CRITICAL EVALUATION OF PARAMETERS AFFECTING RESILIENT MODULUS TESTS ON SUBGRADES

(APPENDICES AND SUPPORTING DATA)

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Research Project 1177

DEVELOPMENT OF ROUTINE RESILIENT MODULUS TESTING FOR USE WITH NEW AASHTO PAVEMENT DESIGN GUIDE

Conducted for

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by

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APPENDIX A

USER'S MANUAL FOR MRREDUCE

A.1 DESCRIPTION

The program **MRREDUCE** was written to reduce data from resilient modulus tests. The program calculates the peak load and displacement, the average base load and displacement, the stress, the strain, and the resilient modulus for each cycle.

Before executing **MRREDUCE**, two data files called **DEFAULT.DAT** and **DATAFIL.DAT** must be created. These data files contain information required for data reduction. **DEFAULT.DAT** contains 13 default parameters. These parameters are:

1) length of sample
2) diameter of the sample
3) duration of collected data
4) sampling frequency
5) number of cycles of data collected
6) starting cycle for data reduction
7) ending cycle for data reduction
8) period of each cycle
9) the duration of load
10) load transducer calibration factor
11) displacement transducer calibration factor
12) confining pressure transducer calibration factor
13) pore pressure transducer calibration factor.

DATAFIL.DAT should also created before **MRREDUCE** is executed. In this file, the deviatoric stresses corresponding to those used in the actual testing are written. This file is for informational use only. If **DEFAULT.DAT** and **DATAFIL.DAT** do not exist, an error may occur and the execution may be terminated.

A.1.1 INPUT AND OUTPUT FILES The input files must have the extension 'DAT'. A new file is generated for each loading sequence. These files should be numbered consecutively. The last two characters of the file name correspond to these numbers. The first file name should be numbered as 00. The first six character of the file name should be the same for all the tests. For example, if an experiment is run with the file name EXP, then all the input data files should have the following format: EXP00.DAT, EXP01.DAT, EXP02.DAT and so on. The user only needs to input the file name EXP. MRREDUCE will incorporate the rest of the file name.

The input file must have the following format:

four lines of characters,

1024 data points for the displacement,

four lines of characters,

1024 data points for the load

one line of characters,

1024 data points for the confining pressure,

one line of characters and

1024 data points for pore pressure (optional).

In all cases, the data points should be in volts. **MRREDUCE** will convert the voltages into actual numbers.

After MRREDUCE is executed, an output file for each loading sequence will be generated. Once again, the output files will have the same format as the input files, but the extension will be '.OUT' instead of '.DAT'.

The output file is written in a tabular form. A typical output file contains eight columns of data. The columns (from left to right) correspond to: cycle number, base displacement, base load, peak displacement, peak load, stress, strain and resilient modulus. Figure A.1 shows a typical output file. The output file has a header containing information with respect to the specimen, followed by the data. The cycle number ranges between 1 and 7. The data are collected for 8 seconds or 8 cycles. The last cycle is not reported in the output file. The base displacement and load are the relaxation period of the displacement and load cycles, respectively. The peak displacement and load are the maximum deformation and deviatoric load in a cycle. Under these values, the data point which maximum numbers occurred are reported. The stress, the strain and resilient modulus are calculated as described in Chapter 2.

MRREDUCE allows the user to run the program interactively or in a batch mode. If the user selects the batch mode, then a second output file is generated. This output file is called the summary file. This summary file has the same file name as the input file name, but the extension for the summary file is '.STA'.

The summary file contains six columns of data. These parameters are from left to right: confining pressure, deviatoric stress, strain, average modulus, standard deviation for the modulus and the cycle where the data was collected. These parameters are averages of the seven cycles in the output file. Each row in this summary file corresponds to one output file.

A typical summary file is shown in Figure A.2. The top line in this file is the input file name for the test.

A.2 USER'S GUIDE

Next, a description of the program is explained.

The first question that appears on the screen is:

THE TEST WAS PERFORMED UNDER THE FOLLOWING CONDITIONS :
FILE NAME: CL50O105 .OUT
DATE 08:21:1990
CONFINING PRESSURE==> 4.04PSI
DEVIATORIC STRESS==> 2.00PSI
THE LOAD DURATION IS .10 SEC.
THE FREQUENCY OF THE PULSE IS 8 SEC.
THE LENGTH OF THE SPECIMEN 6.147 in.
THE DIAMETER OF THE SPECIMEN 2.802 in.

CYCLE	LOADMAX	DISPMAX	AVLOAD	AVDISP	STRESS	STRAIN	MODULUS
1	.128E+02 57	.138E-01 58	.192E+01	.127E-01	1.490	.164E-03	9077.
2	.129E+02 185	.138E-01 186	.197E+01	.128E-01	1.496	.163E-03	9183.
3	.129E+02 313	.138E-01 314	.194E+01	.128E-01	1.498	.164E-03	9155.
4	.128E+02 441	.138E-01 442	.192E+01	.128E-01	1.489	.162E-03	9200.
5	.128E+02 569	.138E-01 570	.194E+01	.128E-01	1.477	.161E-03	9160.
6	.130E+02 697	.138E-01 697	.190E+01	.128E-01	1.521	.163E-03	9344.
7	.129E+02 825	.138E-01 826	.194E+01	.128E-01	1.499	.163E-03	9212.

Figure A.1 - Typcial Output File Generated by MRREDUCE.

TESTS FILE NAMES:CL50O1

CONFINING PRESSURE (PSI)	DEVIATORIC STRESS (PSI)	STRAIN (IN/IN)	MODULUS (PSI)	STANDARD DEVIATION (PSI)	
6.03	1.70	.133E-03	12776.	58.	100
6.01	3.72	.304E-03	12230.	37.	100
6.00	5.64	.663E-03	8503.	37.	100
6.07	7.37	.108E-02	6792.	9.	100
6.10	9.10	.152E-02	5992.	10.	100
4.04	1.50	.163E-03	9209.	70.	100
4.03	3.52	.447E-03	7879.	21.	100
4.03	5.40	.813E-03	6640.	19.	100
4.02	7.34	.120E-02	6097.	12.	100
4.02	9.18	.160E-02	5757.	13.	100
1.96	1.59	.168E-03	9466.	74.	100
1.96	3.57	.499E-03	7159.	33.	100
1.96	5.38	.930E-03	5781.	9.	100
1.96	7.21	.136E-02	5280.	9.	100
1.96	8.98	.179E-02	4998.	6.	100

Figure A.2 - Typcial Summary File Generated by MRREDUCE.

CHOOSE ONE OF THE FOLLOWING:

<1> DATA REDUCTION OF RAW DATA

<2> RECREATE ANOTHER SUMMARY FILE

<3> PLOT ALREADY REDUCED DATA

If the first choice is selected, the program will proceed with the data reduction. If the second option is chosen, a summary file will be created. Finally, the last option will plot reduced data onto the screen. The last option utilizes the summary file created in Option 1 or 2. These options are described in detail below.

A.3.1 OPTION 1: In this section, the step by step procedure involved in Option one will be discussed. The program reads the content of file DEFAULT.DAT and writes them on the screen with a brief description of what each number represents. The screen will look like this:

THE DEFAULTS VALUES ARE THE FOLLOWING:

<1>LENGTH = 3.00 INCH

<2>DIAMETER = 1.50 INCH

<3>COLLECTED DATA DURATION = 8 SEC

<4>SAMPLING FREQUENCY = 512 POINTS/SEC

<5>TOTAL NUMBER OF CYCLES = 8

<6>STARTING CYCLE FOR REDUCTION = 1

<7> ENDING CYCLE FOR REDUCTION = 8

<8>PERIOD OF LOADING SEQUENCE = 1 SEC

<9>PULSE DURATION = 0.1 SEC

<10>LOAD CALIBRATION = 50 LBS/VOLT

<11>DISPLACEMENT CALIBRATION = 0.001 INCH/VOLT

<12>CONFINING CALIBRATION = 30 PSI/VOLT

<13>PORE PRESSURE CALIBRATION = 30 PSI/VOLT

<14>QUIT

DO YOU WANT THE DEFAULT VALUES? <Y> OR <N>

If the answer is yes, the program will proceed; if the answer is no, then the question on the screen will be

ENTER THE NUMBER THAT NEEDS CHANGES

ENTER <14> WHEN FINISHED

Once a number corresponding to a parameter is chosen, the following question will appear asking the new value of the parameter. When all the parameters are corrected, the user should type 14 to resume the execution.

The next question that will appear on the screen is:

SHOULD YOUR ANSWERS TO QUESTIONS BE READ FROM SCREEN<1> OR FROM A FILE <2>?

If the Option 1 is chosen, the program will be interactive while in Option 2 the program will run in a batch mode. In other words, in Option 2, the program will not ask the user any question during the reduction of raw data. Typically, the first option should be chosen if there is only one data file to be reduced while the second option is chosen for a group of input files.

First, the interactive option will be discussed followed by the automated option.

A.3.1.1 OPTION 1 If the interactive selection is chosen, the next question follows:

ENTER INPUT FILE NAME(20 CHARACTERS MAXIMUM)

THE INPUT EXTENSION MUST BE .DAT(DO NOT

INCLUDE THE EXTENSION IN FILE NAME)

The input file name is entered. As mentioned before, the extension is not entered.

The program will check if the input file exists. If it does not, the following will appear:

INPUT FILE DOES NOT EXIST, WOULD YOU LIKE TO CONTINUE(Y/N)?

If the answer is yes, the program will again ask for a new input file name and will check to determine if it exists. If the answer is no, the program will terminate.

If the input file name exist, the program will check if the output file, '.OUT', has already been created. If the output file name is present, the following message will appear:

OUTPUT FILE ALREADY EXISTS, DO YOU WANT TO REWRITE(Y/N).

If the answer is yes, the existing file will be deleted and new one will be created, while if the answer is no the program will stop.

