

SWELL/CONSOLIDATION

Manuals _____

USER MANUAL

- ◆ **INSTALLATION AND OVERVIEW**
- ◆ **CONFIGURING CONS**
- ◆ **TEST DATA ENTRY AND MODIFICATION**
- ◆ **PRINTING TEST SUMMARIES AND REPORTS**
- ◆ **TECHNICAL SPECIFICATIONS**
- ◆ **TUTORIAL**
- ◆ **HELP!**
- ◆ **CONVERTING DOS CONS DATA FILES**

Click on a topic, or click on the icon shown at the right to start at the first chapter



SWELL/CONSOLIDATION

Manuals _____

INSTALLATION AND OVERVIEW

- ◆ **INSTALLATION**
- ◆ **HARDWARE AND SOFTWARE REQUIREMENTS**
- ◆ **DATA REQUIREMENTS**
- ◆ **DATA ACQUISITION SUPPORT**

Click on a topic, or click on the icon shown at the right to start at the first chapter



SWELL/CONSOLIDATION

Manuals _____

CONFIGURING CONS

- ◆ **SETUP DIALOG**
- ◆ **DEFLECTION TABLES**
- ◆ **CONSOLIDOMETER TABLES**

Click on a topic, or click on the icon shown at the right to start at the first chapter



SWELL/CONSOLIDATION

Manuals _____

TEST DATA ENTRY AND MODIFICATION

- ◆ **TEST PARAMETERS**
- ◆ **READINGS DATA ENTRY/CURVE DISPLAY SCREEN**
- ◆ **EDITING DATA FOR AN EXISTING SWELL/CONSOLIDATION TEST**

Click on a topic, or click on the icon shown at the right to start at the first chapter



SWELL/CONSOLIDATION

Manuals _____

PRINTING TEST SUMMARIES AND REPORTS

- ◆ **PRINTING TEST SUMMARIES**
- ◆ **PRINTING TEST REPORTS**

Click on a topic, or click on the icon shown at the right to start at the first chapter



SWELL/CONSOLIDATION

Manuals

TECHNICAL SPECIFICATIONS

- ◆ **CALCULATION OF SPECIMEN PARAMETERS**
- ◆ **VOID RATIOS AND PERCENT CHANGE CALCULATION**
- ◆ **CONSOLIDATION VS. LOAD CURVE / PARAMETER CALCULATIONS**
- ◆ **TIME-CONSOLIDATION CALCULATIONS**
- ◆ **CONVERSION FACTORS**
- ◆ **DATA EXPORTED BY THE PROGRAM**

Click on a topic, or click on the icon shown at the right to start at the first chapter



SWELL/CONSOLIDATION

Manuals

HELP!

- ◆ **FREQUENTLY ASKED QUESTIONS**
- ◆ **ERROR MESSAGES**

Click on a topic, or click on the icon shown at the right to start at the first chapter



1. Installation and Overview

The GEOSYSTEM Swell/Consolidation Test module (CONS) is designed to reduce laboratory data from a one-dimensional consolidation or swell test. Spreadsheet style screens simplify the data entry process, while extensive graphics options make checking and correcting entered data a snap.

CONS specifically supports the ASTM D 2435 and D 4536 (Methods “A” and “B”) standards.

CONS features full reduction of time-consolidation data, including both square root and log of time methods. Coefficient of consolidation, void ratios, compression and recompression indices, preconsolidation and swell pressures, and swell/collapse percentages are calculated and reported by the program. For those values which are ordinarily determined using various tangent line construction rules, the program uses similar interactive graphics constructions. CONS has the ability to automatically perform unit conversions on all dimensions, stresses and unit weights.

CONS utilizes the GEOSYSTEM Data Manager program (GDM) for all of its file processing operations. The user should be familiar with the material in the GDM reference manual prior to starting with this manual.

1.1 Installation

The GEOSYSTEM for Windows package requires Windows 3.1, 3.11 (Windows for WorkGroups), Windows95, or OS/2 with Win-OS/2 support.

For users of the older MS-DOS Consolidation program: the installation program for the GEOSYSTEM for Windows CONS module provides the option of re-using the MS-DOS program's consolidometer (oedometer) and machine deflection tables. If this option is not selected, and, at a later date the user would like to re-use the MS-DOS program's tables, simply re-install the CONS Windows module and choose the option to re-use the MS-DOS program's tables.

1.1.1 For Users Who Already Have GEOSYSTEM for Windows Installed

During the following installation process you will be asked which directory to install the CONS module into. Please be sure to install it into the same hard disk subdirectory where your GEOSYSTEM for Windows base module is already installed. (You can find the name of this directory by selecting Help, About This Program... from the GEOSYSTEM for Windows' opening screen and then clicking on the "System Info." button.)

For Windows 3.1 and 3.11

Load the Windows File Manager. Place the CONS disk in a drive and click on that drive icon. When the list of files appears, double-click on SETUP.EXE.

For Windows95

From the "Start" menu select "Run". Place the CONS disk in a drive then select the correct drive and type SETUP.

1.1.2 For Users Who Do Not Have GEOSYSTEM for Windows Installed

See [Chapter 2 of the GDM manual](#) for instructions on installing the Data Manager module. Once the Data Manager is installed the installation program will ask you if there are more modules to be installed. Select "Yes", place the Swell/Consolidation module disk into the same drive the GDM disk was in, and click "Ok" to continue.

1.2 Hardware and Software Requirements

CONS supports the same range of hardware and software listed in [Chapter 1 of the GDM manual](#). CONS in particular requires 700,000 bytes of hard disk space.

CONS requires a VGA or SVGA monitor. **For better viewing results, it is recommended that the user's Windows installation be configured for 800x600 or better resolution.**

(Viewing resolution is changed using the “Display Properties” sheet in the Windows95 Control Panel, or through the “Windows Setup” icon in the Windows 3.1/Windows for WorkGroups “Main” program group.)

Users who have previously purchased the MS-DOS CONS program may import the older program's test files into the GEOSYSTEM for Windows environment. (Instructions on doing this are given in [Chapter 8](#).)

1.3 Data Requirements

CONS requires the dimensions of the consolidometer and its dial and drainage characteristics, and optionally uses a table of deflections for mechanical loading frames. This information is entered once during the initial setup discussed in Chapter 2 so the required values may be retrieved from the tables using a machine or consolidometer number reference: for each test the program will ask for the consolidometer and, optionally, the machine ID, and retrieve the correct information from the tables.

CONS also requires **Untrimmed Sample** data for initial moisture, density, void ratio and saturation calculations on the whole sample, and **Trimmed** or **Test Specific Sample** information such as the height of the sample at the start of the consolidation test. Optionally, the program will also utilize the **Final Sample Weight**.

A brief discussion of the required and optional sample and test data follows:

1.3.1 Untrimmed Sample Data

Untrimmed sample data is required for initial moisture, void ratio and saturation calculations: The untrimmed sample data may be from either the actual trimmed test specimen, or a larger sample representative of the test specimen.

Initial Moisture Weights: These are the weights for a representative sample moisture content determination.

Sample Height and Diameter: This is the initial height and diameter of the sample as used to calculate the soil's unit weight; these values may be either the trimmed sample as used in the actual consolidation test, or a larger representative sample.

Weight of Sample: This is the moist weight; as with all weights used by the program, this value should be recorded in grams.

1.3.2 Test Specific Data

Specific Gravity: Entry of a specific gravity for the sample is optional; however, the program is unable to calculate void ratios unless a specific gravity is supplied by the user.

Deflection Table Id: This is an optional data field for users with mechanical loading frames who need to apply loading frame deflection corrections to dial readings. The program will automatically look up the deflections for a given loading pressure. Refer to [Chapter 2](#) for more information about this option.

Consolidometer Number: This is a number from 1 to 20 that corresponds to an entry in the program's consolidometer database. The consolidometer number is required. Refer to Chapter 2 for more information about the consolidometer data table.

Trimmed Height: Corresponds to the height of the specimen at the beginning of the consolidation test. This entry defaults to the consolidometer height as stored in the consolidometer table.

Overburden Pressure: This is an optional item that can be used by the program when calculating the C_r , the recompression index.

1.3.3 Swell/Consolidation Test Data

CONS breaks up data entry for the actual swell/consolidation test into *loading increments*, consisting of a pressure, and a minimum of two time/dial reading pairs: an initial time and dial reading recorded *prior* to the addition of the loading stress (the time is either 0 seconds, or the 24-hour clock time just prior to the addition of the loading stress), and a time/dial reading taken at the end of the loading increment; further (intermediate) readings may be entered if the user would like to plot time-rate charts.

Note that the term “loading increment” is used generically to represent both loading and unloading increments.

Time readings may be entered as either elapsed time in decimal minutes, or as 24-hour clock times.

1.3.4 Post-Test Specimen Data

The post-test wet and dry sample weights may also be entered: these numbers may be utilized for double-checking the program's calculated dry sample weight. (If the calculated dry sample weight, which is derived from the density and volume of the untrimmed sample, appears incorrect, the user may force the program utilize the post-test dry weight in place of the derived weight).

1.4 Data Acquisition Support

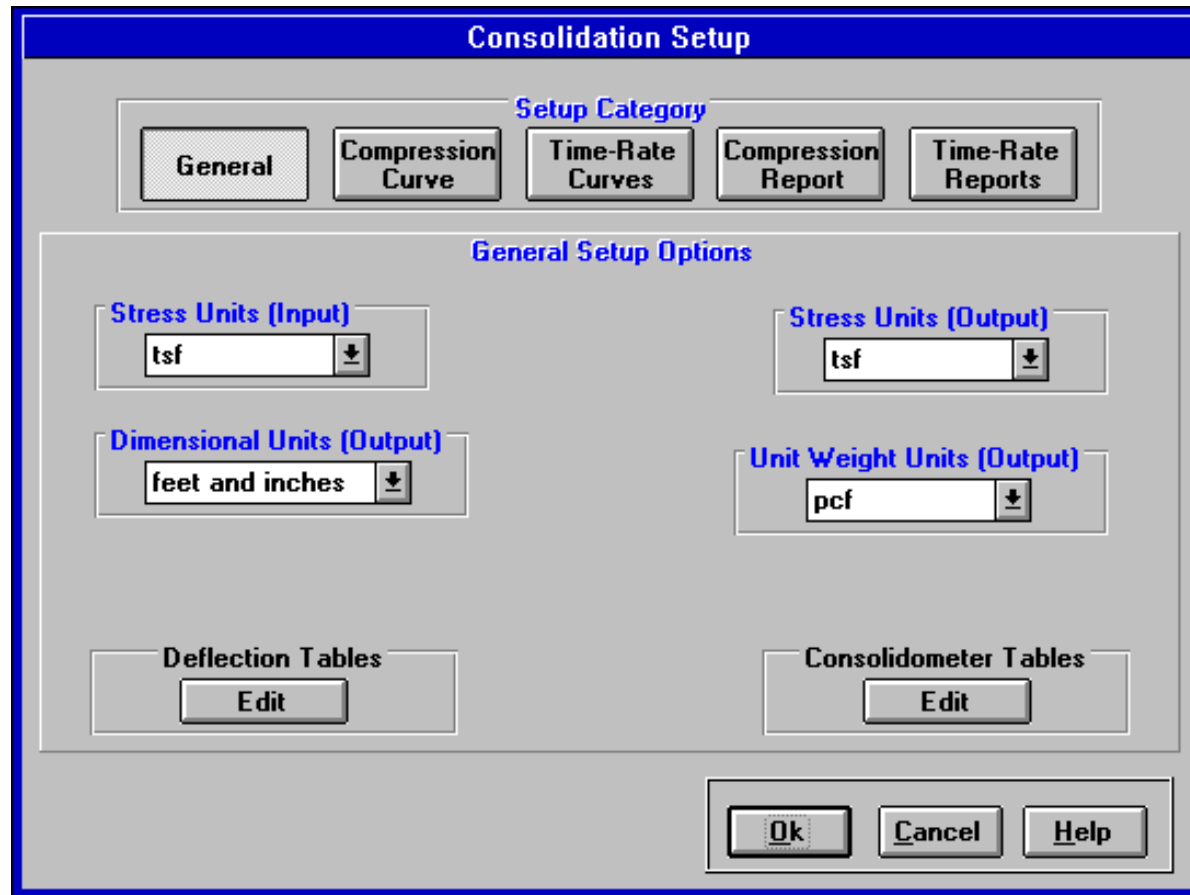
The ability to import data recorded by data acquisition equipment is an optional feature in CONS - versions of the program customized for data import may be obtained directly from the makers of consolidation test hardware.

2. Configuring CONS

CONS includes a number of user-configured parameters: when the software is first installed, the user should begin by setting up the program with the options that most closely match the test to be run. The following sections detail the various configuration options available.

2.1 Setup Dialog

CONS program options are configured from the program's setup dialog (below). The dialog may be accessed from two places: the first is the Options, CONS Setup menu selection available within the GEOSYSTEM for Windows program, the second, Setup, is available from the CONS data entry screen.



Setup Dialog Showing the General Setup Panel

Note that it does make a difference as to which method is used to view the setup screen: When the setup screen is displayed using the Setup option from the CONS data entry screen, many of the configuration options apply strictly to the test data set currently being entered, or to all tests entered into the current project. When the setup screen is displayed from the GDM Options, CONS Setup menu, the same configuration options will be applied only to test data sets entered into newly-created project files. As an example, the following table demonstrates the effect that selecting a new “Stress Input Units” would have.

Change Stress Units From:	Change Affects:
GDM <u>Options</u> , <u>CONS Setup</u>	Only newly-created project files
CONS Data Entry Screen	Only tests stored in the current project

When creating a new project file that will be used to store data that utilize dimension or stress units that are different than normal, make sure to change the units (using the Options, Setup General Options... and Options, Cons Setup menu items available from the GDM opening screen) *before* creating the new project file.

The setup dialog is composed of a number of different setup panels which are viewed by clicking on one of the five buttons grouped under **Setup Category**. Each panel is described in a following section.

2.1.1 General Setup

Changing any of the following options while entering data for a consolidation test defines the corresponding option for **every** consolidation test entered into the current project.

Stress Units (Input): these are the units in which the loading pressures for the Swell/Consolidation test were recorded.

If a project file was mistakenly created with the wrong stress units, open a CONS test stored in the project, then select Setup from the CONS data entry screen and change the “Stress Units (Input)” to the appropriate selection.

Stress Units (Output): these are the units to be used when reporting or graphing loading pressures. Note that the output stress units may be different than the input stress units: the program will automatically perform any necessary conversions.

Dimension Units (Output): Selects the units to be used when reporting or graphing dimensions. Again, the output dimension units may be different from the input dimension units. (Refer to [Section 3.2 of the GDM manual](#) for information on changing the input dimension units.)

Unit Weight Units (Output): Selects the units to be used when reporting the initial wet and dry sample densities.

Deflection Tables: Clicking this button allows the user to enter and modify loading frame deflection tables. These tables are discussed in detail in [Section 2.2](#).

Consolidometer Tables: Clicking this button allows the user to enter and modify consolidometer tables. These tables are discussed in detail in [Section 2.3](#).

2.1.2 Compression Curves

Consolidation Setup

Setup Category

General **Compression Curve** Time-Rate Curves Compression Report Time-Rate Reports

Compression Curve Options

Compression Curve Starts At
First Load ☒ Load=0 ☐

Compression Curve Plots
Final Dial Reading ☒ D100 ☐

ASTM D 4546 Compatibility
Yes ☐ No ☒

Swell Pressure Calculated As
pressure at restoration

Recompression Index Is
average slopes of rebound and reload intervals

Ok Cancel Help

Compression Curve Setup Panel

Compression Curve Starts At: The user has the option of starting the compression curve at either the first loading stress or at the left edge of the graph. (When starting at the left edge of the graph, the program plots from a void ratio=to the initial void ratio, a % change of 0, and a deformation of 0.)

