.

The laboratory data for a given mixture is unique, i.e., only one set of laboratory data exists for the mixture, even though it may have been used on numerous tests. As a result the total amount of laboratory data available for query, while quite large, is considerably smaller than the set of field data.

Main
Click Main to return to the Main Form.

Materials List
Click Materials List to view a list of materials used to prepare the mixture.

Available on the Property/Component and Name Forms.

Mixture and Plastic Data
Click Mixture and Plastic Data to display the Mixture and Plastic Data Form.

Available on the Property/Component and Name Forms.

Mixture Class
Mixtures included in the database are placed into three general classes: Grout, Concrete, or Groutcrete.

Presented on the Mixture and Plastic Data Form.

Mixture Name
The name of a mixture.

The names, for the most part, were assigned by WES personnel. A loosely applied guide was followed in naming many (not all) of the mixtures. The first two initials generally refer to a Test Name, e.g. a mixture developed for the test Diamond Skulls might begin with DS. Other initials often refer to the type of mixture, e.g., a groutcrete (gc) or a high strength grout (hsg). Still other initials or numbers may represent modifications to a mixture through the substitution of a component.

Mixture Name List Box, Name Form
Initially, this list box contains all the mixture names in the database. If a mixture name is selected, NTS-DB searches the database for all tests which used the mixture and displays the results in the Test Name List Box.

If a test is selected from the Test Name List Box, NTS-DB searches the database for all mixtures used on the test and displays the results in the Mixture Name List Box.

Mixture Name List Box, Property/Component Form
Click the Mixture Name List Box to display the mixture names that meet the specified property criterion and/or contain the specified component(s). Once a mixture is selected, NTS-DB searches the database to find all tests which used the mixture. The results of the search are displayed in the Test Name List Box, Property/Component Form.

Notes
Any note recorded for a mixture.

Laboratory notes are presented by clicking the Criteria/Notes button on the Property/Component or Name Forms.

Field notes, specific to a location on a test, are presented on the Field Data Plotting Options Form (when available) after selecting an item from the Select a Location List Box.

NTS-DB Icon
Click the icon to display the About NTS-DB Form.

Available on the Main Form.

Plot Data
Click Plot Data to display a scatter plot of the specified data.

Available on the Laboratory Data and Field Data Forms.

Plot Display
Visible on the Laboratory or Field Data Forms after clicking the Plot Data button.

Hint: Double-click on a data point to see its (x,y) values.

Plotting, Display Commands
These buttons allow the user to alter the Plot Display.

Available on the Laboratory or Field Data Forms after clicking the Plot Data button.

Plotting, Export Commands
These buttons allow the user to save the data values to a file, copy the plot image to the clipboard, copy the data values to the clipboard, and print a hard copy of the plot image.

Available on the Laboratory or Field Data Forms after clicking the Plot Data button.

Print
Click Print to print a hard-copy of the Materials List for a mixture.

Available on the Property/Component and Name Forms after the Materials List button is clicked.

Prior to Shot Day
Click this option to view property data determined Prior To Shot Day.
Available on the Field Data Plotting Options Form.

roperty
A material property of a mixture determined from standard test procedures. For example, unconfined compressive strength, density, or static modulus.

Query
The process by which the database is searched, depending on parameters selected by the user.

Query a Property and/or Component
Click Query a Property and/or Component to initiate a Property/Component query.

Available initially on the Main Form or after clicking Cancel.

Query a Mixture Name or Test Name
Click Query a Mixture Name or Test Name to initiate a Name query.

Available initially on the Main Form or after clicking Cancel.

Query Different Property/Comp
Click Query Different Property/Comp to return to the Main Form where the query may be modified.

Available on the Property/Component Form.

Select a Field Test
Select the field test data to view. A single test or all tests using the mixture may be selected. If a single test is selected, the Select a Location List Box is presented.

Available on the Field Data Plotting Options Form.

Select a Location
Select the location on a field test to view. A single location or all locations on a test may be selected.

After a field location is selected, the Date Cast, Temperature Change, and Notes for the location are presented (when available).

Available on the Field Data Plotting Options Form if a single test is selected in the Select a Field Test List Box.

Select a Mixture
A mixture must be selected from the Mixture Name List Box, Property/Component Form. Once selected, NTS-DB searches the database for information about the mixture.
Available on the Property/Component Form.