The program then proceeds to calculate the resilient modulus. The next question that program will ask is

ENTER THE DEVIATORIC STRESS.

The deviatoric stress that corresponds to the file being reduced is entered. The deviatoric stress is not used to calculate the resilient modulus but rather is for information. It is written in the output file as part of testing conditions. The deviatoric stress actually calculated by the program is used when calculating the resilient modulus.

Next, the computer will ask:

DO YOU WANT TO PLOT THE DATA(Y/N)?

If the answer is no, the program will stop; while if the answer is yes, the program will proceed to plot the data. Initially, three graphs will be plotted. In the top left corner, stress versus number of data points, in the top right corner, the strain versus number of data points, and across the bottom the resilient modulus versus the cycle number. To exit this screen, press return key and the following options appear:

WOULD YOU LIKE TO(PICK ONE OPTION)

<1> LOOK AT STRESS CURVE WITH CURSOR

<2> LOOK AT STRAIN CURVE WITH CURSOR

<3> LOOK AT MODULUS CURVE WITH CURSOR

<4> LOOK AT THE THREE PLOTS AGAIN

<5> QUIT

If Option 1, 2, or 3 are chosen, the corresponding plot will appear on the screen. Options 1, 2, and 3 corresponds to the stress versus number of data points, the strain versus number of data points and the resilient modulus versus cycle number, respectively. For all three plots, a cursor may be used to select a desired location on the graph. The cursor will appear on the screen if the return key is pushed. The cursor will appear on the screen and it may be moved using the arrow keys on the keyboard. If the return key is pressed the coordinates or location of the cursor is shown in the top right corner of the screen. The coordinates will be displayed for 5 seconds on the screen. The screen will then be cleared, the above options will reappear. If Option 4 is chosen, all three plots will appear on the screen simultaneously. Option 5 is selected, the program will be terminated.

This is the end of Option 1 or the interactive version. The batch version is explained, next.

A.3.1.2 OPTION 2 In this option, the file **DATAFIL.DAT** must exist. This option allows the user to reduce several files without answering any questions during the execution of the program.

The next question to appear on the screen is

ENTER <1> FOR GRANULAR OR <2> FOR COHESIVE TEST.

Option 1 is for tests on granular or Type 1 soils, and Option 2 is for the cohesive or Type 2 soils. The next question is:

ENTER THE STARTING FILE AND ENDING FILE NUMBERS.

Enter the beginning and ending input file numbers. These correspond to the two digit numbers following the file name.

Now, the program asks

DO YOU WANT TO PLOT THE RESULTS?

If the answer is yes, results of all the files will be plotted; while a negative answer will not show any plots. The plots that will appear on the screen will be explained later. The next question is:

ENTER THE NUMBER OF FILES COLLECTED PER LOADING SEQUENCE.

Enter the number of files collected for every loading step. If during the resilient modulus tests, more than one file per loading step is collected then that number should be entered.

Next question is

THE CYCLE WHICH # FILE WAS COLLECTED.

This question and the previous question depend on each other. The "#" symbol is number that starts from one, increased by one up to the number entered on the previous question. The parameter(s) to input here is the cycles corresponding to the input data was collected.

The following question will appear next:

ENTER THE NAME OF INPUT FILE.

As before, the file name, without the extension and without the two digit number, should be entered. The program will then check whether all the input files exist. If one or more files are missing the following message appear:

FILE "FILENAME" DOES NOT EXIST,

where "FILENAME" is the particular input file name missing. However, the program will resume.

The program will then check whether if there are any output files already exists. If any file exits, the following message will appear:

"FILENAME" OUTPUT FILE ALREADY EXISTS, DO YOU WANT TO REWRITE (Y/N)?,

where "FILENAME" is same as above. If yes is chosen, the file will be deleted and the program will resume; if no is chosen, then the program will stop.

The program calculates the resilient modulus for one file at a time. If the option to plot data is selected, then three plots for granular soils or two plots for cohesive soils will appear on the screen.

For granular soils, in the upper left corner, resilient modulus versus deviatoric stress, in the upper right corner, the resilient modulus versus loading sequence, and in the bottom, the resilient modulus versus the bulk stress will be plotted. The last graph also contains a best-fit line and its equation is displayed.

Again to exit this screen press return key and the following options will appear:

WOULD YOU LIKE TO(PICK ONE OPTION)

<1> LOOK AT Mr vs. DEV. STRESS WITH CURSOR

<2> LOOK AT Mr vs. LOADING SEQ. WITH CURSOR

<3> LOOK AT Mr. vs. THETA WITH CURSOR

<4> LOOK AT THE THREE PLOTS AGAIN

<5> QUIT

THETA is the bulk stress. Options 1, 2, and 3 will display their respective plots on the full screen. Each of these plots allows the use of the cursor; the cursor use is as explained in the previous section. Option 4 will display all three plots without the use of cursor and Option 5 will terminate the program.

For cohesive soils, the plots are the same as the granular soils but the third plot is the resilient modulus versus deviatoric stress.

Once the return key has been pressed, the message appears

WOULD YOU LIKE TO(PICK ONE OPTION)

<1> LOOK AT Mr vs. DEV. STRESS WITH CURSOR

<2> LOOK AT Mr. vs. LOADING SEQ. WITH CURSOR

<3> LOOK AT Mr. vs. SIGMA WITH CURSOR

<4> LOOK AT THE THREE PLOTS AGAIN

<5> QUIT.

SIGMA is the deviatoric stress. Options 1, 2 and 3 will plot their respective plots onto the entire screen. The cursor will appear once return key is pressed and the use of the cursor is similar as before. Option 4 will show both plots on the screen and Option 5 will end the program. The three typical plots are shown in Figure A.3.

This concludes the step by step procedure for the option to reduce raw data. Next, the option to recreate another summary file is explained.

A.3.2 OPTION 2 (RECREATE ANOTHER SUMMARY FILE) This option is chosen if all the output files have been already generated exist. The program will create a new summary file for the group of output files. The group of questions to follow is the same as previously been explained. The following messages will appear on the screen:

ENTER <1> FOR GRANULAR OR <2> FOR COHESIVE TEST.

DO YOU WANT TO PLOT THE RESULTS.

ENTER THE NUMBER OF FILES COLLECTED PER LOADING SEQUENCE.

THE CYCLE WHICH # FILE WAS COLLECTED

The following questions appears:

ENTER THE GENERAL NAME OF INPUT FILES.

Enter the file name without the extension '.OUT'. The program checks whether the summary file already exists. If it does, the following message will appear:

FILE ALREADY EXIST, DO YOU WANT TO OVERWRITE?.

Enter Y to delete the file and open a new one or N to end the program.

If the plotting option is selected, the following question will appear:

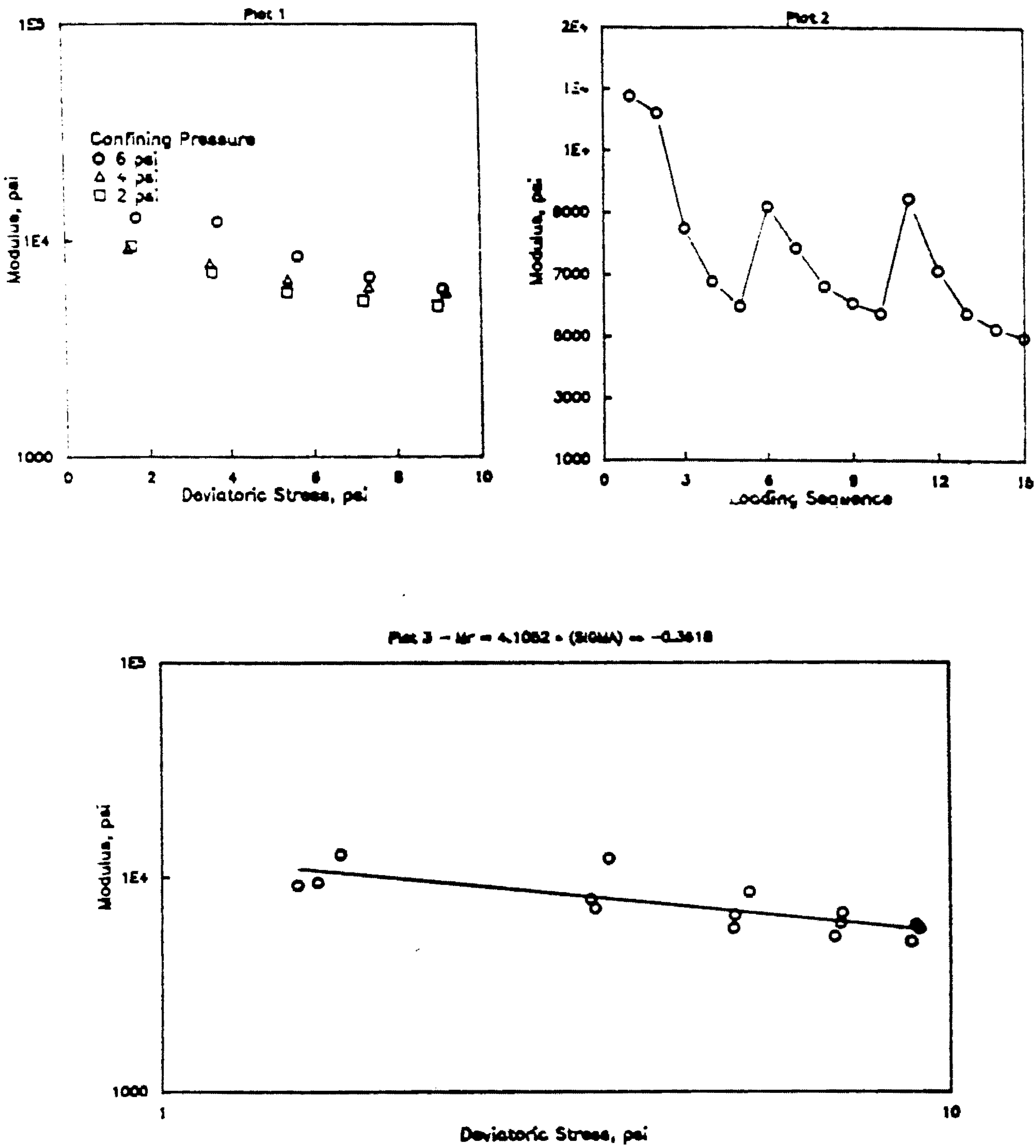

Figure A.3 - Typical Plots for Cohesive Soils by MRREDUCE.