Compression Curve Plots: The compression curve may be plotted as the void ratio/deformation/% change at either the final dial reading taken at each loading increment, or at the calculated end of primary consolidation (D₁₀₀) for each loading increment.

If the D₁₀₀ option is chosen, loading increments without time-rate readings will be plotted at the final dial reading for the loading increment *minus* the difference between the final dial reading and D₁₀₀ at the first previous loading increment where time-rate readings were taken.

Changing this option while entering data for a consolidation test defines the corresponding option for **every** consolidation test entered into the current project.

ASTM D 4546 Compatibility: If this option is chosen, hardcopy compression curve charts will include a right-hand scale indicating % heave. (Refer to the [Technical Documentation chapter](#) for a discussion of how % heave is calculated.)

Swell Pressure Calculated As: CONS will calculate swell pressure as either the pressure required to restore the wetted sample to the void ratio at the time of wetting or the difference between the restoration pressure and the pressure on the sample when it was wetted.

Recompression Index Is: some references define C_r as the average slope of the rebound cycle(s), while other references define the value as the average slope of both the rebound and recompression cycles. The program may be configured to calculate C_r by either method, or to not or report C_r .

For swell tests, the software will always calculate C_s , the swell index, as the average slope of the only the rebound cycle(s), and C_s will be reported in place of C_r .

2.1.3 Time-Rate Curves

The screenshot shows a software dialog box titled "Consolidation Setup". It has a blue header bar with the title. Below the header is a "Setup Category" section with five buttons: "General", "Compression Curve", "Time-Rate Curves" (which is highlighted with a dotted border), "Compression Report", and "Time-Rate Reports". The main area of the dialog is titled "Time-Rate Curve Options" in blue. It contains three main settings: 1. "Min. Data Points for Time-Rate Curves" with a text box containing the number "4" and a dropdown arrow. 2. "Report Cv Values As" with a text box containing "feet²/day" and a dropdown arrow. 3. "Calculate Secondary Compression As" with a text box containing "do not calculate" and a dropdown arrow. At the bottom of the main area is a section titled "Default Time-Consolidation Graph is Dial Reading vs." with two radio buttons: "Log of Time" (which is selected) and "Square Root of Time". At the very bottom of the dialog are three buttons: "Ok", "Cancel", and "Help".

Time-Rate Curves Setup Panel

Min. Data Points for Time-Rate Curves: In order to generate C_v values, the program requires a **minimum** of 4 data points per loading increment; however, the user may opt to increase the minimum required number points by changing this value.

Report C_v Values As: The program supports a number of different units for reporting C_v values. Note that the selections available depends upon the **Output Units** chosen from the General Setup Options panel.

Calculate Secondary Compression As: Standard references list the secondary compression equation as either the slope of the secondary compression line divided by the sample height, or as divided by the height of solids. The program supports both methods; in addition, if the user does not require secondary compression values, selecting *do not calculate secondary compression* eliminates the secondary compression value from the program's hardcopy reports.

Changing the " C_v units" or "Secondary Compression Calculation Method" while entering data for a consolidation test defines the corresponding option for *every* consolidation test entered into the current project.

Default Time-Consolidation Graph is Dial Reading vs.: When a new loading increment is entered the program displays either a square-root(time) or log(time) time-rate graph - the setting of this option determines which graph is chosen. (Note that once a loading increment has been entered, the user may override the default graph selection.)

2.1.4 Compression Reports

The image shows a software dialog box titled "Consolidation Setup". At the top, there is a "Setup Category" section with five buttons: "General", "Compression Curve", "Time-Rate Curves", "Compression Report", and "Time-Rate Reports". The "Compression Curve" button is currently selected. Below this, the "Compression Curve Report" section contains a dropdown menu labeled "Compression Curve Report Includes" with the value "compression curve only". There are two groups of radio buttons: "Show Construction Lines" with "Yes" and "No" (selected) options, and "Engineering Units" with "Yes" and "No" (selected) options. Below these is a "Report form" dropdown menu showing "\"Standard\" Form - Includes Pc & overburden (CSCONS1)". At the bottom of the main area is a "Report Title" text field containing "CONSOLIDATION TEST REPORT". At the very bottom of the dialog are three buttons: "Ok", "Cancel", and "Help".

Compression Reports Setup Panel

Compression Curve Report Shows: Underneath the standard consolidation graph on hardcopy reports, the user may opt to add either a table or a graph of C_v values. **Note that neither the C_v table nor the C_v graph will be plotted unless time-rate data have been entered for several loading increments (meaning 4 or more time/dial reading pairs per increment).**

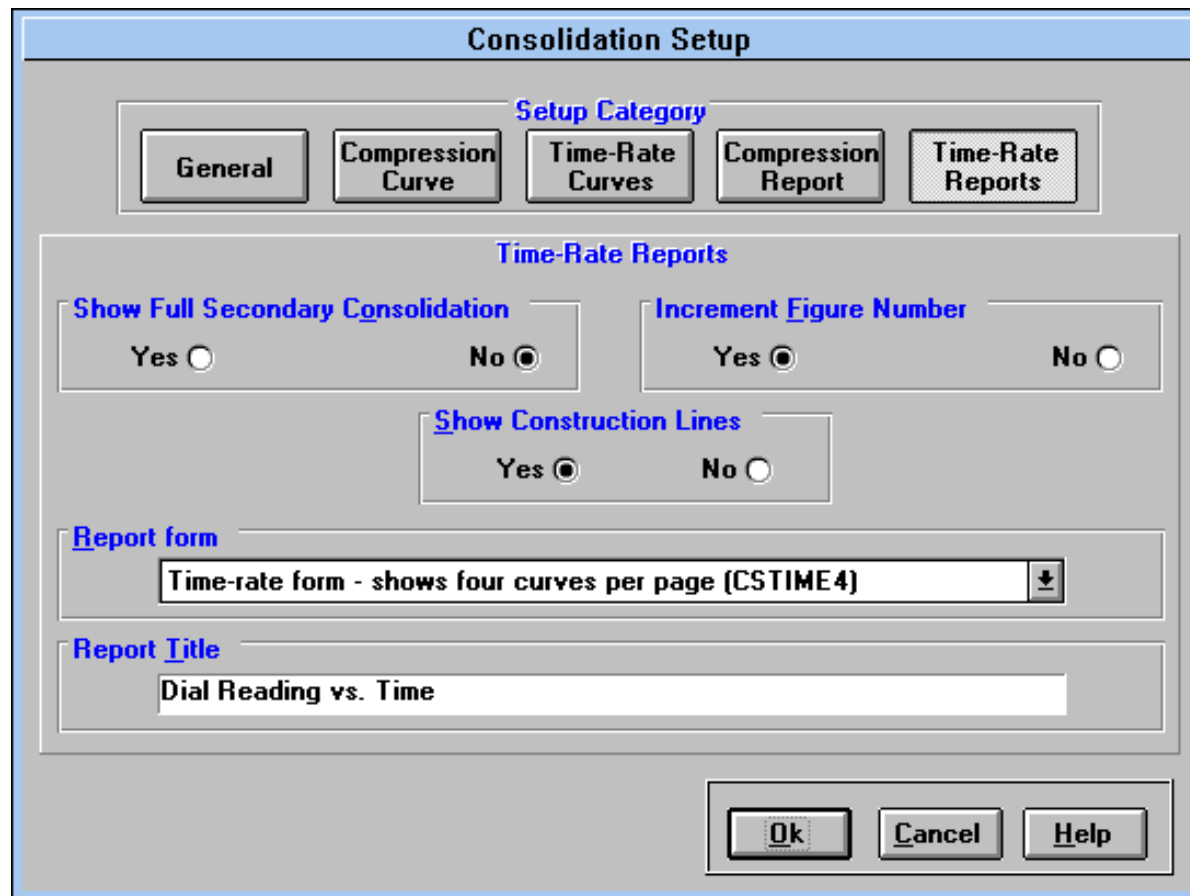
Show Construction Lines: Optionally, CONS may be configured to show the C_c/P_c (compression index/preconsolidation pressure) construction lines on hardcopy compression curve reports.

Engineering Units: The user may opt to have the program display the %change/ void ratio/deformation consolidation graph axis in divisions that are directly readable using one of the ranges on an engineering scale. Note that the program determines whether the 10, 20, 30, 40, 50 or 60 scale is chosen.

Report Form: The program features a number of unique formats for presenting the consolidation curve in hardcopy form. Examples of each of the report formats listed in the **Report Form** box may be found in Appendix A.

Report Title: Each hardcopy consolidation report form includes a common title that may be modified by the user.

2.1.5 Time-Rate Reports



The image shows a software dialog box titled "Consolidation Setup". It has a tabbed interface with five tabs: "General", "Compression Curve", "Time-Rate Curves", "Compression Report", and "Time-Rate Reports". The "Time-Rate Reports" tab is currently selected. Inside this tab, there are three sections. The first section, "Time-Rate Reports", contains two groups of radio buttons. The first group is for "Show Full Secondary Consolidation" with "Yes" and "No" options; "No" is selected. The second group is for "Increment Figure Number" with "Yes" and "No" options; "Yes" is selected. Below these is a third group for "Show Construction Lines" with "Yes" and "No" options; "Yes" is selected. The second section is "Report form", which has a dropdown menu currently showing "Time-rate form - shows four curves per page (CSTIME4)". The third section is "Report Title", which has a text field containing "Dial Reading vs. Time". At the bottom right of the dialog are three buttons: "Ok", "Cancel", and "Help".

Consolidation Setup

Setup Category

General Compression Curve **Time-Rate Curves** Compression Report Time-Rate Reports

Time-Rate Reports

Show Full Secondary Consolidation

Yes ☐ No ☒

Increment Figure Number

Yes ☒ No ☐

Show Construction Lines

Yes ☒ No ☐

Report form

Time-rate form - shows four curves per page (CSTIME4) ▾

Report Title

Dial Reading vs. Time

Ok Cancel Help

Time-Rate Reports Setup Panel

Show Full Secondary Consolidation: The primary consolidation portion of many square-root(time) curves occupies only the left 10 or 20% of the time-rate graph, making an accurate evaluation of the C_v construction difficult. To avoid this, the user may choose to have the program drop the linear secondary consolidation portion of the curve and expand the rest of the curve accordingly. Note that this option is only available when plotting time-rate curves on hardcopy reports: the on-screen square-root(time) plot instead features a zoom option.

Increment Figure Numbers: This option allows the user to specify increasing figure numbers on successive pages of time-rate curve reports: if this option is chosen, then the figure number printed on the *consolidation* curve report matches the number specified under "Figure No.:" in the Test Parameters window (see [Section 3.1](#)); the figure number used on the first time-rate curve report is the "Figure No.:" value increased by one; each subsequent page increments this number by one. (Refer to [page 28 of the GDM manual](#) for a discussion of how the figure number is incremented.)

If the user chooses not to have the program increment the figure number, the consolidation curve report and all time-rate curve reports will show the same figure number.

Show Construction Lines: Optionally, CONS may be configured to show the C_v construction lines on hardcopy time-rate curve reports.

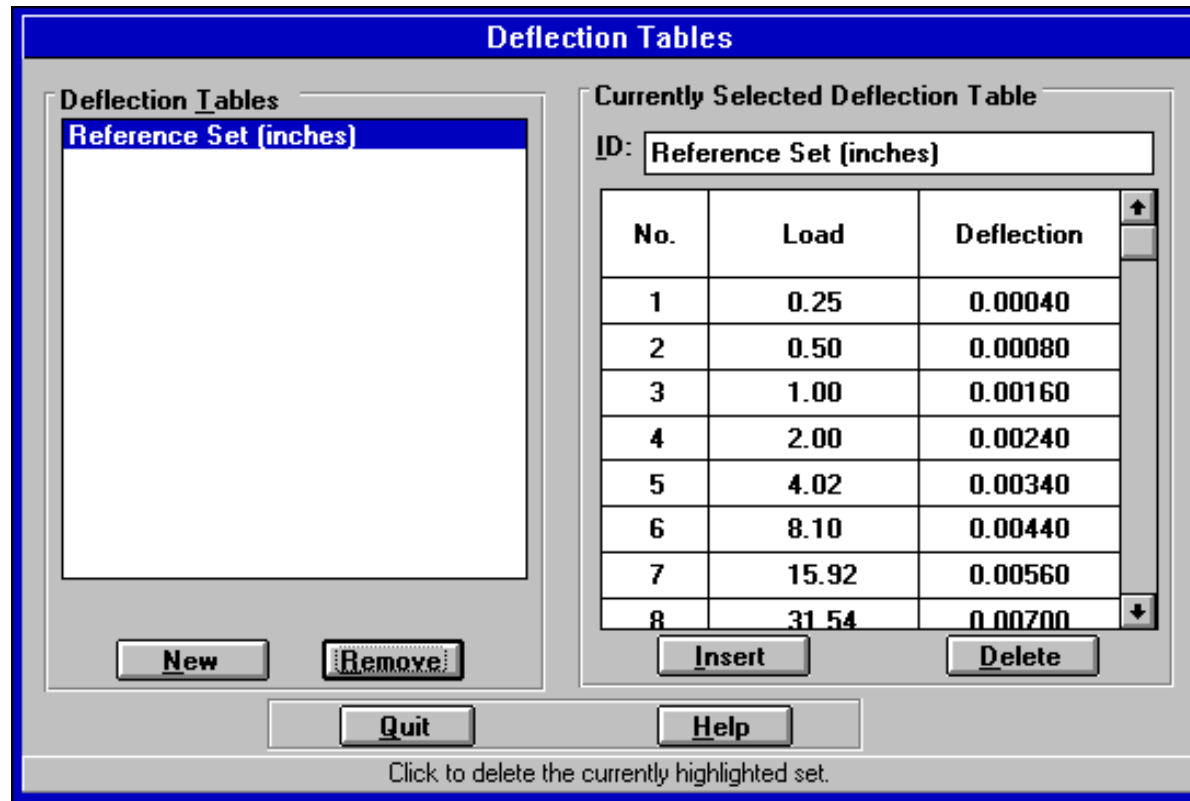
Report Form: The program features several unique formats for presenting the time-rate curves in hardcopy form. Examples of each of the report formats listed in the **Report Form** box may be found in Appendix A.

Report Title: Each hardcopy time-rate report form includes a common title that may be modified by the user.

2.2 Deflection Tables

Because the loading frame can deform when subjected to increasing stresses, the ASTM D 2435 specification requires that a table of loading frame deflections be generated for the various loading pressures to be utilized in the consolidation test: The deflections are taken using a non-deformable disk in place of the sample, along with (optionally) filter papers if they will be used in the actual test. Deflection tables are stored in a database by the program so that they may be shared between tests that use the same loading frame and loading sequence.

To view or edit the program's database of deflection tables, select "Edit" from the "Deflection Tables" box in the General Setup dialog panel ([Section 2.1.1](#)), or from the "Deflection Table" prompt on the Test Parameters dialog ([Section 3.1.2](#)).



Deflection Table Dialog

Current deflection tables are shown in the **Deflection Tables** panel. The **New** button at the bottom of the panel causes the program to create a new deflection table, and the **Remove** button deletes the currently highlighted deflection table.

To view or edit an existing deflection table, click on the table ID in the **Deflection Tables** panel.

Deflection Table Prompts:

ID: Each deflection table must be associated with a unique ID or description so that the user may select the table from a list of deflection tables stored in the system. Enter anything into this field, as long as it is unique from the other ID's shown in the **Deflection Tables** panel.

When entering pressures into the deflection table, use the stress units that will be used to enter loading pressures for tests that will utilize the new deflection table.