Select a Mixture and/or Test Name
Each time the mixture name or test name is changed in Mixture Name List Box or Test Name List Box on the Name Form, respectively, NTS-DB updates the other list box to reflect the results of the search.

To initialize the query, the user may select the first item in either of the list boxes "Initialize Lists", or click the Initialize Query Lists button.

Available on the Name Form.

Select Data to View
Choose to view properties determined Prior to Shot Day or on Shot Day.

Available on the Field Data Plotting Options Form.

Select the X-Axis
Choose the parameter to plot along the x-axis. The default is Age. NTS-DB prevents the user from making a selection for which there are no data, i.e., the options are disabled (appearing gray) if there are no data available.

Available on the Laboratory Data and Field Data Forms.

Select the Y-Axis
Choose the parameter to plot along the y-axis. The default is Strength. NTS-DB prevents the user from making a selection for which there are no data, i.e., the options are disabled (appearing gray) if there are no data available.

Available on the Laboratory Data and Field Data Forms.

Set
The condition reached by a mixture when it has lost plasticity to an arbitrary degree, usually measured in terms of resistance to penetration or deformation. Initial set refers to first stiffening; final set refers to attainment of significant rigidity; determined according to ASTM C 403 (concretes) or ASTM C 953 (grouts). Available for laboratory data only.

Presented on the Mixture and Plastic Data Form.

Shot Day
The day a field test was conducted at the Nevada Test Site.

Click this option to view property data determined on Shot Day. The age at which the properties were determined is not available for this option.

Available on the Field Data Plotting Options Form.

Slump
A measure of consistency of a freshly mixed concrete or groutcrete equal to the subsidence measured to the nearest 1/4 in. of the molded specimen immediately after removal of the slump cone; determined according to ASTM C 143. Available for laboratory data only.

Presented on the Mixture and Plastic Data Form.

Static Modulus
The value of Young's modulus of elasticity obtained by arbitrary criteria from measured stress-strain relationships derived from other than dynamic loading; determined according to ASTM C 469.

Strength
Unconfined compressive strength; the measured maximum resistance of a mixture to axial loading, expressed as lb/sq. in.; determined according to ASTM C 39.

Temperature Change
The measured rise in temperature of a mixture; determined according to ASTM D 1064.

Test Name
The name of a test conducted at the Nevada Test Site (NTS).

Test Name List Box, Name Form
Initially, this list box contains all the test names in the database. If a test name is selected, NTS-DB searches the database for all mixtures used on the test and displays the results in the Mixture Name List Box.

If a mixture is selected from the Mixture Name List Box, NTS-DB searches the database for all tests that used the mixture and displays the results in the Test Name List Box.

Test Name List Box, Property/Component Form
Click the Test Name List Box to display the test names that used the mixture selected in the Mixture Name List Box.

Unit Weight
Weight per unit volume of the mixture, expressed as lb/cu ft; determined according to ASTM C 138.

Presented on the Mixture and Plastic Data Form.

Velocity
Sonic (or pulse) velocity; determined according to ASTM C 597.

Water/Cement Ratio
The ratio of the amount of water, exclusive only of that absorbed by the aggregates, to the amount of cement in a mixture.

Presented on the Mixture and Plastic Data Form.

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ATTN: FCTOE
ATTN: FCTOH
ATTN: FCTOS
ATTN: FCTR JUAN QUINTANA
ATTN: FCTR LT COL COPELAND
ATTN: FCTR MAJ NELSON
ATTN: FCTR, R W SHOUP
ATTN: FCTT-E, J KING
ATTN: FCTT/MAJ JEFF DURAY
10 CY ATTN: FCTT, DR BALADI
ATTN: FCTT, J HUGHES
ATTN: FCTTD LT COL JAMES
ATTN: FCTTD MAJ P DEREGO
ATTN: FCTTD J THOMPSON
ATTN: FCTTS
ATTN: FCTTS A MARTINEZ
ATTN: FCTTS D SEEMANN
ATTN: FCTTS G GOODFELLOW
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ATTN: CEWES-SD O, R MOXLEY
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ATTN: CEWES-SS-R (W HUFF)
ATTN: CEWESS-SS-RE, RANDY HOLMES
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ATTN: CEWES-SD-R J WINDHAM
ATTN: J ZELASKO, CEWES-SD-R
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ATTN: AMSRL-WT-NC, J SULLIVAN
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