ENTER WHICH CYCLE TO BE PLOTTED.

This corresponds to the cycle for which the data was collected. The user chooses the cycle to be plotted. From this point on to the end of program, the same messages will appear as before. The plots will be shown on the screen. The number of plots that are shown depends whether the test is on a granular or a cohesive soil. Refer to above section for the explanation.

This concludes the option two, or recreate another summary file. A new file with the extension '.STA' will be created.

A.3.3 OPTION 3 (PLOT ALREADY REDUCED DATA) The file takes the summary file and plots it onto the screen. Therefore, a file with the extension '.STA' must already exist. All the following questions are the same as before. So, the questions will be shown without a description.

ENTER <1> FOR GRANULAR OR <2> FOR COHESIVE TEST.

DO YOU WANT TO PLOT THE RESULTS.

ENTER THE NUMBER OF FILES COLLECTED PER LOADING SEQUENCE.

THE CYCLE WHICH # FILE WAS COLLECTED.

ENTER THE NAME OF DATA FILE.

MUST HAVE THE EXTENSION OF ".STA" BUT DO NOT INCLUDE THE EXTENSION.

INPUT FILE DOES NOT EXIST!!

DO YOU WANT TO CONTINUE.

If the option to plot the data is selected, the following question will appear:

ENTER WHICH CYCLE TO BE PLOTTED.

This concludes the step by step procedure to run MRREDUCE program. The program provides the user the choice of several options for data reduction and presentation. The next section will illustrate some examples for inputs, output file and summary file.

A.4 EXAMPLES

In this section, four examples are includes to clarify further the process.

A.4.1 EXAMPLE 1 The first example is for the reduction of raw data. The test was performed on a granular material and two files were collected per loading sequence. Data was collected at the 50^{th} and 100^{th} cycles. Five loading sequences were performed and the following input files were created: TEST00.DAT, TEST01.DAT, TEST02.DAT, TEST03.DAT, TEST04.DAT, TEST05.DAT, TEST06.DAT, TEST07.DAT, TEST08.DAT and TEST09.DAT. A part of file TEST00.DAT is shown in Figure A.4. The program is executed and the following would be inputs for the questions:

CHOOSE ONE OF THE FOLLOWING:

<1> DATA REDUCTION OF RAW DATA

<2> RECREATE ANOTHER SUMMARY FILE

<3> PLOT ALREADY REDUCE DATA

1

THE DEFAULTS VALUES ARE THE FOLLOWING:

<1>LENGTH = 3.00 INCH

<2>DIAMETER = 1.50 INCH

<3>COLLECTED DATA DURATION = 8 SEC

<4>SAMPLING FREQUENCY = 512 POINTS/SEC

<5>TOTAL NUMBER OF CYCLES = 8

<6>STARTING CYCLE FOR REDUCTION = 1

<7> ENDING CYCLE FOR REDUCTION = 8

<8>PERIOD OF LOADING SEQUENCE = 1 SEC

<9>PULSE DURATION = 0.1 SEC

<10>LOAD CALIBRATION = 50 LBS/VOLT

<11>DISPLACEMENT CALIBRATION = 0.001 INCH/VOLT

<12>CONFINING CALIBRATION = 30 PSI/VOLT

<13>PORE PRESSURE CALIBRATION = 30 PSI/VOLT

<14>QUIT

DO YOU WANT THE DEFAULT VALUES? <Y> OR <N>

Y

DO YOU ANSWERS TO QUESTIONS BE READ OFF SCREEN<1>
OR FROM A FILE <2>?

2

ENTER <1> FOR GRANULAR OR <2> FOR COHESIVE TEST

1

ENTER THE STARTING FILE AND ENDING FILE NUMBER

0,9

DO YOU WANT TO PLOT THE RESULTS

N

ENTER THE NUMBER OF FILES COLLECTED PER LOADING
SEQUENCE.

2

THE CYCLE WHICH 1 FILE WAS COLLECTED

50

THE CYCLE WHICH 2 FILE WAS COLLECTED

100

ENTER THE NAME OF FILE

TEST

The program checks that all the files exist. If all the files exist, the program will start to create the 10 output files and one summary file.

A.4.2 EXAMPLE 2 In this example, only one file of resilient modulus test is reduced. The name of the input file is WORD03.DAT and was performed with deviatoric stress of 4 psi. The inputs are the following:

CHOOSE ONE OF THE FOLLOWING:

<1> DATA REDUCTION OF RAW DATA

<2> RECREATE ANOTHER SUMMARY FILE

<3> PLOT ALREADY REDUCE DATA

1

THE DEFAULTS VALUES ARE THE FOLLOWING:

<1>LENGTH = 3.00 INCH

<2>DIAMETER = 1.50 INCH

<3>COLLECTED DATA DURATION = 8 SEC

<4>SAMPLING FREQUENCY = 512 POINTS/SEC

<5>TOTAL NUMBER OF CYCLES = 8

<6>STARTING CYCLE FOR REDUCTION = 1

<7> ENDING CYCLE FOR REDUCTION = 8

<8>PERIOD OF LOADING SEQUENCE = 1 SEC

<9>PULSE DURATION = 0.1 SEC

<10>LOAD CALIBRATION = 50 LBS/VOLT

<11>DISPLACEMENT CALIBRATION = 0.001 INCH/VOLT

<12>CONFINING CALIBRATION = 30 PSI/VOLT

<13>PORE PRESSURE CALIBRATION = 30 PSI/VOLT

<14>QUIT

DO YOU WANT THE DEFAULT VALUES? <Y> OR <N>

Y

DO YOU ANSWERS TO QUESTIONS BE READ OFF SCREEN<1>

OR FROM A FILE <2>?

1

ENTER INPUT FILE NAME(20 CHARACTERS MAXIMUM)

THE INPUT EXTENSION MUST BE .DAT(DO NOT INCLUDE THE

EXTENSION IN FILE NAME)

WORD03

ENTER THE DEVIATORIC STRESS

4

DO YOU WANT TO PLOT THE DATA(Y/N)

N

The program ends. The output file WORD03.OUT will be produced. No summary file has been created.

A.4.3 EXAMPLE 3 In this example, the use of the option to recreate another summary file will be illustrated. A resilient modulus test on a cohesive soil was performed. Five loading steps were utilized and data were collected at only the 100^{th} cycle. The data has already been reduced so the output files already exist. The names of the output files are MOD00.OUT, MOD01.OUT, MOD02.OUT, MOD03.OUT and MOD04.OUT. MOD00.OUT. The inputs are as follows:

CHOOSE ONE OF THE FOLLOWING:

<1> DATA REDUCTION OF RAW DATA

<2> RECREATE ANOTHER SUMMARY FILE

<3> PLOT ALREADY REDUCE DATA

2

ENTER <1> FOR GRANULAR OR <2> FOR COHESIVE TEST

2

ENTER THE STARTING FILE AND ENDING FILE NUMBER

0,9

DO YOU WANT TO PLOT THE RESULTS

N

ENTER THE NUMBER OF FILES COLLECTED PER LOADING SEQUENCE.

1

THE CYCLE WHICH 1 FILE WAS COLLECTED

100

ENTER THE GENERAL NAME OF INPUT FILES

MOD

The program proceeds to check if MOD.STA exists and deletes it if desire. The program creates a new summary file, MOD.STA. File MOD.STA is similar in format to Figure A.2.

A.4.4 EXAMPLE 4 In this example, the option to plot existing data is illustrated. The output file of Example 3 is used here. The summary file is MOD.STA. The inputs are the following:

CHOOSE ONE OF THE FOLLOWING:

<1> DATA REDUCTION OF RAW DATA

<2> RECREATE ANOTHER SUMMARY FILE

<3> PLOT ALREADY REDUCE DATA

3

ENTER <1> FOR GRANULAR OR <2> FOR COHESIVE TEST

2

ENTER THE STARTING FILE AND ENDING FILE NUMBER

0,9

DO YOU WANT TO PLOT THE RESULTS

Y

ENTER THE NUMBER OF FILES COLLECTED PER LOADING SEQUENCE.