Pressure: Enter each loading pressure used in the calibration procedure **in order of application**. Note that if an unload and/or reload cycle was included as part of the calibration, the table will feature multiple entries for the same loading pressure (one for the initial loading, one for the unload, one for the reload, etc.). This is acceptable: When the table is applied to a consolidation test, the program will determine which of the calibration entries will be used for a given loading increment based upon whether or not the increment was in an initial loading cycle, an unloading cycle, or a reloading cycle.

Note that the loading increment immediately prior to a water-added cycle and the actual water-added cycle share the same loading pressure and deflection: enter a pressure/deflection line for the loading increment immediately prior to the water-added cycle; do not enter a line for the actual water-added cycle.

Deflection: Enter the reading on the dial gauge after the given pressure was applied. **Note that the dial gauge must be zeroed prior to starting the calibration procedure.** Use the same measurement units (cms. or inches) that will be used during the actual consolidation tests utilizing the new deflection table.

NOTE: all deflection readings should be positive. If the dial gauge DECREASES with compression, enter the deflection as the (positive) amount of deflection.

2.3 Consolidometer Tables

Several properties are common to all tests run with a given consolidometer rig, including the diameter and height of the consolidometer, the drainage path and the direction of change for the dial gauge. These properties are stored in the *consolidometer table*, from which the user must select an entry for each new swell or consolidation test performed. (Multiple consolidometers featuring the same diameter, height, drainage paths and dial change directions may be incorporated into a single entry in the table).

Consolidometers				
Currently Selected Deflection Table				
No.	Height	Diameter	Dial Change with Compression	Drainage Path
1	1.000	2.500	Decreasing	Double
2	1.000	2.500	Decreasing	Double
3	1.000	2.500	Decreasing	Double
4	0.750	0.000	Increasing	Double
5	2.489	5.893	Decreasing	Double
6	1.000	2.500	Decreasing	Double
7	1.000	2.500	Decreasing	Double
8	1.000	2.500	Decreasing	Double
9	1.000	2.500	Decreasing	Double
10	1.000	2.500	Decreasing	Double

Consolidometer Table Dialog

To input a new consolidometer type, select Window, Test Parameters, and click on the “Edit” button next to “Consolidometer No.” ([Section 3.1.2](#)), or select “Edit” from the “Consolidometer Tables” box in the General Setup dialog panel ([Section 2.1.1](#)). The program supports a fixed set of consolidometers: to create a new entry, change one of the existing consolidometer types. Begin entering data by clicking on the “Height” column.

Consolidometer Table Columns:

Height, Diameter: Enter the height and inside diameter of the consolidometer ring. (The height is used only to provide a default value for the **Sample Height** prompt in the Test Parameters dialog.)

Note that the measurement units used for the sample height and diameter must be identical to the measurement units to be utilized in consolidation tests that will use the consolidometer: e.g. if measurements for the consolidation tests will be taken in inches, enter the consolidometer height and diameter in inches. If the same consolidometer will be utilized for tests measured in inches AND for tests measured in centimeters, two separate consolidometer types must be created: enter one type using centimeter dimensions and the second using inches, then select the appropriate consolidometer on a test-by-test basis.

If the consolidation test is to be performed directly within a ring-lined sampler without trimming, enter 0 as the consolidometer diameter: The program will assume that the diameter of the sample during the consolidation test is identical to the value entered as the **Untrimmed Sample Diameter** in the Test Parameters dialog.

Dial Change With Compression: The program supports dial gauges that read increasing values as the sample is compressed and gauges that read decreasing values as the sample is compressed. Select the correct option from the list. **If an incorrect selection is made, the compression vs. log(pressure) curve for tests utilizing the consolidometer will appear upside-down.**

Drainage Path: If a porous stone was utilized on both faces of the test sample select *Double*; otherwise, select *Single*.

3. Test Data Entry and Modification

To begin entering data for a swell or consolidation test, start by following the steps outlined in [Section 3.8](#) or [Section 3.9 of the GDM manual](#) for creating and revising a sample. When the appropriate sample window is displayed, double-click on "Swell/Consolidation" in the Test Modules panel. (To edit the CONS data already entered for a given sample, follow the steps outlined in [Section 3.9 of the GDM manual](#) to re-edit the sample then click on "Swell/Consolidation".)

3.1 Test Parameters

If swell/consolidation data for the selected sample have not yet been entered, CONS will begin the data entry process by displaying the Test Parameters dialog shown below. (When revising data, the same dialog may be viewed by selecting Window, Test Parameters from the Test Readings screen discussed in [Section 3.2](#).)

Test Parameters			
Close Edit Help			
General Sample Information			
Liquid Limit:	<input type="text"/>	Plasticity Index:	<input type="text"/>
USCS:	<input type="text"/>	AASHTO:	<input type="text"/>
Figure No.:	<input type="text"/>		
Testing Remarks:	<input type="text"/>		
Test Specific Data			
Deflection Table:	<input type="text" value="Reference Set (inches)"/>	<input type="button" value="Edit"/>	
Consolidometer No.:	<input type="text" value="18"/>	<input type="button" value="Edit"/>	Sample Height at Test Start (in.): <input type="text" value="1"/>
Overburden Pressure (tsf):	<input type="text"/>	Time Values Entered As:	<input type="text" value="elapsed time"/>
Initial (Untrimmed) Sample Data		Post-Test Sample Data	
Wet Weigh+Tare (gm.):	<input type="text" value="949.7"/>	Height (in.):	<input type="text" value="1"/>
Dry Weight+Tare (gm.):	<input type="text" value="914.8"/>	Diameter (in.):	<input type="text" value="2.841"/>
Tare Weight (gm.):	<input type="text" value="737.2"/>	Weight (gm.):	<input type="text" value="212.5"/>
Specific Gravity:	<input type="text" value="2.752"/>	Use Final Weight of Solids? <input type="checkbox"/>	
Initial Calculated Values		Final Calculated Values	
Moisture = 19.6%		Est. Weight of Solids = 177.66 gm.	
Wet Density = 127.7 pcf		Est. Height of Solids = 0.6215 in.	
Dry Density = 106.8 pcf		Void Ratio = 0.609	
		Saturation = 88.7 %	
Press Tab to change fields; select Help for editing keys			

CONS Test Parameters Dialog

Three categories of sample test data are entered into the dialog: the *Untrimmed Sample* data, the *Test Specific* data and the *Post-Test* data. Also included are prompts for entering general information concerning the sample, such as the sample's liquid and plastic limit, the soil classification, etc.

3.1.1 General Sample Information

Swell/consolidation reports include information that is neither part of the actual swell/consolidation testing data (e.g. the weight of the trimmed sample), nor part of the program's calculated data (e.g. the calculated final void ratio). This information, termed the *general sample information*, varies according to which report format is selected; i.e. some forms may include a place for listing the sample's USCS classification, while other forms may omit this information. (Refer to Appendix A for a list of available report forms, and to [Sections 2.1.4](#) and [2.1.5](#) for instructions on selecting a new form.) General sample information is entered into the *General Sample Information* box.

Some items in the General Sample Information box may be automatically filled in by other data reduction modules (for example, the sample's USCS classification may be determined by the Classifications module). Leave these items blank as they will be completed by the appropriate module. Other items, such as the testing remarks, will need to be entered manually. For further instructions on entering this information, refer to [Section 3.6 of the GDM manual](#).

3.1.2 Test Specific Data

Deflection Tables, Section 2.2 .
--

Deflection Table: Because the loading frame can deform when subjected to increasing stresses, the ASTM Consolidation test specification requires that a table of loading frame deflections be generated for the various loading stresses to be utilized in the consolidation test: The deflections are taken using a non-deformable disk in place of the sample, along with filter papers, if they will be used in the actual test. Deflection tables remain entered into the program indefinitely, so if a table appropriate to the current loading frame and loading sequence has already been entered, it need not be entered again; instead, select the table from the list shown next to the “Deflection Table” prompt. To enter a new table, click on the “Edit” button next to the “Deflection Table” prompt then enter the new deflection table. After the new table has been entered, make sure to select it from the “Deflection Table” prompt.

If a deflection table was not taken, select (*none*) from the list shown next to the “Deflection Table” prompt.

Consolidometer Tables, Section 2.3 .
--

Consolidometer No.: Several properties are common to all tests run with a given consolidometer rig, including the diameter and height of the consolidometer, the drainage path, and the direction of change for the dial.

For a new consolidometer, click on the “Edit” button next to the “Consolidometer No.” prompt then enter the consolidometer parameters. Because these tables are permanently stored by the program, after a table has been entered, for subsequent tests the user may simply enter the appropriate table number at the “Consolidometer No.” prompt.

Sample Height at Test Start: Enter the *trimmed* height of the sample at the start of the test.

The trimmed *diameter* of the sample is assumed to be equal to the diameter of the consolidometer ring as entered into the consolidometer table selected for use with the test.

Overburden Pressure: This is an optional parameter used to indicate the pressure exerted by the overburden material on the sample: If entered, the pressure is used by the program in recompression index calculations (as discussed in the [Technical Documentation chapter](#)). Leave the prompt blank if the pressure was not recorded.

Time Values Entered As: For the entry of loading increments where time-rate data are desired the program will accept time readings as either the decimal number of minutes elapsed since the start of the current loading increment (e.g. 1.5 min), or the current clock time in 24-hour format (e.g. 01:23:24). This selection must be made before data for any loading increments have been entered - changing the selection after time-rate readings have already been entered will cause existing readings to be erased.

If time-rate data (D_{100} and C_v values) are not desired and the user intends to enter just initial and final time/dial readings for each loading increment, the "Elapsed Time" option should be selected.

3.1.3 Initial (Untrimmed) Sample Data

Enter all weights in grams.

Wet Weight+Tare, Dry Weight+Tare, and Tare Weight: These values are used to determine an initial (natural) moisture percentage for the sample. Note that the weights are not the weights of the sample to be used in the consolidation test; rather, they are from additional material sampled from the same location as the consolidation test sample. If more than one moisture content test was performed, select the data from the test most representative of the consolidation sample.

Untrimmed Sample Height, Weight and Diameter: These values may actually be either from the untrimmed sample, or from the trimmed sample, as long as all three are from the same source (trimmed or untrimmed). The weight, height and diameter values are used to calculate the initial (natural) density.

Specific Gravity: This parameter is optional; however, if it is left blank, the program will not calculate void ratios.

3.1.4 Post-Test Sample Data

The post-test sample weights are optional items - these prompts may be left blank if the sample was not weighted after the completion of the consolidation test. If entered, the program will utilize them to calculate the final weight of solids and final moisture content.

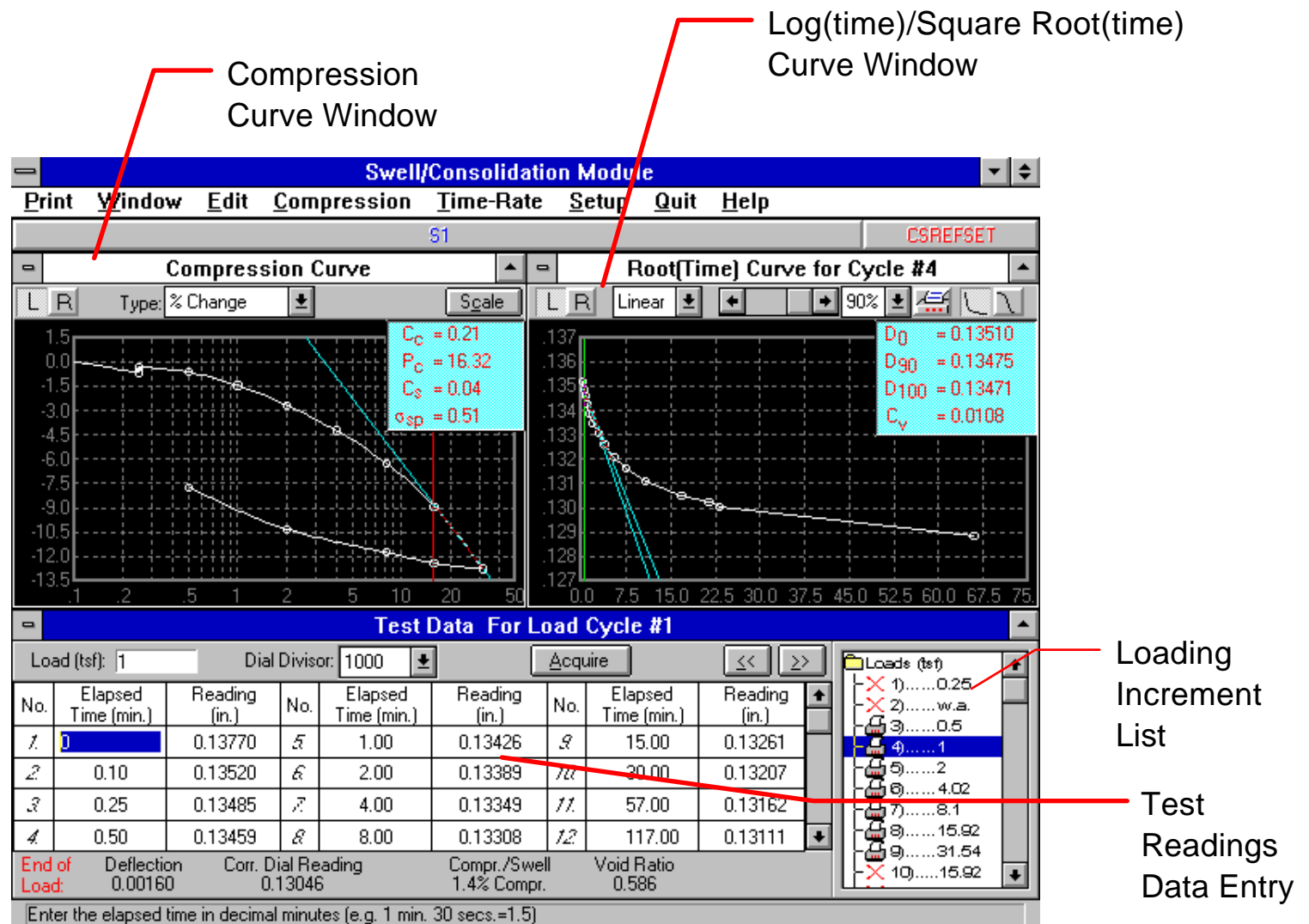
If the post-test sample weights are entered, the user may opt to have the program utilize the final weight of solids in all calculations involving the weight of the consolidation test sample: do this by checking the **Use Final Weight of Solids?** box.

If the “Use Final Weight of Solids?” box is to be selected, the final moisture content test must have been run using the *entire* sample that was utilized in the actual swell/consolidation test.

If the post-test weights aren't entered, or if the “Use Final Weight of Solids?” box isn't selected, then the program will utilize an estimated weight of solids based upon the dry weight of the untrimmed sample multiplied by the ratio of the volume of the untrimmed sample to the volume of the trimmed sample.





3.2 Readings Data Entry/Curve Display Screen

The readings data entry/curve display screen consists of the compression curve window, the $\log(\text{time})/\sqrt{\text{time}}$ curve window, and the test readings data entry window. These windows allow the user to enter data and view graphed results all on the same screen.



Test Readings/Curve Display Screen

Note that only one window at a time may receive input from the keyboard: this window is called the “focus” window, and has a title bar shown in blue and white (using the default Windows coloring scheme). Switch focus from one window to another by clicking the left mouse button once while the mouse pointer is in the title bar of the window you want to activate, or select the appropriate window from the Window menu.

Each of the windows on the test readings screen can be maximized to the full size of the screen by clicking on the  (or  in Windows95) button shown in the top right-hand corner of the window. Reduce the window to its original size by clicking on the *lower*  (or  in Windows95 button.

3.2.1 Menu Selections

Print menu selections:

Test Reports - begins the process of printing or previewing test reports by displaying the print selection dialog. Refer to [Section 4.2](#) for details on this option.