1

THE CYCLE WHICH 1 FILE WAS COLLECTED

100

ENTER THE NAME OF DATA FILE

MUST HAVE THE EXTENSION OF ".STA" BUT DO NOT INCLUDE THE EXTENSION

MOD

ENTER WHICH CYCLE TO BE PLOTTED

APPENDIX B

PLOTS FOR SYNTHETIC SPECIMENS

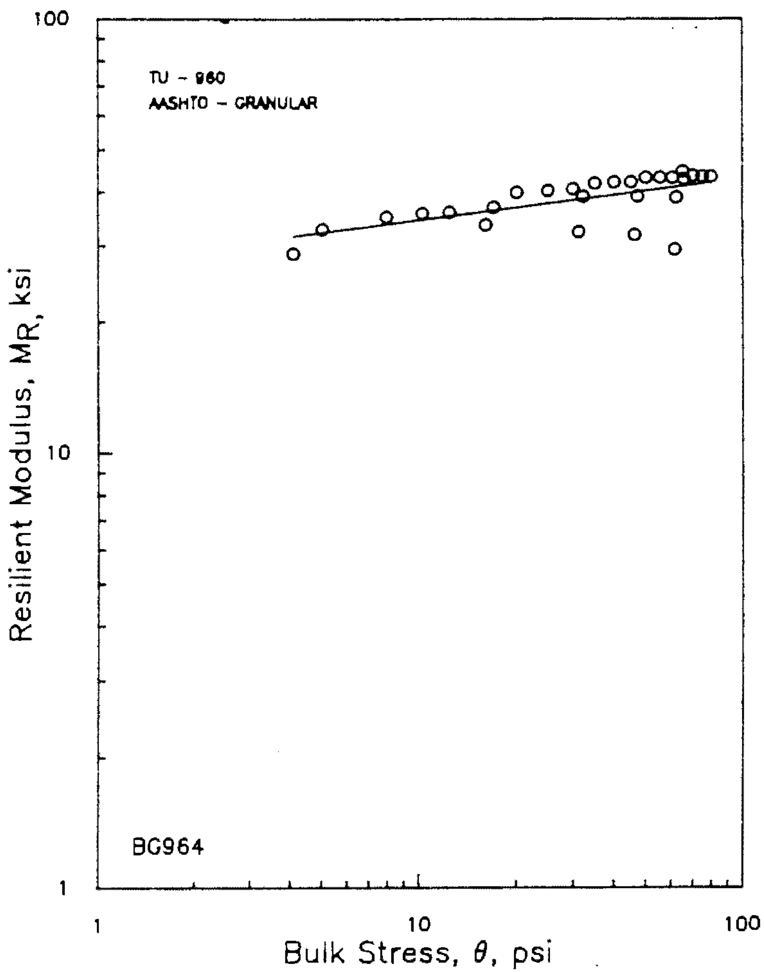

Figure B.3 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-960 using AASHTO Granular Procedure.

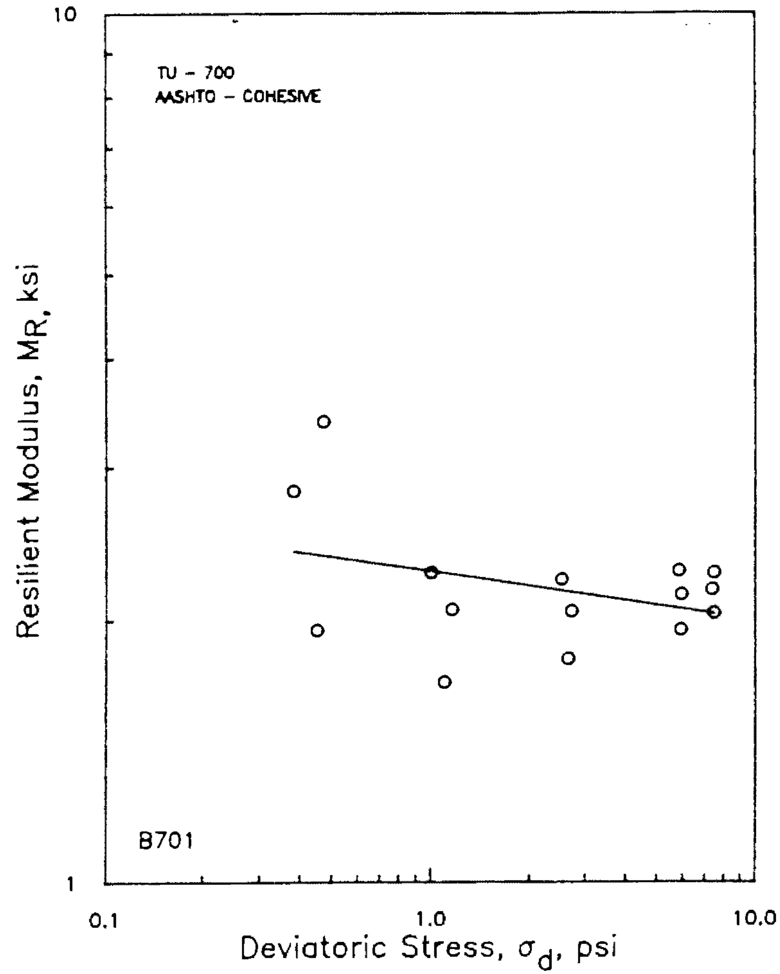

Figure B.4 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-700 using AASHTO Cohesive Procedure.

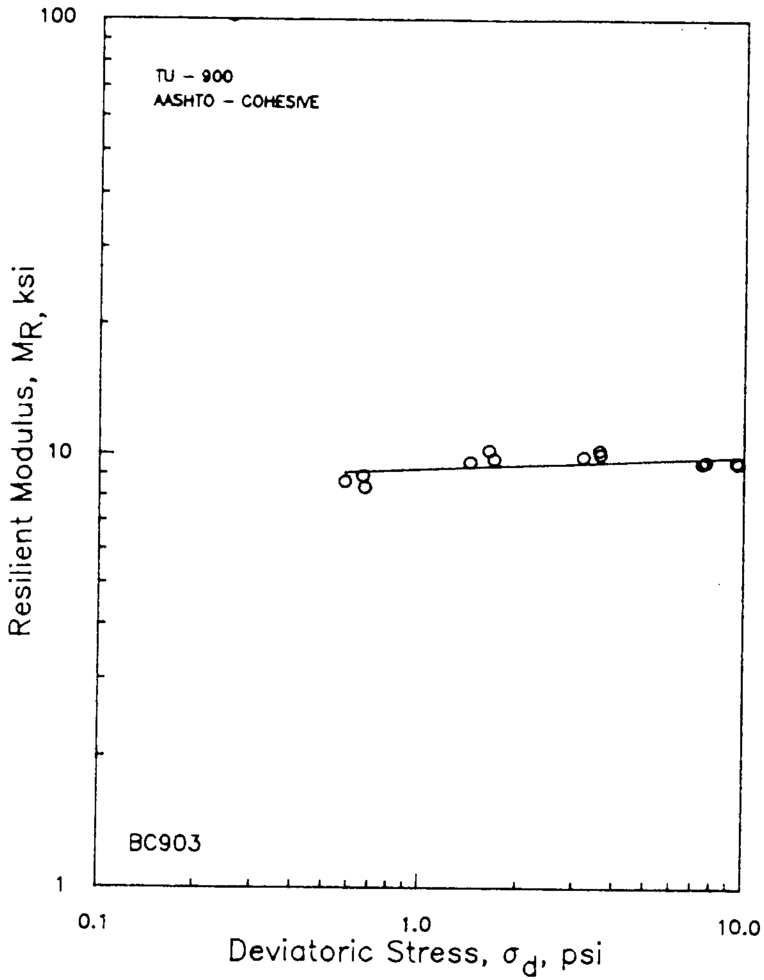

Figure B.5 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-900 using AASHTO Cohesive Procedure.

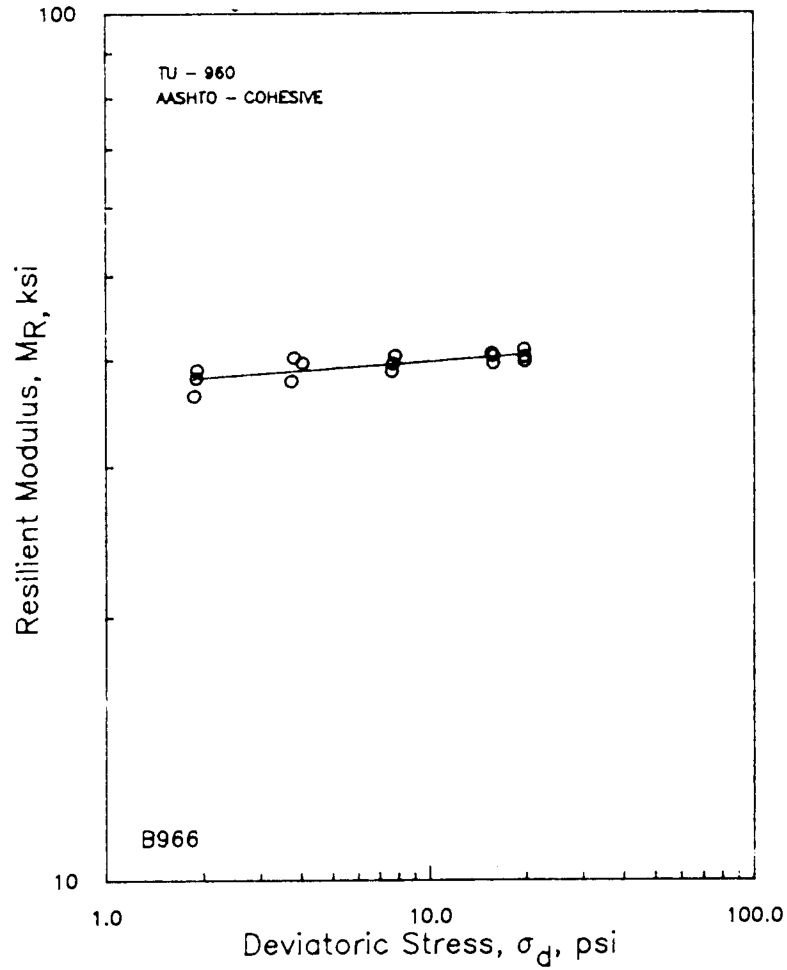

Figure B.6 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-960 using AASHTO Cohesive Procedure.

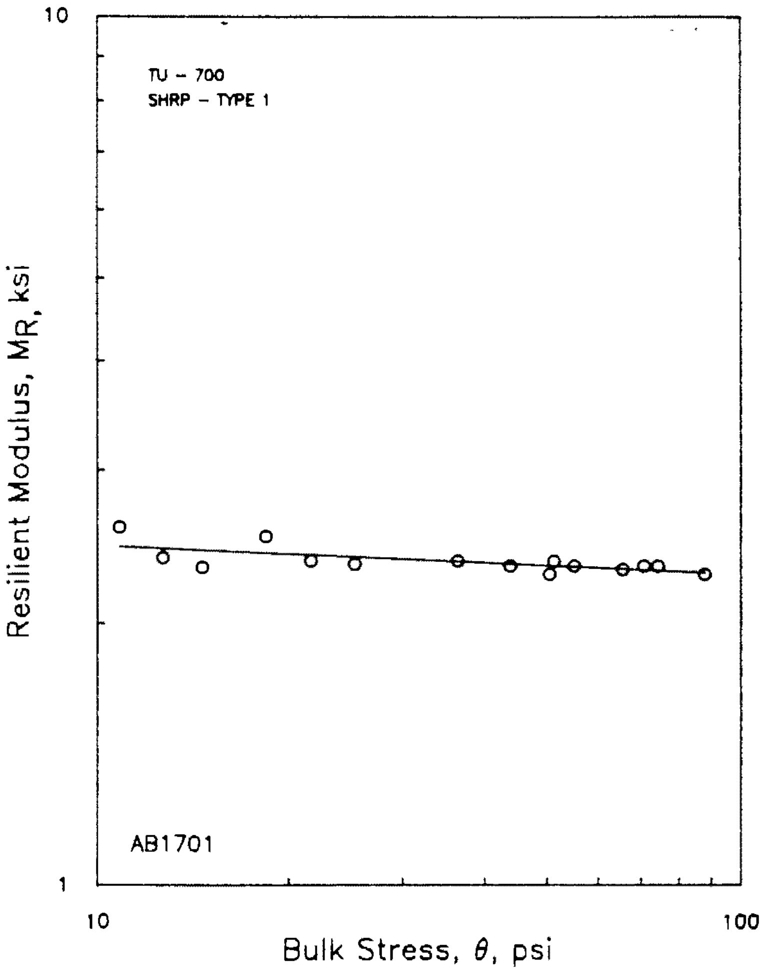

Figure B.7 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-700 using SHRP Type 1 Procedure.

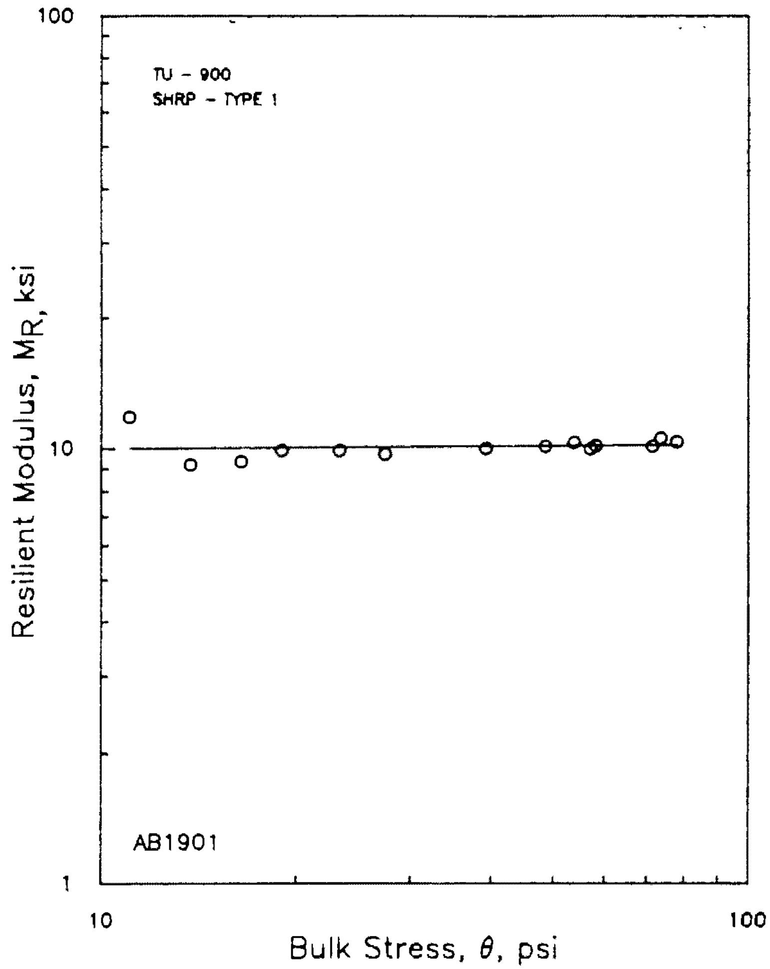

Figure B.8 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-900 using SHRP Type 1 Procedure.

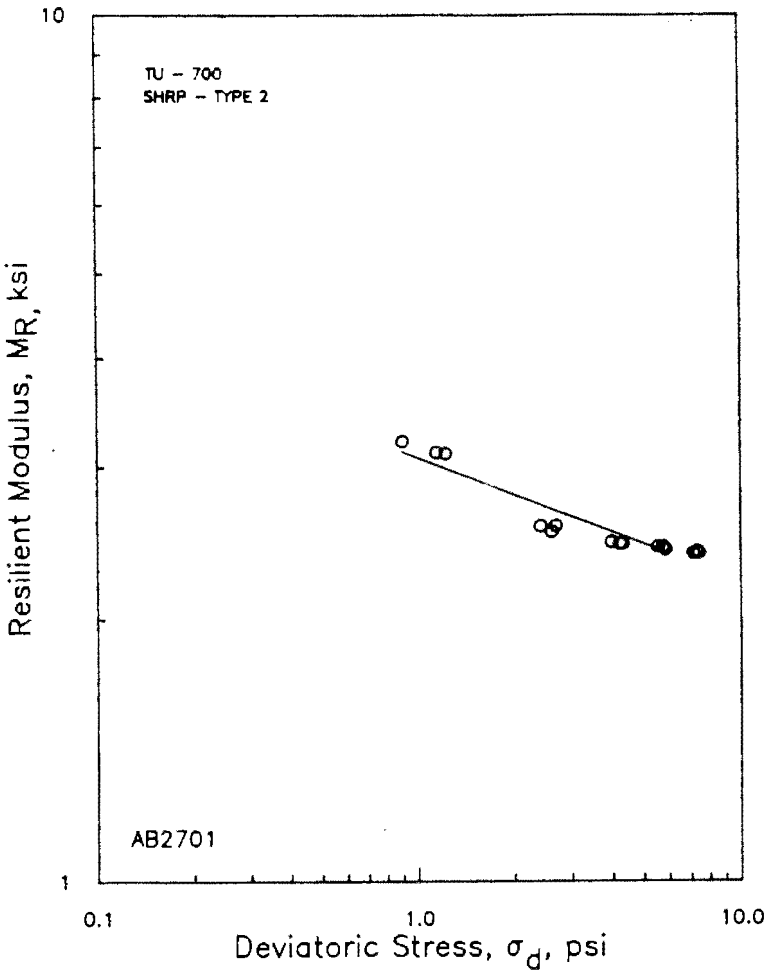

Figure B.9 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-700 using SHRP Type 2 Procedure.

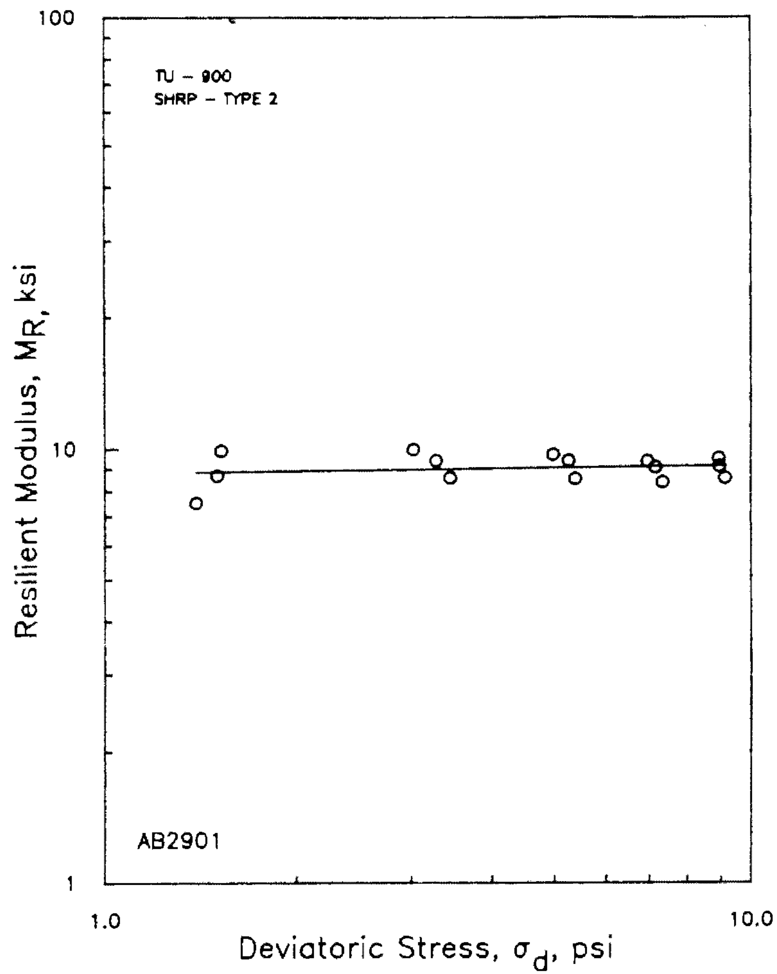

Figure B.10 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-900 using SHRP Type 2 Procedure.