Test Summary - begins the process of printing test summaries. Refer to [Section 4.1](#) for details on this option.

Window menu selections: lists the four available windows on the test readings data entry screen. Selecting a window from the list will shift the focus to that window.

The window that currently has the focus is listed next to a check mark.

Edit menu selections: The edit menu allows you to make additions or deletions to be made to the data entered into the test readings window.

Note that this menu may also be displayed by clicking the right mouse button anywhere within the test readings data entry window.

Insert a Readings Line - this menu option allows the insertion time/dial reading data into an existing loading increment. To do this, position the cursor at the beginning of the line that will appear AFTER the line to be inserted, and select Insert a Readings Line.

Delete a Readings Line - this option allows you to remove a line of time/dial reading data. To do this, make sure that the data entry cursor is within the time/dial reading pair that is to be deleted and select Delete a Readings Line.

Insert a New Loading Increment - this option allows the insertion of a new loading increment BEFORE the current loading increment. To do this, make sure that the appropriate increment is currently displayed, (i.e. the increment that will appear immediately AFTER the new increment), then select Insert a New Loading Increment.

Delete Current Loading Increment - this option deletes the currently displayed loading increment.

Compression menu selections:

Note that this menu may also be displayed by clicking the right mouse button anywhere within the compression curve window.

% Strain

Void Ratio

Deformation - selecting one of these menu items changes the compression curve window to display %strain, void ratio or deformation versus log(pressure). Note that this selection also determines which type of compression curve is included on hardcopy reports.

1 Adjust Cc Tangent, Left End

2 Adjust Cc Tangent, Right End - selects which end of the compression curve tangent line (used for calculating Cc) is currently being adjusted. (The current end is listed next to a check mark.) For further information, refer to [Section 3.2.4](#).

Add Shaping Point

Delete Shaping Point

Return to Original Curve - “shapes” the compression curve. Refer to [Section 3.2.4](#) for further details.

Setup - displays the setup dialog (see [Section 2.1](#)).

Quit - closes the CONS module and returns to GDM.

Time-Rate menu selections:

Note that this menu may also be displayed by clicking the right mouse button anywhere within the time-rate curve window.

Square-Root(time) -

Log(time) - selects which of two display methods will be used for the *currently displayed* loading increment. See [Section 3.2.3](#).

Include This Curve on Printouts

Omit This Curve From Printouts - selects whether or not the currently displayed loading increment will be printed as part of any hardcopy time-rate chart reports.

Previous Loading Increment

Next Loading Increment - displays data for the previous and next loading increments.

In addition to the menu items listed above, the Time-Rate menu also includes some items which are available only if the current time-rate curve display method is log(time), and items which are only available when displaying a square-root(time) curve. A list of these options and their explanations is provided below.

Square-root(time) menu items:

Fitted Curve

Linear Curve - the user has the option of having the program either generate a mathematically modeled curve based upon the time/dial readings for the current loading increment, or just draw a series of straight lines between successive time/dial reading points. For further information, refer to [Section 3.2.3](#).

Adjust Cv Construction Left End

Adjust Cv Construction Right End - selects which end of the C_v construction line may be adjusted. See [Section 3.2.3](#).

Log(time) menu items:

Construction Determines D0

Reading at Time=0 Determines D0 - determines whether D_0 , the initial dial reading, is determined mathematically or is just taken as the actual initial dial reading.

Adjust Cv Primary Line, Left End

Adjust Cv Primary Line, Right End

Adjust Cv Secondary Line, Left End

Adjust Cv Secondary Line, Right End - selects which of the two C_v construction lines may be adjusted, and which end of that line will be adjusted. See [Section 3.2.3](#) for details on these options.

3.2.2 Test Data Entry Window

Next load button

Loading increment list

Test readings grid

Current increment summary

No.	Elapsed Time (min.)	Reading (in.)	No.	Elapsed Time (min.)	Reading (in.)	No.	Elapsed Time (min.)	Reading (in.)
1	0.00	0.14151	17			33		
2	0.10	0.14007	18			34		
3	0.25	0.13995	19			35		
4	0.50	0.13977	20			36		
5	1.00	0.13969	21			37		
6	2.00	0.13955	22			38		
7	4.00	0.13934	23			39		
8	8.00	0.13919	24			40		
9	15.00	0.13903	25			41		
10	30.00	0.13882	26			42		
11	60.00	0.13856	27			43		
12	117.00	0.13838	28			44		
13	235.00	0.13818	29			45		
14	480.00	0.13805	30			46		
15	1455.00	0.13770	31			47		
16			32			48		

End of Load: Deflection 0.00080 Corr. Dial Reading 0.13850 Compr./Swell 0.6% Compr. Void Ratio 0.599

Enter the elapsed time in decimal minutes (e.g. 1 min. 30 secs.=1.5)

Test Data Entry Window

Pressing Ctrl-PgUp and Ctrl-PgDn while the focus is on the Test Data Entry window scrolls through the list of loading increments.

Swell/Consolidation tests are composed of *loading increments*, which consist of loading pressures along with at least two time/dial reading pairs - an initial time at 0 minutes and the dial reading prior to the application of the loading pressure, and the elapsed time (in decimal minutes or clock time) at the end of the test along with the dial reading at the end of the test. *Intermediate* time and dial readings may be entered for some or all loading increments if the user would like to obtain C_v values for these increments.

The term “loading increment” is used generically to indicate both loading and unloading increments.

Begin entering data for a loading increment by specifying the loading pressure in response to the "Pressure:" prompt. Make sure that the correct stress units are displayed next to the prompt - if they aren't, choose the Setup menu option, then select the appropriate units from the General Setup panel ([Section 2.1.1](#)).

Saturation cycles are entered by typing a "**w**" or "**s**" in response to the "Pressure:" prompt, then pressing ENTER. This indicates to the program that the loading pressure has not changed, but that the current increment consists of readings taken following the addition of water to the sample.

Each test may be set up to accept either 24-hour clock times or elapsed times: the choice is made from the Test Parameters dialog discussed in [Section 3.1](#). The column headings on the test readings grid indicate which option was chosen for the current test:

Elapsed Time indicates that the program expects times to be entered as the decimal number of minutes (e.g. 1 min. 30 seconds should be entered as "1.5") elapsed from the application of the current loading pressure. Elapsed times may be entered with a precision of .01 minutes.

24 Hr. Clock indicates that times are to be entered as 24 hour clock readings rounded to the nearest second (e.g. 1:00 PM should be entered as "13:00:00"). After the initial clock reading for each loading increment, the user must also enter the number of days elapsed since the application of the current loading pressure. These times are entered as "+DD HH:MM:SS" - "DD" is the number of complete days elapsed since the application of the current loading pressure, "HH:MM:SS" is the current clock time, again, in 24-hour format. Note that the program will automatically enter the "+", " " and ":" symbols: "+01 13:23:12" should be typed as "01132312".

Note that the program does not recognize daylight-savings time changes. The user must manually add or subtract an hour from clock times taken after the time change ONLY during the loading increment being processed during the time change. Clock times for subsequent loading increments may be entered as-is.

Dial readings may be entered with a precision of up to .00001 inches or centimeters. The program includes an automatic *dial divisor* option designed to save a few keystrokes per reading: with the selection of the appropriate divisor, the user can enter "2631" instead of "0.2631". Once each reading is entered, the program divides the number entered by the divisor to obtain the true dial reading. Select an appropriate divisor from the "Dial Divisor" selection box shown in the data entry window's toolbar. If "1" is selected as the dial divisor, the program will expect that actual dial readings will be entered.

The first time/dial reading pair entered in the test readings grid should be at time=0: the dial reading should be identical to the final dial reading taken on the previous loading increment; for the first loading increment, enter the initial reading on the dial prior to the application of *any* pressure.

For tests without time-consolidation data, enter F in the second line of the table for the elapsed time (the program will display "final" for the time), then enter the final dial reading. (After doing this once, CONS will assume that subsequent loading increments will only include the final dial reading, automatically display "final", and jump directly to the readings column.)

Note that this option is valid only when entering elapsed times (as opposed to 24-hour clock readings).

After the final dial reading has been entered for the loading increment, pressing Enter twice will begin a new loading increment.

When entering time-rate data for C_v calculations, the user should check the time-rate curve display window to make sure that the C_v constructions for the current loading increment have been properly placed prior to starting a new loading increment.

To create a saturation cycle, enter all of the time/dial reading pairs taken for the loading increment prior to the addition of water, then start a new loading increment. Enter a "W" or "S" as the loading pressure for the new increment, then enter the time/dial readings taken between the time the water was added and the application of the next loading pressure.

The Loading Increment List

On the right-hand side of the test data entry window the program maintains a list of the loading increments entered into the current test file. A symbol is shown to the left of each increment in the list; the symbol indicates the following:

 This indicates that the corresponding time-rate curve will be included on hardcopy reports that include time-rate curves.

✗ This indicates that the corresponding time-rate curve will NOT be included on hardcopy reports. There are three possible reasons for this condition:

1. The user manually selected the “DO NOT PRINT” time-rate toolbar button.

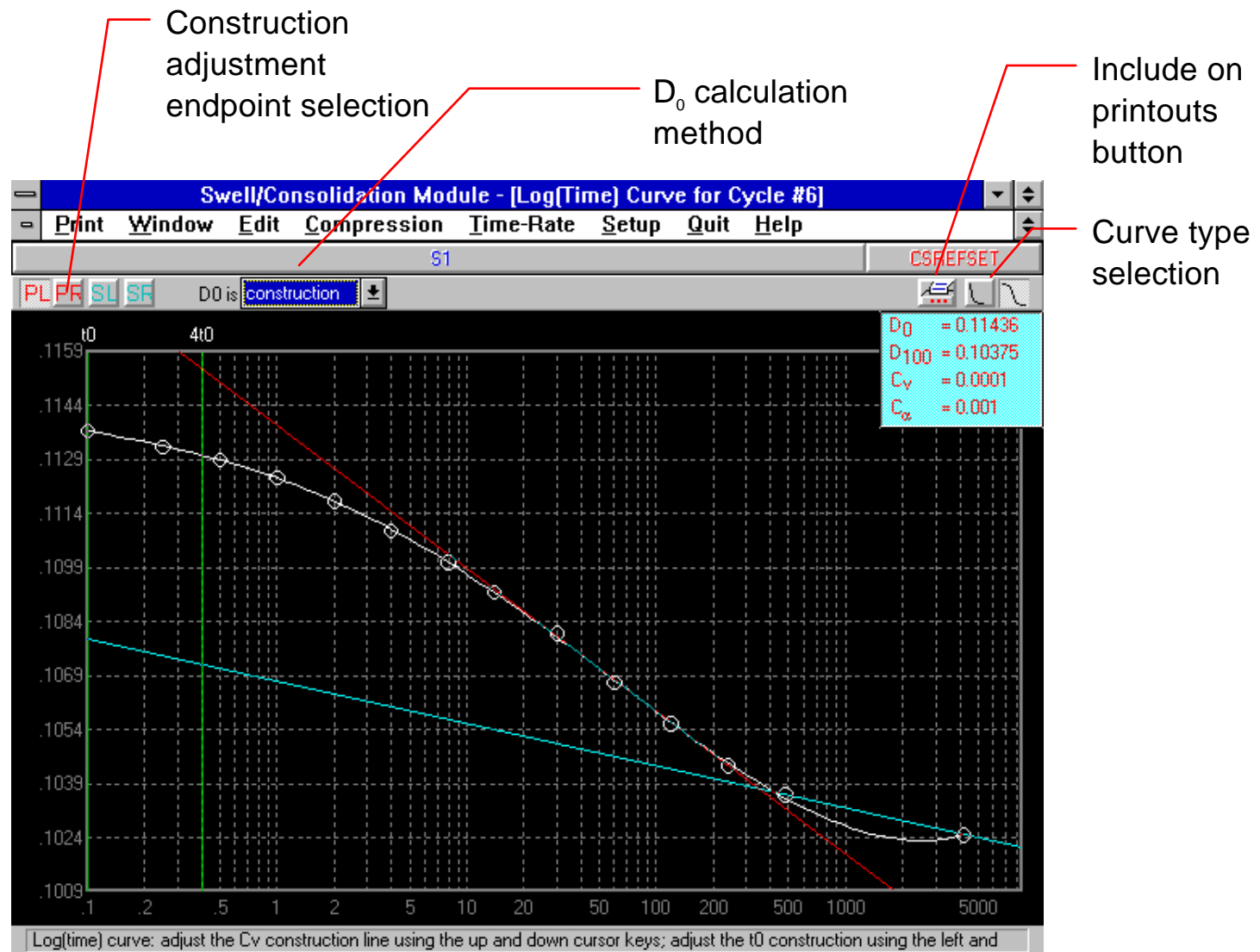
2. The program was unable to calculate a C_v value for the corresponding loading increment. If the C_v value shown in the time-rate curve display's status window reads "n/a", then the program could not calculate a valid C_v value--this is usually due to a problem with the adjustment of the C_v construction lines.
3. The time-rate curve has not been viewed on the screen. If a change is made to the data in the test's parameters window, or if the loading increment was acquired from an external data file (this is an optional feature), then the time-rate curve for the loading increment must be viewed on the screen prior to printing. (To view the curve, follow the instructions below.)

To view the data and time-rate curve for a loading increment, click the left mouse button with the mouse cursor located on the appropriate increment in the loading increment list.

3.2.3 Time-Rate Window

The ASTM consolidation test specification provides two methods of displaying time-rate test data: dial readings vs. $\log(\text{time})$ and dial readings vs. $\text{square-root}(\text{time})$. CONS supports both methods: the user may specify which method the program defaults to when a new loading increment is entered through the Time-Rate Curves panel in the Setup dialog ([Section 2.1.3](#)); once a loading increment has been entered, the user may switch between $\log(\text{time})$ and $\text{square-root}(\text{time})$ through the Time-Rate menu, or through buttons on the time-rate windows' toolbars, discussed in the following sections. Note that the curve display method may be selected individually for each loading increment.

Log(Time) Curve



Log(time) Window

The log(time) window displays a graph of dial reading vs. \log_{10} (elapsed time). The purpose of this window is to allow the user to adjust the construction lines used to determine D_0 , D_{100} and C_v for the current loading increment.

Note that the C_v value is presented in the units selected from the time-rate curves panel of the setup dialog. All other calculated values and scales are displayed in the units selected to represent entered data.

C_v Construction Adjustment

The log(time) method requires the placement of a line tangent to the steepest portion of the time-rate curve (called the *primary* construction line), and a second line tangent to the final readings which represent a straight-line trend (called the *secondary* construction line). The intersection of these two lines represents D_{100} .

Make sure that the time-rate display window has the “focus” prior to attempting to adjust the C_v constructions. (See [Section 3.2.](#))



These two lines may be moved one end at a time by using the up and down cursor keys. Use the End key to alternate between moving the left and right ends of each line. The four buttons labeled "PL", "PR", "SL" and "SR" window's toolbar indicate which end of which line is currently being adjusted: when the "PL" button is depressed, the left endpoint of the primary construction line may be moved, "PR" depressed means that the right end of the primary construction line will be moved, etc. **A finer adjustment may be obtained by pressing the Shift key in conjunction with the up and down cursor keys.**



The intersections between the construction lines and the curve are shown in red as an aid to properly placing the tangents.

To determine D_0 the program requires an additional construction consisting of two vertical lines labeled "t0" and "4t0". These lines represent a time ratio of 1 to 4 on the curve: D_0 is taken as the dial reading at time "t" minus the difference between the dial readings at "4t" and "t". Adjust the location of the interval using the left and right cursor keys - *note that the program will not allow the interval to end at a time corresponding to less than 1/4 of the total deformation for the loading increment or at a time corresponding to greater than 1/2 of the total deformation.* Again, a finer adjustment may be obtained by pressing the **Shift** key in conjunction with the left and right cursor keys.