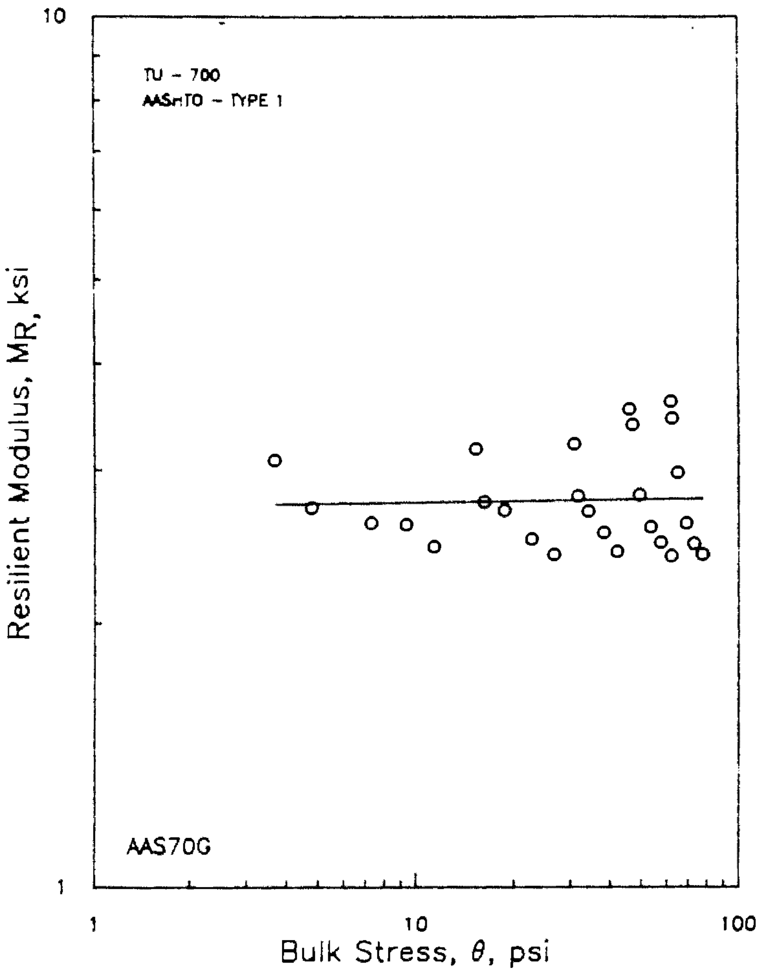

Figure B.11 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-700 using AASHTO Granular Procedure and Hydrostone.

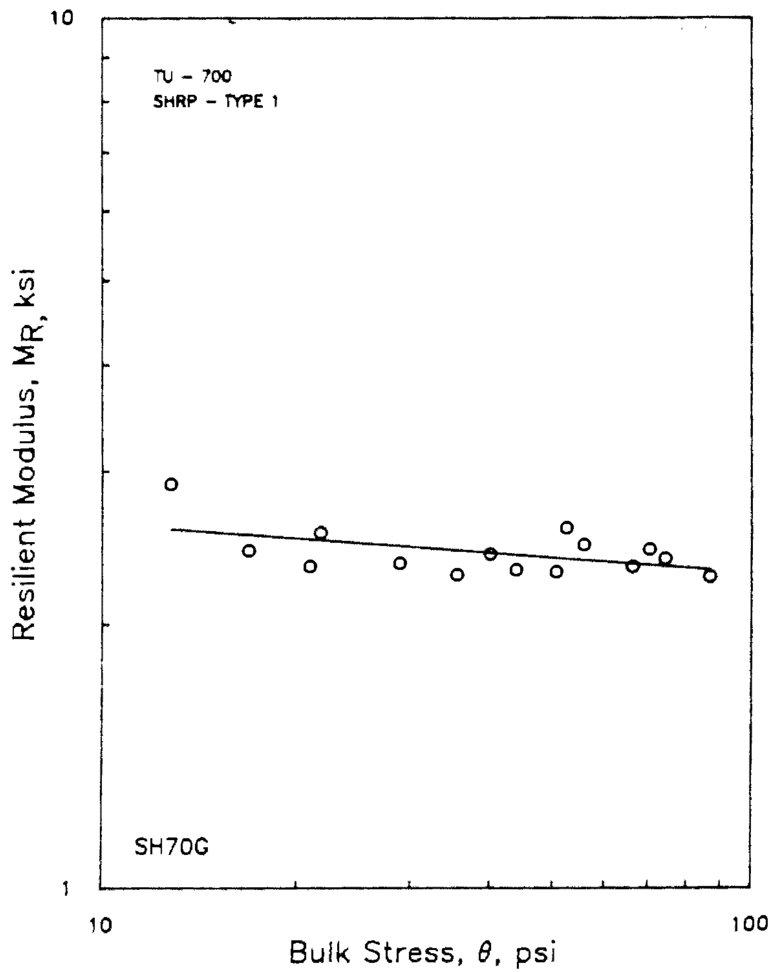

Figure B.12 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-700 using SHRP Type 1 Procedure and Hydrostone.

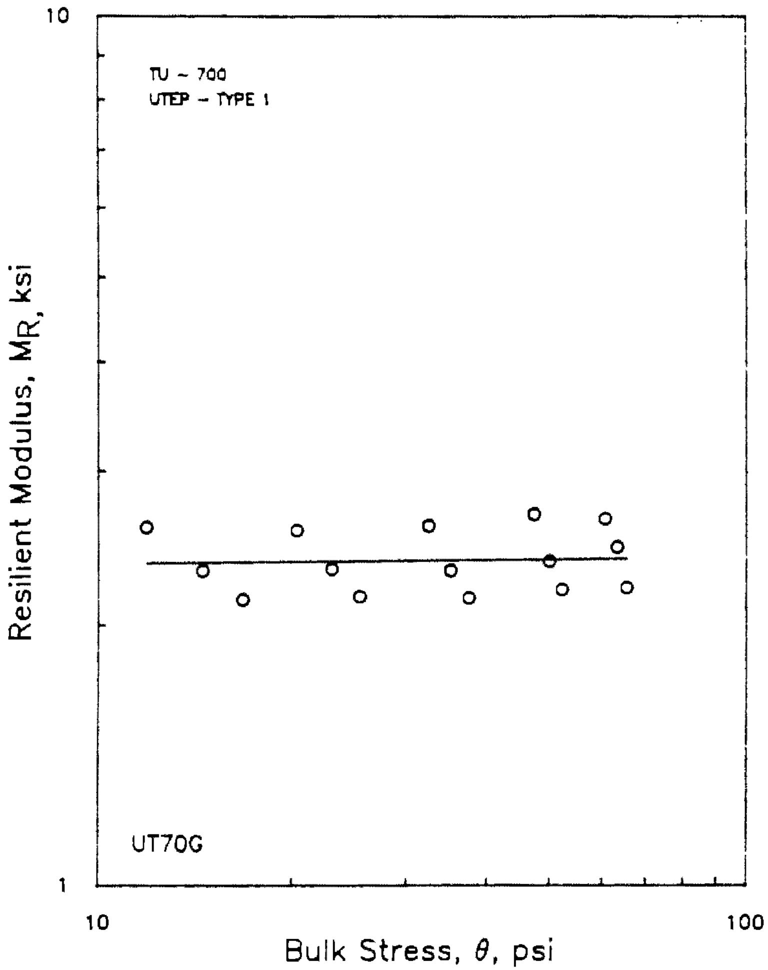

Figure B.13 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-700 using UTEP Type 1 Procedure and Hydrostone.

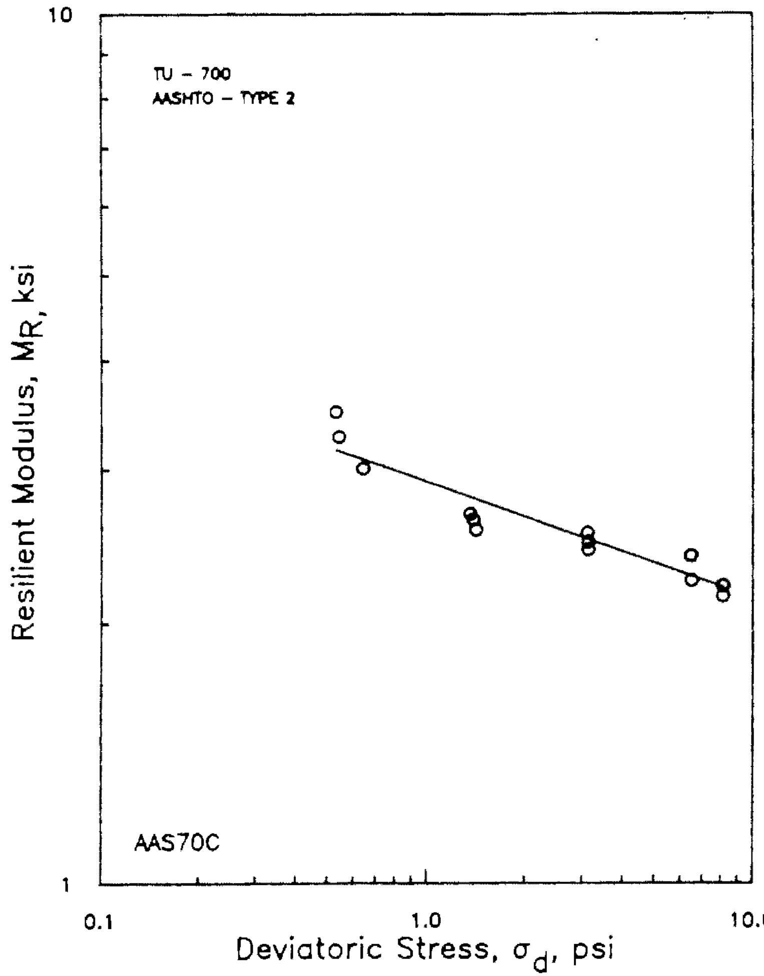

Figure B.14 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-700 using AASHTO Cohesive Procedure and Hydrostone.