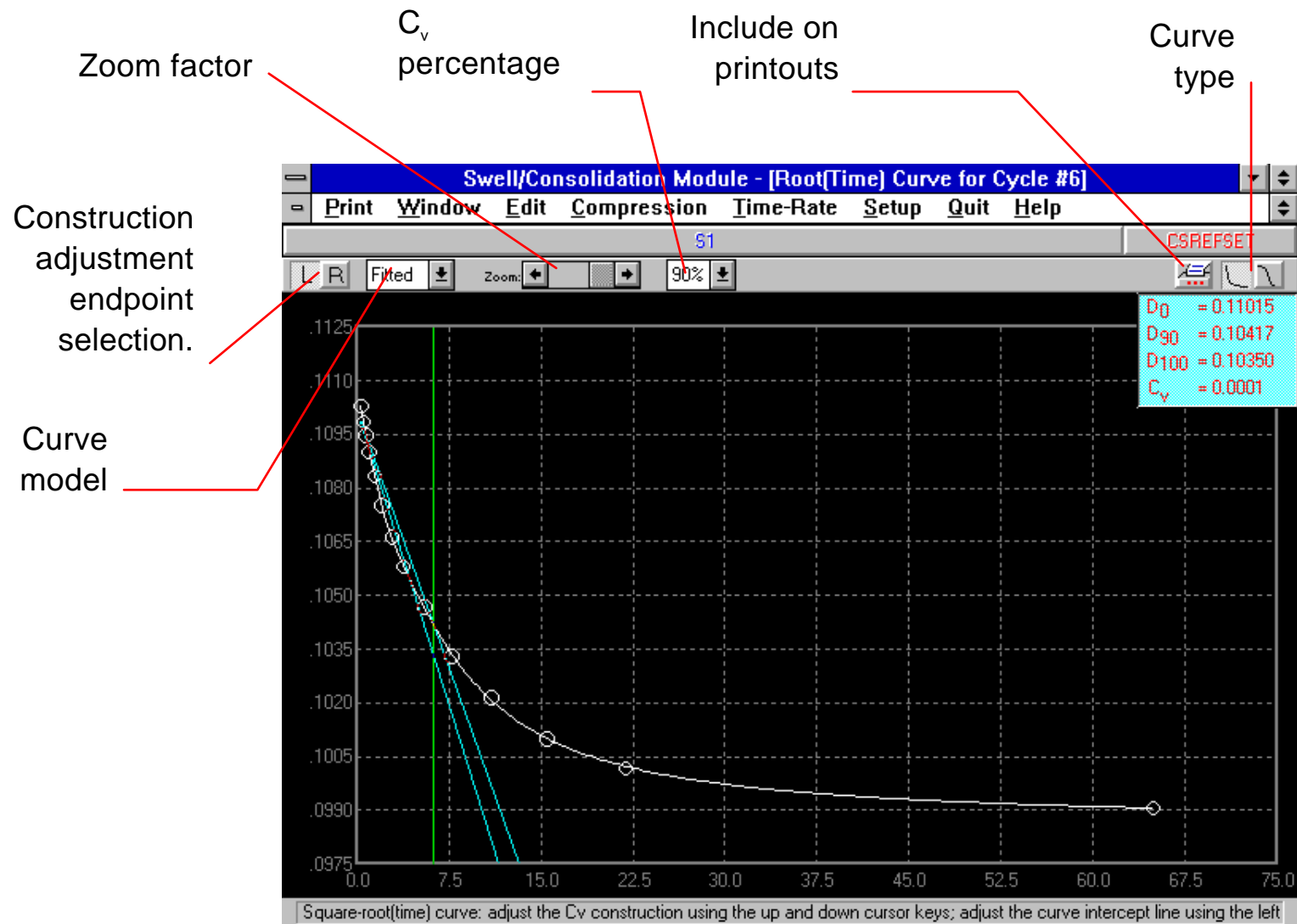
The time interval construction will only appear if the selection box shown in the window's toolbar indicates that D_0 is "construction".

Toolbar Objects

-  These buttons select which end of the C_v construction lines may currently be adjusted. (Refer to the previous section.)
- The selection box labeled "D0 is" determines whether D_0 is determined using the interval construction discussed above, or taken to be the actual dial reading at the time the current loading pressure was applied. If the D_0 value determined from the interval construction differs significantly from the actual dial reading at time $t=0$, change the selection box to read "initial dial" - the program will use the actual dial reading at time $t=0$ as D_0
-  The printer button indicates whether or not the current time-rate curve and calculated C_v value will be included on hardcopy time-rate printouts. If the icon is shown with a red "X", the curve will not be included as part of the hardcopy time-rate reports.

-  Click on this button to change the time-rate method for the current loading increment to be dial reading vs. square-root(time).
-  This button merely indicates that the current time-rate display method is dial reading vs. log(time).

Square-Root(Time) Curve



Square-Root(time) Display

The square-root(time) window displays a graph of dial reading vs. square-root(elapsed time). The purpose of this window is to allow the user to adjust the construction lines used to determine D_0 , D_{90} and C_v .

Note that the C_v value is presented in the units selected from the time-rate curves panel of the setup dialog. All other calculated values and scales are displayed in the units selected for the inputted data.

C_v Construction Adjustment

C_v constructions are shown as a pair of lines intersecting at D_0 , the program's calculated initial dial reading. The left-most of the two lines should be tangent to the initial points of the curve which indicate a straight line trend. The right-most line has a slope 1.15 times that of the left-most; the intersection of this line with the curve provides T_{90} and D_{90} , the time and dial reading at which 90% of the primary consolidation has been completed.


Make sure that the time-rate display window has the “focus” prior to attempting to adjust the C_v constructions. (See [Section 3.2.](#))

The pair of lines used to determine D_0 may be moved by using the up and down cursor keys. Use the End key to alternate between moving the left and right ends of the lines. The "L" and "R" buttons in the window's toolbar indicate which ends of the lines will be moved: when the "L" button is depressed, the left endpoint of the construction lines may be moved; the right endpoints move when the "R" button is depressed. **A finer adjustment may be obtained by pressing the Shift key in conjunction with the up and down cursor keys.**

The intersection between the C_v construction line and the curve is shown in red as an aid to properly placing the tangent.

The T_{90} intersection is indicated by a vertical line which may be moved left or right by pressing the left or right cursor keys. Again, a finer adjustment may be obtained by pressing the Shift key in conjunction with the left and right cursor keys.

Toolbar Objects




-  These buttons select which end of the C_v construction lines may currently be adjusted. (Refer to the previous section.)

Note that the selection of the curve drawing method has no effect on the calculated D_0 value, and little overall effect on the calculated D_{90} and C_v values. The choice between the linear and fitted methods is mainly made for aesthetic reasons.

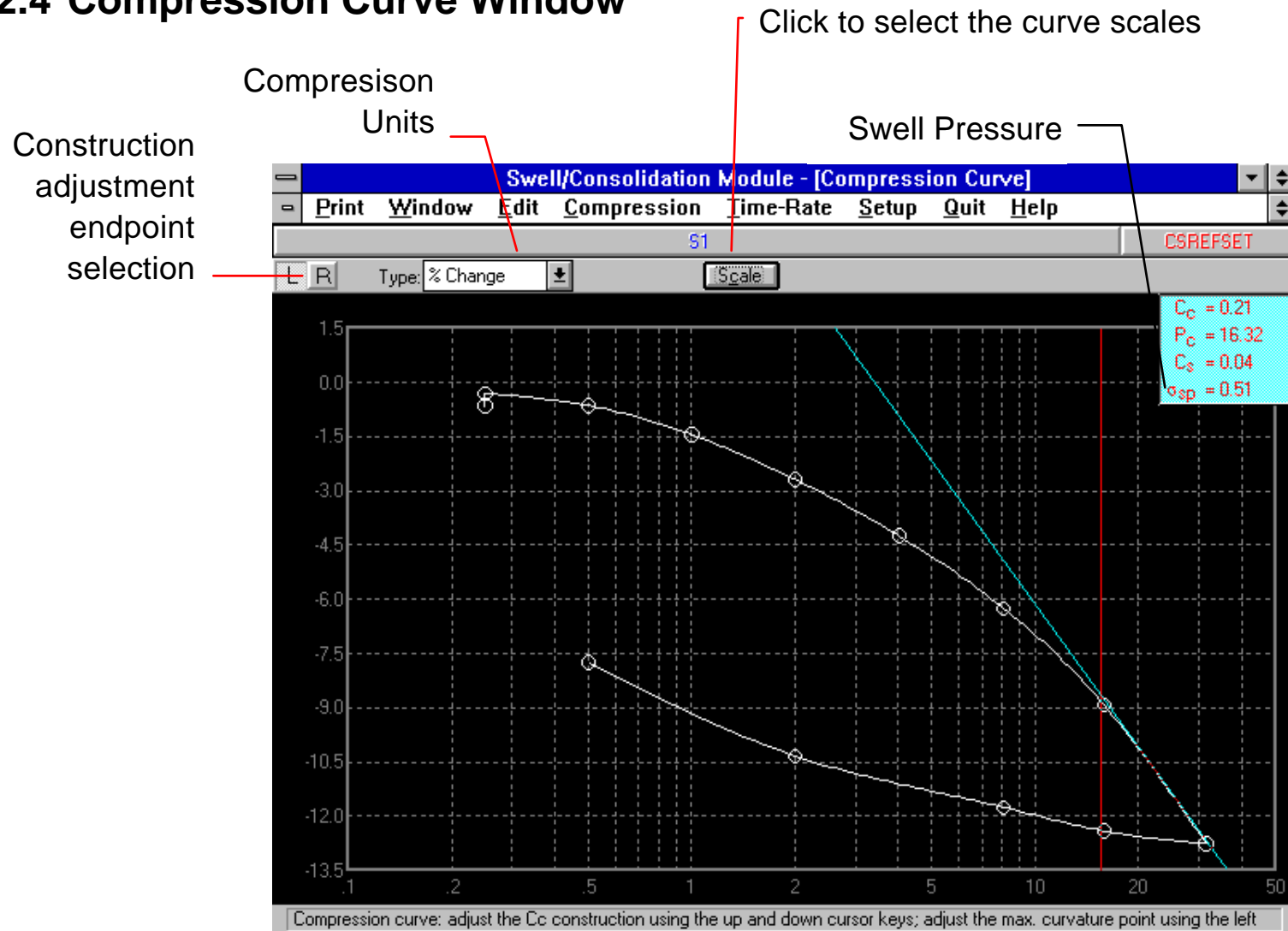
- The selection box listing "Fitted" and "Linear" determines whether the curve is drawn by using a smoothed, mathematically generated shape (i.e. "Fitted"), or as a series of straight lines drawn between readings ("Linear"). Each curve drawing option has its own advantages and drawbacks: The "Fitted" method mathematically smoothes out any time-rate readings that may not lie on an idealized curve form. For example, if the sample quit consolidating temporarily due to friction between the sample and the ring, a couple of data points on the time-rate curve may not accurately follow the actual consolidation curve for the soil. The fitted curve will minimize the effect of problems such as this.

However, because the fitted curve is an artificial model for a physical process, there are curves for which an accurate model cannot be generated. Also, the curve fitting process is much slower than the process of drawing point-to-point (linear) curves: because the "Linear" method simply draws straight lines between adjacent time/dial reading pairs, the time-rate window displays faster. The drawback to the linear method

is that because it incorporates no data smoothing, outlying data points will have a much larger effect over a given section of the curve.

- The "Zoom" scrollbar allows the user to zoom in on the left-hand portion of the curve as an aid in properly placing the C_v constructions. Note that this does not affect any hardcopy views of the curve.
- The selection box listing percentages allows the user to calculate a C_v value at a different percentage of primary consolidation than the default value of 90%.
-  The printer button indicates whether or not the current time-rate curve and calculated C_v value will be included on hardcopy printouts. If the icon is shown with a red "X", the curve will not be included as part of the hardcopy time-rate reports.
-  Click on this button to change the time-rate method *for the current loading increment* to be dial reading vs. log(time).
-  This button merely indicates that the current time-rate display method is square-root(time).

3.2.4 Compression Curve Window



Compression Curve Window

If the curve appears upside-down, see the compression curve FAQs in the [Help! chapter](#).

The compression curve window displays a graph of % change, void ratio, or deformation vs. $\log_{10}(\text{pressure})$. From this window, the user has the option to adjust the construction lines used to determine the preconsolidation pressure (P_c) and compression index (C_c) values, to choose the type of compression graph (%change, void ratio or deformation) and to specify the scales to be used on the graph.

Note that the pressure and deformation scales are shown in the "Output Stress" and "Output Dimension" units selected from the General Setup dialog ([Section 2.1](#)).

C_c and P_c Construction Adjustment

Make sure that the time-rate display window has the “focus” prior to attempting to adjust the compression curve constructions. (See [Section 3.2.](#))

The compression index (C_c) line, shown in cyan, should be tangent to the steep, linear portion of the compression curve. The endpoints of the line may be adjusted individually by using the up and down cursor keys; use the End key to alternate between moving the left and right ends of the line. The "L" and "R" buttons in the window's toolbar indicate which end of the line will be moved: when the "L" button is depressed, the left endpoint of the construction line may be moved; the right endpoint moves when the "R" button is depressed. **Note that a finer adjustment may be obtained by pressing the Shift key in conjunction with the up and down cursor keys.**

As an aid in placing the tangent line, the intersection between the line and the compression curve turns red.

The preconsolidation pressure (P_c) calculation requires the location of the point of maximum curvature on the consolidation curve - this point is automatically chosen by the program and marked with a red vertical line. This location may be adjusted by using the left and right arrow keys; again, note that a finer adjustment may be obtained by pressing the Shift key.

Curve Shaping

Circular markers are plotted on the curve to indicate the calculated compression points; “shaping” points are indicated by crosses.

Once data have been entered, the program will display the compression curve which may be shaped by adding or deleting “shaping” points. These additional points are treated the same as actual test points by the program’s calculation routines. Insert shaping points where there is not enough natural data to provide the shape required of the curve. The following sections discuss the available curve shaping options:

Note that the shaping menu discussed in the following sections may be accessed by clicking the right mouse button anywhere within the curve display screen.

To add a point:

Once started, all shaping procedures may be aborted by selecting the Compression, Return to Original Curve menu option.

The shape of the compression curve may be modified by forcing it to pass through a new point. To do this, select the Compression, Add Shaping Point menu item. The program will respond by highlighting a section of the curve: prior to adding the actual shaping point, the user must select the curve section to which the point will be added (the program breaks the curve up into compression, rebound and recompression sections). Move the mouse until the desired curve segment changes from white to red, then click the left mouse button to select the segment. Next, position the mouse pointer at the desired location for the new shaping point and click the left mouse button again. The new shaping point will be marked with a "+" and the curve will be immediately modified to accommodate the new point.

To delete a shaping point:


To remove a shaping point, select the Compression, Delete Shaping Point menu option.

If the curve contains one shaping point, the point will be immediately removed. If more than a single shaping point has been added to the curve, the shaping point nearest the mouse pointer will be shown with a box around it. Move the cursor until the desired shaping point is highlighted then click the left mouse button. A message will appear noting that the shaping point has been removed.

Removing all shaping points

Selecting Compression, Return to Original Curve removes all shaping points.

Toolbar Objects

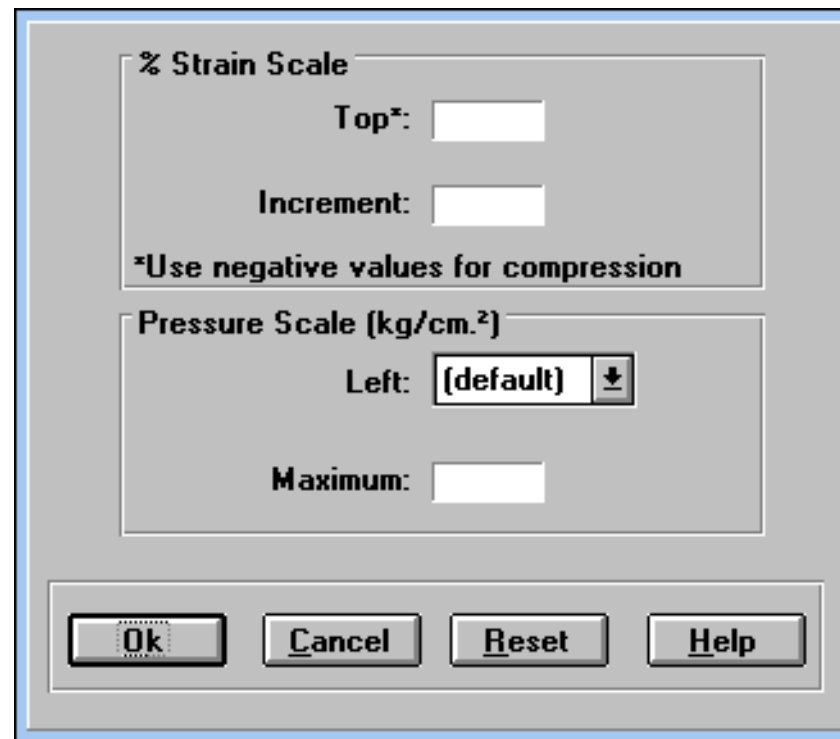
-  These buttons determine which end of the C_c construction line is currently adjustable. (Refer to the previous section on C_c and P_c adjustment for further information.)
- The selection box labeled "Type" allows the selection of one of three units for the deformation scale: % change (in void ratio/sample height), void ratio, or deformation. All are plotted against $\log(\text{pressure})$. Note that this selection does not affect C_c , P_c or C_r .

Note that the void ratio vs. $\log(\text{pressure})$ graph may not be selected if the user did not enter a specific gravity for the current sample (See [Section 1.3.2.](#))

- The "Scale" button allows the user to specify the scales to be used on the compression graph. For further information, refer to the next section.

Setting the Compression Scales

The compression curve scales may be modified by pressing the "Scale" button located on the Compression Curve window toolbar. The program displays a dialog box which allows the user to select the maximum ordinate axis (i.e. % change, void ratio, or deformation) value, the scale increment between two ordinate grid lines, and the minimum and maximum pressures included on the graph.




% Strain Scale

Top*:

Increment:

*Use negative values for compression

Pressure Scale (kg/cm.²)

Left: 

Maximum:

Ok **Cancel** **Reset** **Help**

Compression Curve Scales Dialog

When entering values, make sure to select values appropriate to the selected *output* stress and dimensional units: Keep in mind that these units may be different than the units used to enter the pressure and dial readings: if so, the changed scale values will not be reflected in the on-screen compression curve display. (See General Setup Options, [Section 2.1.1](#), for further information.)

The scale selections may be reset to program-determined default values by either deleting the contents of each data entry field in the scale dialog and setting the minimum pressure scale to "(default)", or by clicking on the "Reset" button.

On % strain scales, if the maximum value is a percent *compression* (as opposed to a percent swell), enter the value as a negative number.

3.3 Editing Data For An Existing Swell/Consolidation Test

To edit swell/consolidation data already entered for a given sample, follow the steps outlined in [Section 3.9 of the GDM manual](#) to re-edit the sample, then click on “Swell/Consolidation” in the Test Modules panel.

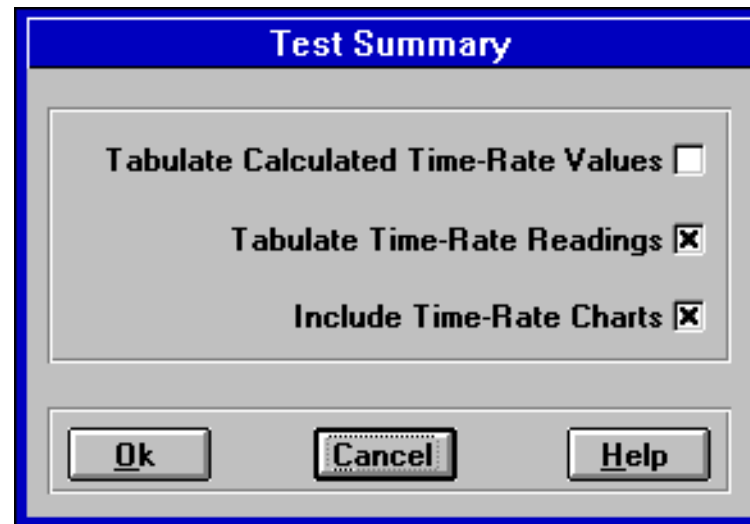
4. Printing Test Summaries and Reports

CONS generates both graphical chart reports and text summaries of the data entered for a single test.

4.1 Printing Test Summaries

As an aid in validating the data entered into the program, CONS includes a facility for printing a test data summary: this is not the same as the data summary tool included with GDM, which has the ability to summarize the data from multiple test types and multiple samples; CONS' data summary merely presents the data that was entered for a single CONS test.

To print a summary for the current swell/consolidation test, select Print, Test Summary from the CONS test readings data entry screen.



Summary Options Dialog

Prior to printing the summary the program displays the *Summary Options* dialog shown above - after selecting the appropriate options, select “Ok” to continue. From this dialog, the following options may be selected:

Tabulate Calculated Time-Rate Values: If this option is selected, then the program will include the C_v and C_α values as part of the "End-of-Load" summary table.

Tabulate Time-Rate Readings: If this option is selected, the program will print a table of elapsed time and dial reading for each loading increment *where intermediate elapsed time/dial reading data were taken*.

Include Time-Rate Charts: Selecting this option causes a miniature chart of dial reading vs. time to be included alongside the elapsed time/dial reading table for each loading increment. Note that this option may only be selected after the "Tabulate Time-Rate Readings" option has been selected.

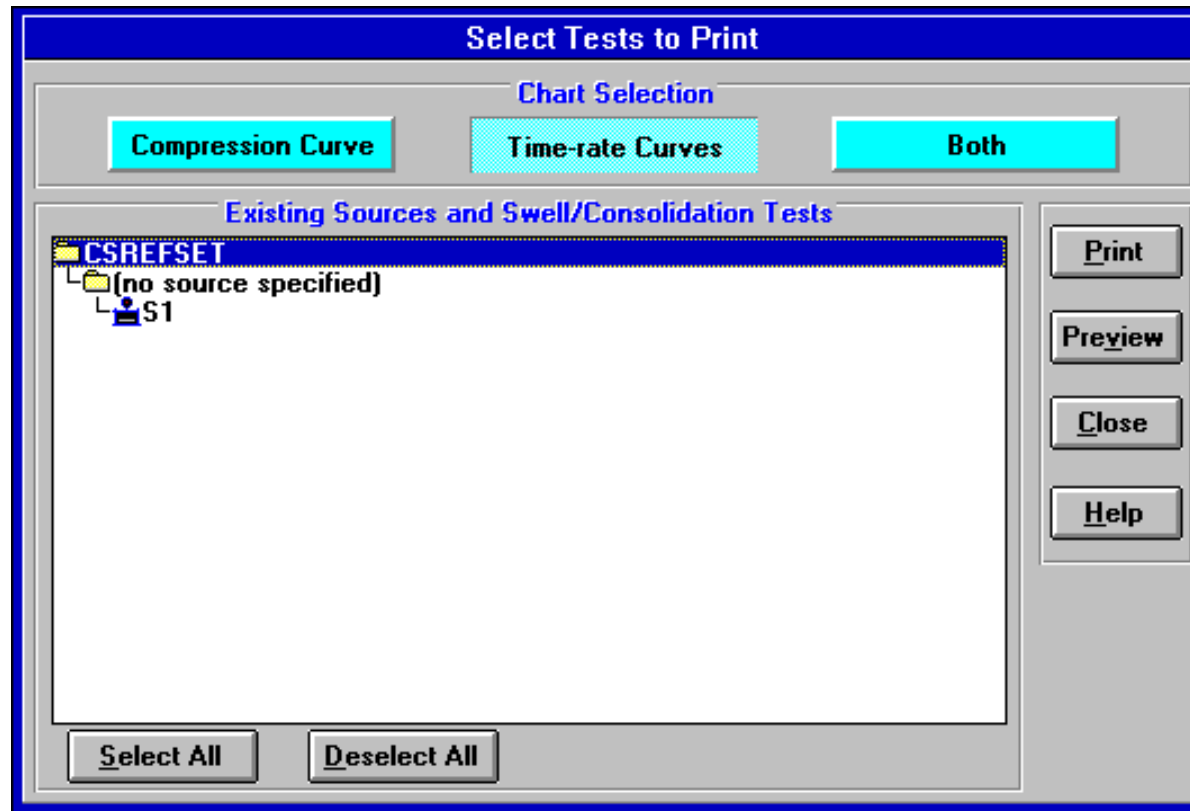
4.2 Printing Test Reports

CONS supports a number of different formats for printing compression and time-rate curves as hardcopy reports - the user may choose between these formats from the program's Setup dialog discussed in [Chapter 2](#). Once the appropriate report format has been chosen, swell/consolidation test reports may be printed through one of the following methods:

- From the GDM main project screen (discussed in [Section 3.7 of the GDM manual](#)), select File, Print Cons Reports.
- Display the sample window for the desired sample (as discussed in [Sections 3.8 and 3.9 of the GDM manual](#)), then right-click on the "Swell/Consolidation" entry in the Test Modules panel, and select Print Test Reports.

This method and the following one automatically select for printing the report that includes the currently selected sample.

- Select Print, Test Reports from the CONS opening screen, as discussed in [Section 3.2](#).



Print Selection Dialog

CONS supports two different types of reports: one showing the compression curve along with an optional table or chart of C_v values, and the second type showing time-rate curves. The user may print either or both types of reports: the buttons at the top of the Print Selection dialog (shown above) control which reports are to be printed. Click on "Compression Curve" to print the compression curve report, "Time-Rate Curves" to print reports showing time-rate curves, or "Both" to print both types of reports.

The "Existing Sources and Swell/Consolidation Tests" lists the sources and CONS tests entered into the current project file. Sample sources are listed next to folder icons: click on a source name to list the swell/consolidation tests associated with the source.

Tests are listed next to CONS icons: click on a test to select that test for printing. Once a test has been selected for printing, the CONS icon listed next to that test is changed into a printer icon: clicking on a test shown next to a printer icon changes the test's status back to "not selected for printing". (Note that, if "Print", "Test Reports" was selected from the CONS data entry screen, the test currently being edited will automatically be selected for printing.)

Clicking on the "Select All" button marks all tests *in the currently open source* for printing; likewise, the "Deselect All" button unselects all tests in the currently open source.

Begin the actual report printing process by clicking on the "Print" button, which prints the reports on the currently selected printer, or by clicking on the "Preview" button, which displays the reports on-screen.

Examples of the report formats supported by the program are presented in Appendix A.

5. Technical Specifications

The following chapter details the calculations employed by CONS to produce the results listed on the program's output. Units are omitted from the following sections for simplification.

5.1 Calculation of Specimen Parameters

Moisture, density, initial void ratio and saturation values are calculated from the measurements on the sample. There are some variations among laboratories in the procedures followed when recording these measurements. Briefly, the different procedures handled by the program and what effect they have on calculations are as follows:

1. The dimensions and weight of a larger sample, not the actual test specimen, are recorded. The height of the actual test specimen is also recorded and entered in the program. In this case, the weight of the test specimen is found by multiplying the weight of the larger sample by the ratio of test specimen volume to the volume of the larger sample.

Data for procedures 1 and 2 are entered into the “Initial (Untrimmed)” panel in the Test Parameters dialog (Section 3.1.3).

2. The actual test specimen dimensions and weight are recorded and entered in the program. This is the simplest case, and the program calculates the moisture, density, saturation, etc. directly from the measurements. The weight of solids is determined from the test specimen's wet weight and moisture content.

This information is entered into the Test Parameters “Post-Test” panel.

3. As an alternative to using the weight of solids calculated by CONS from the initial specimen, the user may enter a dried post-test specimen weight.

The following sections detail the calculation procedures utilized by the software. Note that the equations assume that dimensions are given in centimeters and weights are in grams. (Unit conversion factors are listed in [Section 5.5](#)).

5.1.1 Moisture Content Determination

The initial (natural) moisture content is calculated as follows:

Initial moisture content:

$$MC_i = \frac{W_{wt} - W_{dt}}{W_{dt} - W_t} * 100\%$$

where:

MC_i = initial moisture content

W_{wt} = weight of wet sample with tare

W_{dt} = weight of dried sample with tare

W_t = weight of the tare

5.1.2 Wet and Dry Density Determination

The initial (natural) wet and dry densities are calculated from the untrimmed specimen as follows:

Wet density:

$$\gamma_{wi} = \frac{W_t}{V_t}$$

where:

γ_{wi} = initial wet density

W_t = specimen weight

V_t = volume

and:

$$V_t = \frac{\pi * (D_t)^2 * H_t}{4.0}$$

where:

V_t = volume

D_t = diameter

H_t = total height

Dry density:

$$\gamma_{di} = \frac{\gamma_{wi}}{(1 + MC_i / 100)} * \left(\frac{D_c}{D_t}\right)^2 * \left(\frac{H_c}{H_t}\right)$$

where:

γ_{di} = total sample dry density

D_c = the diameter of the consolidometer

H_c = the height of the sample in the consolidometer

5.1.3 Void Ratio and Saturation Determination

The initial void ratio and saturation are calculated from the actual test specimen size and weight as follows:

Initial void ratio:

$$e_o = \frac{(H_t - H_s)}{H_s}$$

where:

e_o = initial void ratio

H_t = specimen test height

H_s = height of solids

and:

$$H_s = \frac{W_d / G_s}{A_t}$$

where:

W_d = the weight of mineral solids in the test specimen
(calculated from either the pre-test or post-test sample)

G_s = specific gravity of solids

A_t = the area of the tested specimen
(extracted from the chosen consolidometer table entry)

Void ratios and initial/final saturation values will not be reported for a given sample unless a specific gravity is entered.

Initial Saturation:

$$S_i = \frac{(MC_i * W_d)}{(H_t - H_s) * A_t} * 100$$

where:

S_i = the initial percent saturation

H_t = total sample height

A_t = the area of the tested sample

5.1.4 Post-Test Specimen Calculations

A post-test moisture-content test is not mandatory; however, if performed, and the entire test specimen is used for the moisture content sample, the user may opt to use the resulting final dry weight as W_d .