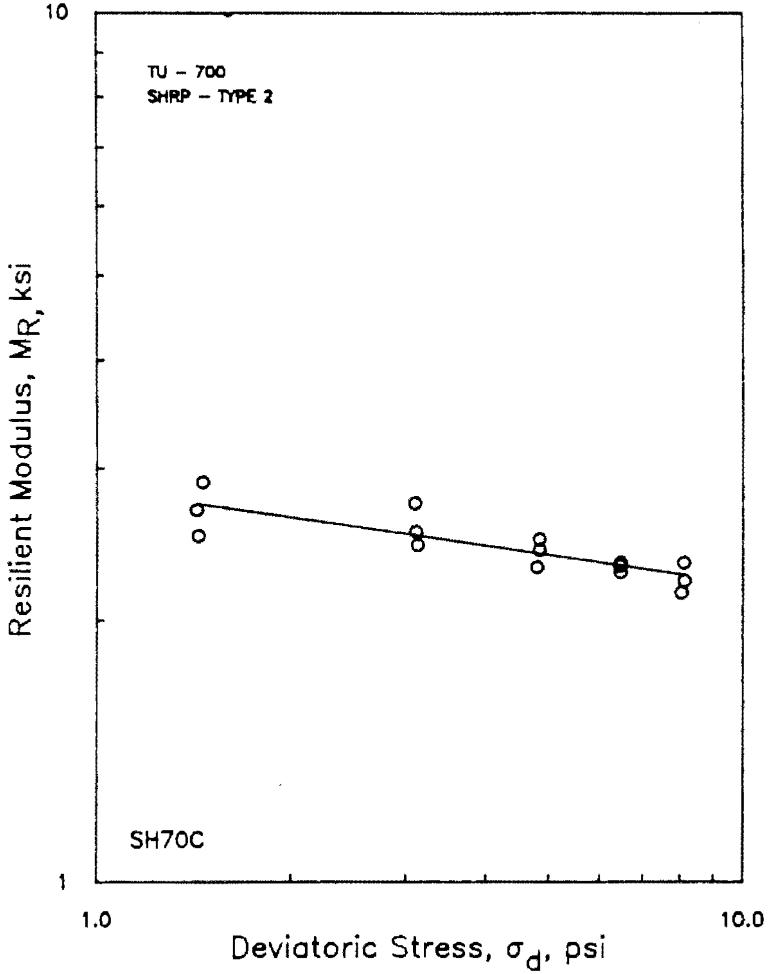

Figure B.15 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-700 using SHRP Type 2 Procedure and Hydrostone.

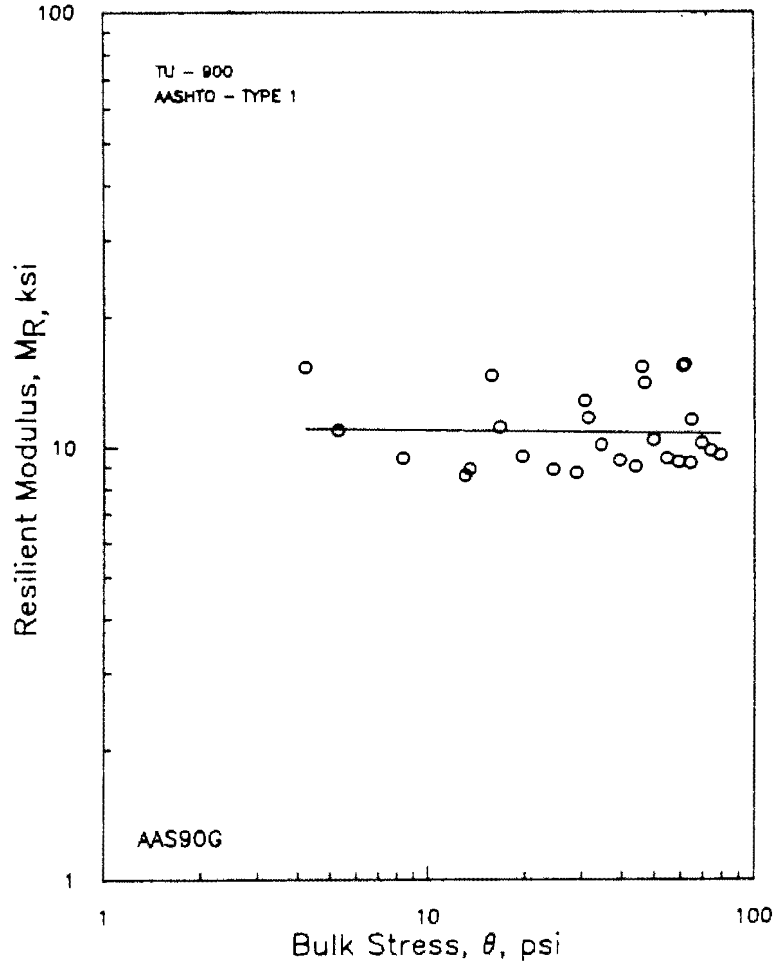

Figure B.16 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-900 using AASHTO Granular Procedure and Hydrostone.

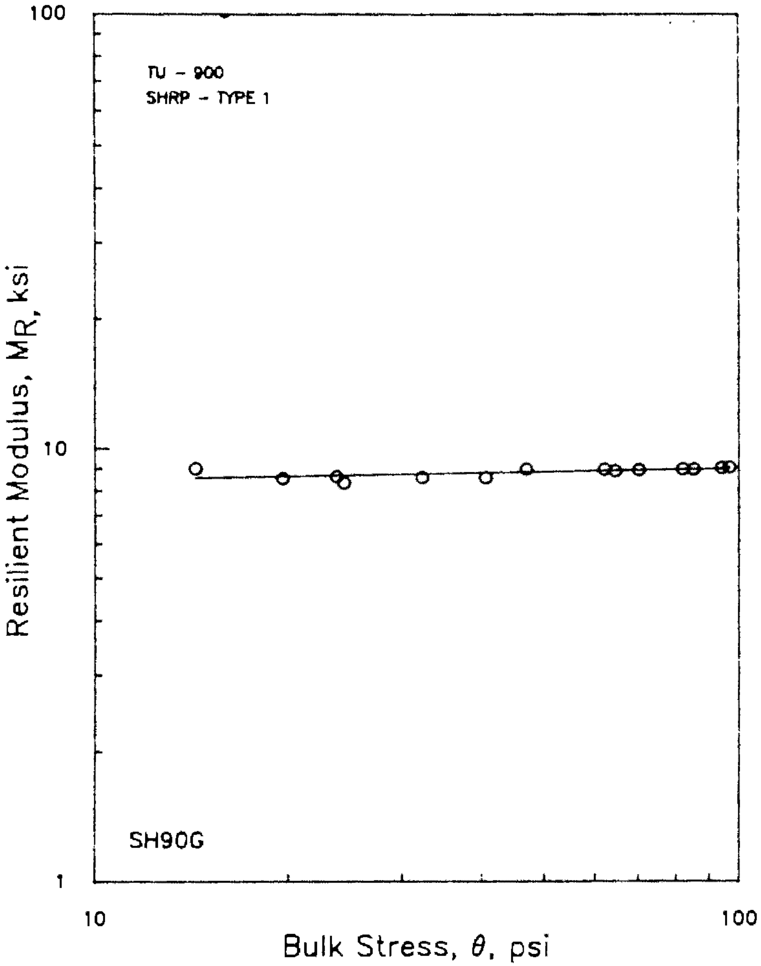

Figure B.17 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-900 using SHRP Type 1 Procedure and Hydrostone.

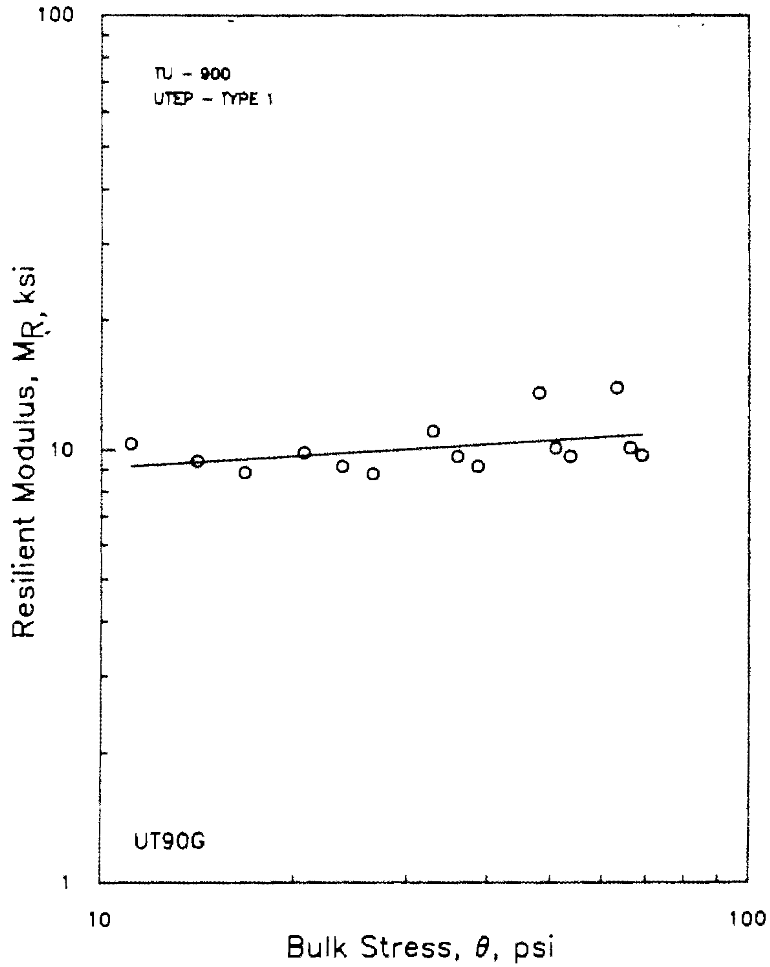

Figure B.18 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-900 using UTEP Type 1 Procedure and Hydrostone.