Final moisture content:

$$MC_f = \frac{W_{wt} - W_{dt}}{W_{dt} - W_t}$$

where:

MC_f = final moisture content

W_{wt} = final weight of wet sample with tare

W_{dt} = final weight of dried sample with tare

W_t = tare weight

Weight of solids (calculated from post-test sample data):

$$W_d = W_{dt} - W_t$$

where:

W_d = weight of solids calculated from the post-test sample

5.2 Intermediate Void Ratio and Percent Strain Calculations

Void ratios and percent strain are calculated at the end of each loading increment using the following equations:

Intermediate Void Ratio

Void ratios subsequent to the initial void ratio are calculated as follows:

$$e_n = e_o - \delta e$$

where:

e_n = void ratio at the end of loading increment n

e_o = the initial void ratio

δe = change in void ratio from the initial (pre-test) sample to the end of load increment n

and:

$$\delta e = \frac{(DR_n - DR_c) - DR_o}{H_s}$$

where:

DR_n = dial reading at the end of the loading increment:

D_{100} , or the final dial reading entered for the increment. (The choice depends upon the “Compression Curve Plots” option discussed in [Section 2.1.2](#))

DR_c = deflection correction (optional), or 0 if D_{100} is used

DR_o = initial dial reading at start of test

H_s = height of solids

Percent Strain:

$$\%S_n = \frac{(DR_n - DR_c) - DR_o}{H_o} * 100\%$$

where:

$\%S_n$ = % strain for loading increment “n”

H_o = initial height of test specimen

Percent Heave:

If the user selects the ASTM D 4546 compatibility configuration option,. CONS will calculate a percent heave for the sample - percent heave is percent strain, adjusted relative to either the height of the sample at the time of inundation, or the height of the sample at the overburden pressure (modified Method A):

$$\%HV_n = \frac{DR_n - DR_i}{H_i} * 100\%$$

where:

$\%HV_n$ = the percent heave

H_i = height of the sample at the time of inundation/overburden pressure

5.3 Consolidation vs. Log(Pressure) Curve Calculations

Void ratio, percent strain or deformation is plotted against the log(applied pressure) using a cubic spline curve fitting method. Once data points are fit to a curve, P_c (preconsolidation pressure), C_c (compression index), C_r (recompression index) and (if applicable) swell pressure, percent heave/swell and C_s (swell index) values are determined using the equations outlined below:

Compression Index

The compression index (C_c) is defined as the slope of the straight-line portion of the consolidation curve. It is expressed as a ratio of the change in void ratio to the change in log of pressure over the straight-line portion of the compression curve:

$$C_c = \frac{\delta e}{\log(\sigma_2 / \sigma_1)}$$

where:

C_c = compression index (always positive)

δe = void ratio change between σ_1 & σ_2

σ_1 = pressure at one end of the straight-line section

σ_2 = pressure at the other end

Preconsolidation Pressure

CONS calculates preconsolidation pressures (P_c) using the standard Casagrande method, outlined below:

1. The point of maximum curvature on the curve is located
2. A tangent to the curve at that point is determined
3. The horizontal line passing through that same point is drawn
4. The equation for the line bisecting the above lines is determined

5. The point is located where the tangent to the linear portion of the virgin consolidation curve meets this bisector line (the same tangent is used that was selected for the C_c): P_c is equal to the pressure corresponding to this point.

Recompression/Swell Indices

CONS will calculate and report a value for either C_r , the recompression index, or C_s , the swell index, depending upon whether or not a saturation cycle was included as part of the test: for tests that include a saturation cycle, C_s is calculated; otherwise, the program calculates C_r .

C_s is always the average of the slopes of the unloading cycles. Depending upon the user's selection for the "Recompression Index is" option in the "Compression Curves" setup dialog panel, C_r will be either the average slope of the reload portions of the curve, or the average of the unload and reload slopes.

If an overburden pressure is entered and the preconsolidation pressure is greater than the overburden pressure then the slope averaging will only be performed on the portion of the curve between the overburden and preconsolidation pressure.

Saturation Cycles

CONS includes the capability to accept data from saturation cycles and report the corresponding swell percentage and pressure, defined and calculated as follows:

Swell percentage: The difference between the percent swell/consolidation before and after sample wetting.

Swell pressure: Depending upon the setting of the “Swell Pressure Calculated As” option in the “Compression Curves” setup dialog panel, the swell pressure is calculated as either the **additional** pressure needed to restore the sample to the percent consolidation attained prior to wetting, or as simply the pressure needed to restore the sample to the percent consolidation attained prior to wetting.

5.4 Time-Consolidation Calculations

Time-consolidation procedures are dependent upon which test method is selected; log(time) or square root(time). The following sections detail the calculations involved with each method.

5.4.1 Log(time)

Log(time) method time-consolidation curves are presented using a least-squares type curve fitting technique ($a+bx+cx^2+dx^3+ex^4$). The resulting curve equation is used to find D_0 and D_{100} , the dial readings at 0 and 100 percent primary consolidation, as discussed in Chapter 3. D_{50} and T_{50} , the dial reading and time at 50 percent primary consolidation, may then be calculated, and the result used to determine C_v :

$$C_v = \frac{0.197 * H_p^2}{T_{50}}$$

where:

C_v = coefficient of consolidation

0.197 = time factor corresponding to 50% consolidation

T_{50} = time for 50% primary consolidation

H_p = the average drainage path length during the current loading increment

and:

$$H_p = \frac{(H_o - \delta H_t - (\delta H_n / 2))}{DF}$$

where:

H_o = initial height of the specimen

δH_t = the total deformation of the specimen up to loading increment **n**

δH_n = the change in specimen height during load **n**:

this is either $D_{100} - D_o$ or the final dial reading for loading increment **n** - the last dial reading of increment (**n-1**), depending upon the “Compression Curve Plots” setting of the compression curve panel on the setup dialog

DF = the drainage path factor = 1 for single drainage and 2 for double drainage

C_{α} , the coefficient of secondary compression, is calculated as the slope of the right-hand C_v construction line divided by either the height of solids (H_s) or the initial sample height (H_0): this choice is based upon the “Calculate Secondary Compression As” setting of the Time Rate Curves setup dialog panel (see [Section 2.1.3](#)).

X (%)	TIME
10	.008
20	.031
30	.071
40	.126
50	.197
60	.287
70	.403
80	.567
90	.848

5.4.2 Square-root(time)

Similar to log(time) method curves, square-root(time) method time consolidation curves are presented using either a point-to-point or a linear least-squares type curve fitting technique ($a + b/x + c/x^2 + d/x^3 + e/x^4$). The resulting equation is used to determine D_0 and D_{90} , the dial readings at 0 and 90 percent primary consolidation; these values are in turn utilized to calculate D_{100} and D_x (where x is the percent of consolidation corresponding to C_v) and T_x and C_v .

$$D_{100} = D_0 - 10/9(D_0 - D_{90})$$

$$C_v = \frac{TF_x * H_p^2}{T_x}$$

where:

C_v = coefficient of consolidation

H_p = the average drainage path length, as explained in the previous section

T_x = time for $x\%$ primary consolidation

TF_x = unitless time factor corresponding to $x\%$ primary consolidation, selected from the list below:

5.5 Conversion Factors

The following tables list the factors utilized by the program to convert to and from the software's internal units.

*	centimeters
inches	2.54

Dimensional Conversion Factors

÷	g/cm ³
lbs./ft. ³	(30.48 ³)/453.59
kg/m ³	1000
kN/m ³	9.8067

Unit Weight Conversion Factors

÷	kg/cm ²
tsf	1.024
ksf	2.048
psf	2048.2
kPa	98.0687

Stress Conversion Factors

5.6 Data Exported by the Program

For each entered test, CONS calculates a number of different data items that may be used on data summaries created by the GDM "Data Summary and Export" tool. Additionally, these items, or "variables", may be referenced in boring logs and data summaries created with the GEOSYSTEM LOGDRAFT program (version 3.3 or later). The following table lists the name of all the calculated variables provided by CONS, and provides a short description of each variable. Note that all data are stored in the output dimension, stress and density units that were in effect the last time the test file was edited by CONS.

Item Name	Description
SPECGR	This is the specific gravity as entered by the user into the Test Parameters dialog.
E0	Initial void ratio - blank if a specific gravity is not specified.
INIT_SAT	Initial saturation.
CSNMI	Natural moisture.
CS_DENS	Natural density.
OVER	Overburden pressure.

Item Name	Description
OCR	“OverConsolidation Ratio”: this is the ratio of the overburden pressure to the preconsolidation pressure. This value is blank if the user does not enter an overburden pressure.
DIDCONS	“Y” for every sample for which a swell or consolidation test was entered. Use the GDM Data List/Export tool to provide a count of the number of swell/consolidation tests performed on a project.
DIDSWELL	“Y” for samples where a consolidation test was performed AND the sample was wetted.
PP	Preconsolidation pressure.
CC	Compression index.
CS	Swell index - only stored for wetted samples.
RECOTYPE	“C _s ” for un-wetted samples, “C _r ” for wetted samples.
SWELL_PRESS	Restoration pressure for a wetted sample - calculated using the method specified from the program’s “Setup” dialog.
SWELL	Percent swell - calculated using the method specified from the program’s “Setup” dialog.
CVALL	Contains a list of all calculated coefficients of consolidation and related loading pressures.
EF	Final void ratio.
FINAL_SAT	Final saturation.
CSMF	Final moisture content

6. Tutorial

1. **Before starting this tutorial, proceed through the tutorial presented in [Chapter 6 of the GDM manual](#).** If the GDM tutorial was just completed, the sample window for Sample 3, from Boring B-4 will currently be displayed by GDM.

If the appropriate sample window isn't currently displayed, do the following:

- a) Start the software by double-clicking on the "GEOSYSTEM for Windows" icon in the "GEOSYSTEM" program group.
- b) From the opening screen, select File, Open Project. When the project dialog box is displayed, select the project called "DEMO" - it will be located in the same directory as the GEOSYSTEM for Windows software.
- c) From the main project screen, click on "Boring B-4", then double-click on "S-3".

CONS setup dialog, Section 2.1 .
--

2. Select Options, CONS Setup, then select Compression Report from the Setup Categories box. Select CSCONS3 as the Report form. Click on the Ok button to continue.
3. From the sample data dialog, double-click on the Swell/Consolidation icon in the Test Modules box.

CONS Test Parameters Screen, [Section 3.1.](#)

4. The next screen to appear is the CONS Test Parameters screen. Enter the following general sample info. in the box at the top of the Test Parameters screen:

Liquid Limit: **32**

Plasticity Index: **14**

USCS: **CL**

AASHTO:

Figure No.: **2B**

Testing Remarks: **Tested by ALV**

5. Proceed to the box titled “Test Specific Data”. Enter the following data:

Consolidometer No. **20**

Sample Height at Test Start (in.) **1.00**

You may leave Deflection Table at “(none)” and Overburden Pressure blank.

Also leave “Time Values Entered As” at “elapsed time”.

6. Enter the following data into the “Initial (Untrimmed) Sample Data” box:

Initial (Untrimmed Sample Data)

Post-Test Sample Data

Wet Weight + Tare: **41.54**

Height: **0.80**

Wet Weight + Tare:

Dry Weight + Tare: **33.28**

Diameter: **2.50**

Dry Weight + Tare:

Tare Weight: **17.63**

Weight: **109.20**

Tare Weight:

Specific Gravity: **2.70**

Leave the Post Test Sample Data box blank.

7. Select Close to continue. The Test Readings Data Entry Screen will now appear. Choose “1000” as the dial divisor, then enter 0.25 as the pressure. Next, enter the following data:

Test Readings Screen, [Section 3.2](#).

	Elapsed	Dial
1	0	2700
2	.10	2697
3	.25	2695
4	.5	2690
5	1	2688
6	2	2682
7	4	2672
8	8	2668
9	15	2666
10	30	2664
11	60	2660
12	120	2652
13	240	2648
14	480	2642
15	1407	2638

8. Once the data above have been entered, press Enter twice (or click on the ">>" button) to move to the next load increment. CONS will automatically select a loading pressure of 0.5 for the new increment: press Enter to accept this value, then enter the following data:

No.	Elapsed	Dial
1	0	2638
2	.10	2505
3	.25	2485
4	.5	2467
5	1	2438
6	2	2397
7	4	2360
8	8	2318
9	15	2305
10	30	2298
11	60	2292
12	120	2282
13	240	2274
14	480	2264
15	1300	2257
16	1435	2253

9. The compression and time-rate curves will be updated as you enter data. When you have finished entering data for the 0.5 tsf increment, check the time-rate curve. Try adjusting the C_v curve constructions: move the mouse cursor to the time-rate curve display window (this is the top right-hand window), then click the left mouse button once. (This sets the input “focus” to the time-rate curve window.) Use the $\leftarrow \rightarrow \uparrow \downarrow$ cursor keys to move the construction lines.
10. Continue entering test data by clicking the “>>” button on the data entry window. A value of 1 tsf will be displayed in the pressure field. Press enter to move the cursor down to line No. 2, then type “f”. This indicates to the program that the information you are about to provide will be the final reading for that increment. Next, enter the readings below, pressing Enter twice after each reading is entered to move to the next load. (Note that the numbers listed in the PRESSURE column below correspond to individual pressures, not the “No.” column on the data entry screen.)

PRESSURE	FINAL DIAL
1	1868
2	1544
4	1205
8	0841
16	0532

11.Continue by entering decreasing pressures. The pressures automatically displayed after the last entry is 32. Change this value to 8 and enter the following data:

PRESSURE	FINAL DIAL
8	0538
4	0597
2	0663
1	0732
.5	0782

12.Again, change the pressure before continuing:

PRESSURE	FINAL DIAL
1	0772
2	0752
4	0686
8	0587

Compression Curve Window, [Section 3.2.4](#).

13.Adjust the C_c/P_c curve constructions: move the mouse cursor to the compression curve window (this is the top left-hand window) then click the left mouse button once to set the input focus to the compression window. Use the $\leftarrow\rightarrow\uparrow\downarrow$ cursor keys to move the construction lines.

Printing Test Summaries, [Section 4.1](#).

14. Print a test summary by selecting Print, Test Summary from the menu. The Summary Options dialog will appear: select all three options then click on the “Ok” button to continue. CONS will produce a two page summary similar to the one shown in [Section 4.1](#).

Printing Test Reports, [Section 4.2](#).

15. Next, print a test report for the sample: begin by selecting Print, Test Reports from the menu. The Print Selection dialog will appear: begin by clicking on the "Both" button so that reports for both the compression and time-rate curves will be produced.
16. When the “Preview” button is clicked, the entire report as it will be printed by the printer appears on screen, reduced so that it can be seen in its entirety. Select Continue from the menu to display the time-rate report, then select Continue to return to the Print Selection dialog.
17. To reports, select the “Print” button. A printer option box will appear. When all of the options are correct, select the Ok button to continue with the printout. The printed reports should look like those shown in Appendix . Select Close to close the window, Quit to exit CONS (all data will be saved), then File, Save and Exit to leave GEOSYSTEM for Windows.

7. Help!

CONS includes on-line, context-sensitive assistance for users with questions. To active it, simply click on the Help menu item or command button. If you don't find an answer to your question in the program's help, be sure to check the frequently asked questions section in this chapter. If you're still stuck, please feel free to contact GEOSYSTEM Software directly. We do not charge for technical support, but we do ask that you be at your computer when you call, with your data easily accessible. Also, please know the operating system and computer model you are using as well as your printer type and network brand (if applicable).

If you have a question regarding the program's calculations, print out and fax to us a test summary that includes tabulated time-rate readings. Instructions for producing the test summary may be found in [Section 4.1](#).

You may contact us at: Phone 970-223-8788
 Fax: 970-223-0668
 Email: GEOSYSTEM@compuserve.com

7.1 Frequently Asked Questions

General

Q. CONS produced an error message and terminated. What should I do?

A. Under normal circumstances, the program should never shut *itself* down. If, for some unusual reason CONS cannot continue, the program will produce a message indicating what went wrong, and then terminate itself. If this happens, make a note of the message and call GEOSYSTEM Software.

Q. How do I copy CONS data files from one machine to another?

Q. Can I use DOS to delete CONS data files?

A. Refer to the [Frequently Asked Questions chapter in the GDM manual](#).

Data Entry

Q. Why does the program immediately change the dial reading values that I enter?

A. CONS multiplies all dial readings by the number listed in the “Dial Divisor” box. Make sure to take this number into account when entering dial readings, or change the divisor to “1” if you wish to enter true dial readings. **Note that CONS does not incorporate a way to automatically correct dial readings that were entered while an incorrect divisor was selected:** these readings must be re-entered after the correct divisor has been selected.

Q. How do I change the initial test parameters such as the sample height, weight, etc.

A. Select the “Window” menu option, then choose “4. Test Parameters”.

Time-Rate Curves

Q. Why does the dial reading axis for the time-rate curve appear incorrect?

A. There are three possible reasons why the dial reading axis for the points plotted on the time-rate curves does not appear to match the actual entered data: if the test utilized a deflection table, a deflection is being subtracted from each reading before it is plotted. Secondly, the dial readings may have been entered using an incorrect dial divisor - refer to the first question in the “Data Entry” section. Thirdly, the program is capable of plotting dial readings entered in inches onto a centimeter scale, and vice versa. Check the setting of the “Dimensional Units (Output)” box on the General Setup panel (see [Section 2.1.1](#)). If this setting is correct, refer to the question regarding incorrect dimension units listed in the Frequently Asked Questions chapter of the GDM manual.

Q. Why does the program show the complete square-root(time) curve for some loading increments, even if the “Show Full Secondary Consolidation” setup option was set to “No”?

A. On some curves the secondary consolidation interval begins so close to the end of the loading increment that chopping off the secondary consolidation interval would not gain much display space for the primary consolidation portion of the curve; for these loading increments, CONS displays the entire curve.

Q. Why doesn't my time-rate curve print on hardcopy reports?

A. There are three possible reasons why the time-rate curve is not included in hardcopy reports:

- 1) The user manually selected the "DO NOT PRINT" time-rate toolbar button.
- 2) The program was unable to calculate a C_v value for the corresponding loading increment. If the C_v value shown in the time-rate curve display's status window reads "n/a", then the program could not calculate a valid C_v value--this is usually due to a problem with the adjustment of the C_v construction lines.
- 3) The time-rate curve has not been viewed on the screen. If a change is made to the data in the test's parameters window, or if the loading increment was acquired from an external data file (this is an optional feature), then the time-rate curve for the loading increment must be viewed on the screen prior to printing. (To view the data and time-rate curve for a loading increment, click the left mouse button with the mouse cursor located on the appropriate increment in the loading increment list.)

Q. Why does the C_v value in the time-rate curve status window show "n/a"?

A. An incorrect adjustment of the curve's C_v construction lines can result in a situation where the software cannot calculate a meaningful C_v value. Additionally, selecting the "DO NOT PRINT" time-rate toolbar button disables reporting of a C_v value.

Compression Curves

Q. My compression curve appears upside-down. What's going on?

A. Two general types of dial gauges are available: those that give increasing readings as the consolidation sample is compressed, and those that give decreasing readings. CONS is designed to work with both types: as part of the test parameters for the sample, a consolidometer table entry is chosen - the setting of the “Dial Change with Compression” option for the chosen entry tells the program what type of gauge was used for the test.

If the compression curve appears upside-down, then the “Dial Change with Compression” setting is reversed: select Window, Test Parameters, then note the number listed next to the “Consolidometer No.” prompt. Next, click on the “Edit” button shown next to the prompt. Go to the consolidometer table row corresponding to the number noted above, then switch the setting of the “Dial Change with Compression” entry for that row: if the setting is currently “Increasing”, change it to “Decreasing”; if the setting is “Decreasing”, change it to “Increasing”. Click on the “Close” button, then select Close from the menu. The compression curve should appear in the correct orientation.

Q. Why does the stress scale for the compression curve appear incorrect?

A. Most likely, an incorrect selection was made for either the “Stress Units (Input)” or “Stress Units (Output)” options. Select Setup and verify that the correct choice was made for both options. (Note that if the “Stress Units (Input)” selection differs from the “Stress Units (Output)” selection, then CONS will convert the loading pressures entered into the units selected as “Stress Units (Output)”.

Q. After I’ve selected a new scale for my compression curve, why doesn’t the scale shown in the Compression Curve on-screen window change?

A. The Scale dialog discussed in [Section 3.2.4](#) allows the user to change the scales used to display the compression curve. However, if the units selected for the “Stress Units (Input)” differ from the units selected for the “Stress Units (Output)” then the selected curve scales will only be applied when the curve is printed on a hardcopy report.

Q. Under what circumstances does the program report C_s instead of C_r ?

A. If water was added to the sample during the test, CONS will report C_s , which is the average slope of the rebound cycle(s). If water was not added, C_r , the average of either just the rebound cycle(s) or both the unload and reload cycles will be reported.

Hardcopy Printouts

Q. Will the software generate reports on A-4 paper?

A. Yes. Make sure that you have selected A-4 paper for the currently defined default printer. CONS will automatically reformat the report from letter-size to A-4 size.

Q. Can I include my company logo on CONS reports?

A. Yes. Users who have licensed the GEOSYSTEM LOGDRAFT program typically receive a digitized logo file with their LOGDRAFT package: CONS can utilize this file to include the logo on all consolidation reports.

Users who have not licensed LOGDRAFT may choose to have GEOSYSTEM Software digitize their logo for use with CONS; there is a small fee for the work involved. (If your company logo is already in a machine-readable format, we may be able to use your copy.)

Q. The report formats included with CONS do not suit my needs. Can a custom report format be designed?

A. GEOSYSTEM Software can custom-design a CONS report format to fit the specific requirements of your organization. Although there is a fee for this service, it will typically be much smaller than we have charged in the past, due to a change in the way we design the forms.

If you would like to receive a quote on the costs involved in duplicating your report, mail or fax us a copy of your format.

Q. On my HP LaserJet, text that is rotated, such as the "Dial Reading" label, is not printed correctly. What's wrong?

A. Your Windows printer driver has a bug. In some cases GEOSYSTEM Software can supply a replacement driver.

7.2 Error Messages

Major error and warning messages provided by the program are presented with an error number - these messages are listed and discussed below. Note that the following list only discusses messages provided by the Swell/Consolidation module.

1000 "The data file for this sample was created with a newer version of CONS. You will need to use the newer program to read this file."

The CONS data file you are attempting to edit was created by another version of the CONS program. Usually this means that you have two copies of the software on your computer: use the "Help", "About This Program..." menu option, then choose the "System Info." button to list the date the program was generated. Compare the dates of the two copies and erase the older copy.

When the program resets the test's C_v constructions, time-rate data and curves associated with the sample will not be included on hardcopy reports until each curve has been previewed on-screen. You can do this by repeatedly clicking the ">>" button in the test readings window until the end of the loading increments list has been reached.

1001 "The specific gravity associated with this test has been changed. All C_v constructions will be reset: You must review each time-rate curve on-screen."

This indicates that the specific gravity associated with the sample was changed by another data reduction module, or through LOGDRAFT. This change means that CONS must recalculate all testing information, so the C_v and C_c/P_c constructions will be reset. Note that the time-rate curves and data associated with the sample will not be included on hardcopy reports until each curve has been previewed on-screen.

When the program resets the test's C_v constructions, time-rate data and curves associated with the sample will not be included on hardcopy reports until each curve has been previewed on-screen. You can do this by repeatedly clicking the ">>" button in the test readings window until the end of the loading increments list has been reached.

1001 "The specific gravity associated with this test has been changed. All C_v constructions will be reset: You must review each time-rate curve on-screen."

This indicates that the specific gravity associated with the sample was changed by another data reduction module, or through LOGDRAFT. This change means that CONS must recalculate all testing information, so the C_v and C_c/P_c constructions will be reset. Note that the time-rate curves and data associated with the sample will not be included on hardcopy reports until each curve has been previewed on-screen.

1002 "The consolidometer data associated with this test have changed. All C_v constructions will be reset: Review each time-rate curve on-screen."

1003 "The deflection table associated with this test has been changed. All C_v constructions will be reset: You must review each time-rate curve on-screen."

Modifying consolidometer or deflection information invalidates the calculated test data for any samples that use the modified consolidometer entry or deflection table. The next time the sample is loaded, CONS will detect that the sample's consolidometer or deflection table has been changed, and will recalculate all testing information based upon the modified information. All C_v and C_c/P_c constructions will be reset - make sure to review each time-rate curve on-screen prior to printing a test report.

**1004 "WARNING. The deflection table selected for use with this test no longer exists.
The table selection will be reset."**

The deflection table used for the test was deleted or ID associated with the table was changed. Because the deflection table could no longer be located, the program has reset all deflections to 0, and all C_v and C_c/P_c constructions have been reset. Make sure to review each time-rate curve on-screen prior to printing a test report.

1005 "Note: due to a sample data change, the time-rate constructions have been reset. Review all time-rate curves on-screen."

Changing a test parameter such as the sample height causes the program to recalculate all testing information based upon the modified parameter. This resets the C_v and C_c/P_c constructions, which must be reviewed on-screen prior to printing a test report.

1006 "Changing the input stress units will not affect any existing CONS data entered for this project. (This setting only affects the units CONS thinks your loading pressures are entered in.) Are you sure that you want to make this change?"

The "stress input units" setting merely informs the program as to the units that were used for entering the loading pressures. If an incorrect setting was chosen when the test was initially entered, the user may change the setting at a later time without re-entering the data. The message is intended to inform the user that the program will not make any changes to the loading pressures that have already been entered. Note that if the units ARE changed, the program will reset the C_v and C_c/P_c constructions, which must be reviewed on-screen following the directions given in the "hint" above.

1007 "Note: selecting a new report form may change the fields listed in the General Sample Information section of the Test Parameters window. You should check this window for new prompts prior to printing any reports."

Different report forms print different data items: for example, the compression report form "A" may list the date the sample was taken, while compression report form "B" may omit the sample date. If the user changes from form "B" to form "A" (through the "Compression Report" Setup panel), a new field will be added to the General Sample Information panel so that a sample date may be entered. When the Compression report form or Time-Rate report form is changed, the user should select the "Window", "Test Parameters" menu option and check the General Sample Information panel for any new fields.

1008 “Changing the output stress, pressure or density units, the C(alpha) calculation method, the Cc/Pp reporting option, or the Cv graphing/tabulation option affects only newly-created projects. Select the SETUP dialog from the CONS data entry screen to change an existing project's options.”

1010 "Note: changing the output stress, pressure or density units, the secondary compression calculation method, the C_c/P_p reporting option, the C_c graph points (final dial or d100) or the C_v graphing/tabulation option will affect only the current project. Select the Cons SETUP dialog from the GDM screen to affect all new projects"

If the user has selected “Setup”, “CONS Setup” from the GDM menu (as opposed to selecting “Setup” from the CONS test data entry screen), changes to any of the items listed in the message above will only affect projects created in the future. To change one of these settings for the swell/consolidation tests entered into an existing project, start a new CONS test for the project or edit a CONS test already entered into the project ([Section 3.3](#)) then select “Setup” from the CONS test data entry screen.

Conversely, if the user has changed one of the listed settings *while editing a CONS test*, the changed setting will only be applied to the tests entered into the current project.

This procedure is designed to allow the user to create projects that utilize different test methods or measurement units without affecting any existing project files.

If the C_c graph point option is changed from final dial to D_{100} (or vice versa) for a given project, it is recommended that the user edit each of the CONS tests entered into the project and re-adjust the C_c / P_c constructions.

1012 **"A water-added cycle already exists."**

CONS supports a single inundation cycle: the message means that an attempt was made to enter a duplicate loading pressure, indicating an inundation cycle. This message usually implies a data entry error where the user may have inadvertently entered the same loading increment twice.

1013 **"The void ratio plot is not available due to an invalid initial void ratio. (Probably, a specific gravity was not selected for the sample.)"**

The program cannot calculate void ratios without a valid specific gravity. Check the Test Parameters dialog ([Section 3.1](#)) to make sure a specific gravity has been entered.

Note that CONS does not require a specific gravity for the sample *unless* the user desires void ratio values.

1014 "Note: changes made to a deflection table will not affect an existing consolidation tests utilizes that table UNTIL the test is revised."

If a change is made to a deflection table, the testing information calculated for any swell/consolidation tests already entered that utilize that table will be invalid. Because the program does not automatically revise the calculations for these tests, the user is responsible for revising each test file (see [Section 3.3](#)). Doing this causes the program to recalculate any data that may have changed when the deflection table was changed.

1015 "The selected ID is not unique: this ID is used by another deflection table. Enter a different ID."

The ID used to identify the deflection table must be unique. Select an ID that does not match one of the table ID's shown in the "Deflection Tables" panel.

1016 "You must enter an ID for the table"

CONS identifies deflection tables by ID's, which are unique names consisting of any combination of letters or numbers. Prior to entering deflection information for a new table, you must enter a unique ID for the table.

1017 "Note: changes made to a consolidometer entry will not affect an existing consolidation tests utilizes that consolidometer UNTIL the test is revised."

If a change is made to a consolidometer entry, the testing information calculated for any swell/consolidation tests already entered that utilize that consolidometer will be invalid. Because the program does not automatically revise the calculations for these tests, the user is responsible for revising each test file (see [Section 3.3](#)). Doing this causes the program to recalculate any data that may have changed when the consolidometer entry was changed.

1018 "WARNING: you have chosen to switch this test from clock time to elapsed time. Are you sure that you want to do this?"

1019 "WARNING: changing from elapsed time to clock time - all test readings will be DELETED! ARE YOU SURE THAT YOU WANT TO PROCEED?"

Once CONS test readings have been entered for a given sample, making a change to the “Time Values” selection (discussed in [Section 3.1.2](#)) will cause the program to erase all existing test readings. Be absolutely sure that you actually want to make the change - there is no way to recover any data lost through making the wrong selection.

1022 "Changing the input stress units affects only projects created in the future."

This message is for informational purposes only: it does not indicate an error. The message indicates that the input stress units were changed from GDM's Options, Cons Setup menu, and that the current project (if one is being edited) will not be affected by the change.

To change the input stress units for an existing project, use GDM to open the project file (refer to [Section 3.12 in the GDM manual](#)), then open a sample window ([GDM manual Sections 3.8](#) and [3.9](#)), and open the CONS program by clicking on the “Swell/Consolidation” entry in the “Test Modules” window. Next, select Setup and choose the correct stress units. This selection will affect every test entered into the current project file.

8. Converting DOS CONS Data Files

The Swell/Consolidation module includes a tool to convert data from the MS-DOS GEOSYSTEM CONS program into a format readable by the Windows module. To convert a MS-DOS CONS data file into a Windows file, first open the GEOSYSTEM for Windows project file into which the test file is to be placed, then follow the steps for entering a new sample or revising an existing sample that are detailed in [Sections 3.8](#) and [3.9 in the GDM manual](#): this is the sample that will be associated with the MS-DOS CONS test file. Once a sample data window for the correct sample is displayed, select Tools, DOSCONS File Conversion.

Note that for licensed copies, installation of the file conversion tool is an option: if DOSCONS File Conversion doesn't show up under the GDM Tools menu, you must re-install the CONS module: during the installation, make sure to select "Yes" when asked about installing the conversion program.

After the menu selection, the file conversion utility will request the complete path to the MS-DOS CONS program. Make sure to enter a complete path, including the disk drive name, e.g. "C:\GEOSYS\CONS".

If, after selecting the DOSCONS File Conversion menu item, a warning is displayed noting that a Swell/Consolidation data file already exists for the current sample, the program has found a Windows Swell/Consolidation test data file that has already been created for the sample. Proceeding with the file conversion process will overwrite the existing Windows data file.

If the conversion program is able to locate a copy of the MS-DOS CONS program at the specified path, a list of tests stored by the MS-DOS program will be displayed. Double-click on the appropriate test to perform the conversion.

Once the file has been converted into a GEOSYSTEM for Windows format, it may be viewed by re-opening the sample data window, then clicking on the “Swell/Consolidation” entry in the Test Modules panel of the window. Initially, a message will be displayed indicating that the specific gravity associated with the sample has been changed: ignore this message. The program will proceed to display the test readings screen for the sample - make sure to open the Test Parameters window and check the deflection table and consolidometer number for the test, as these values may not be correct. If desired, an overburden pressure may also be entered: since the MS-DOS program did not include the option to enter an overburden pressure, this value will initially be blank.