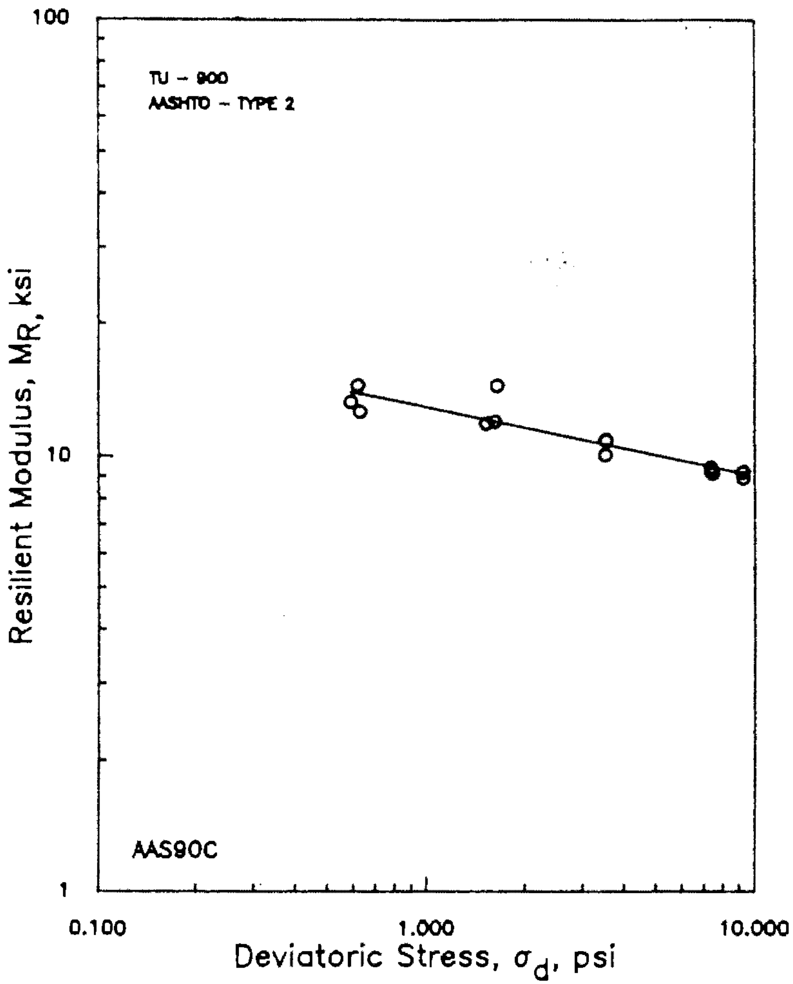

Figure B.19 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-900 using AASHTO Cohesive Procedure and Hydrostone.

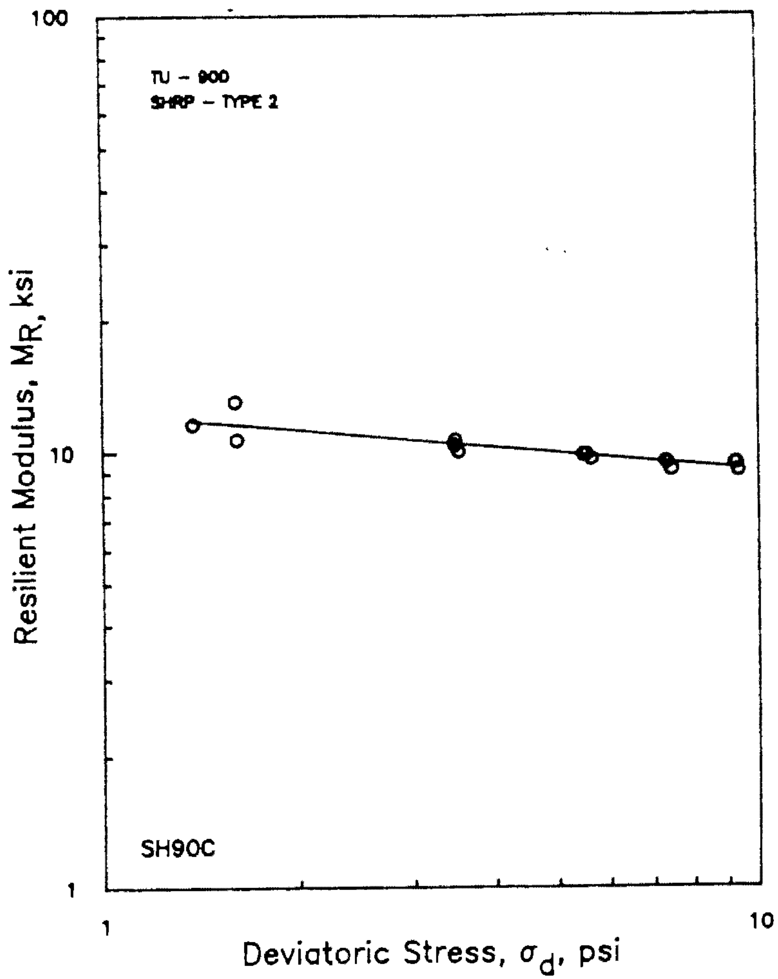

Figure B.20 - Variation in Resilient Modulus with Deviatoric Stress for Specimen TU-900 using SHRP Type 2 Procedure and Hydrostone.

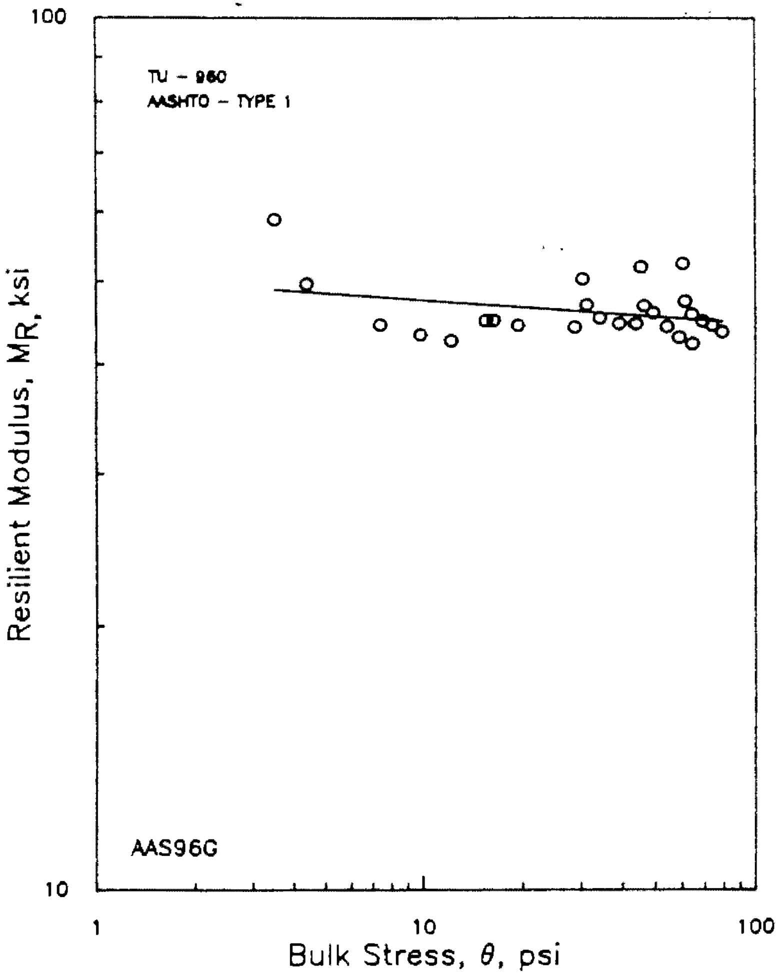

Figure B.21 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-960 using AASHTO Granular Procedure and Hydrostone.

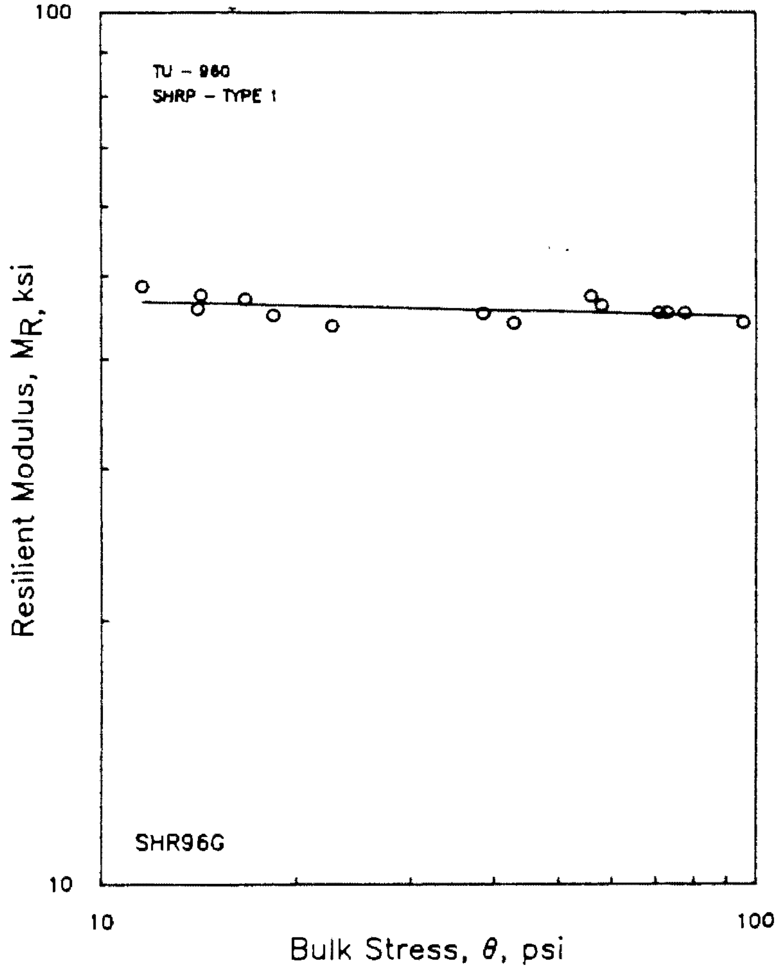

Figure B.22 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-960 using SHRP Type 1 Procedure and Hydrostone.

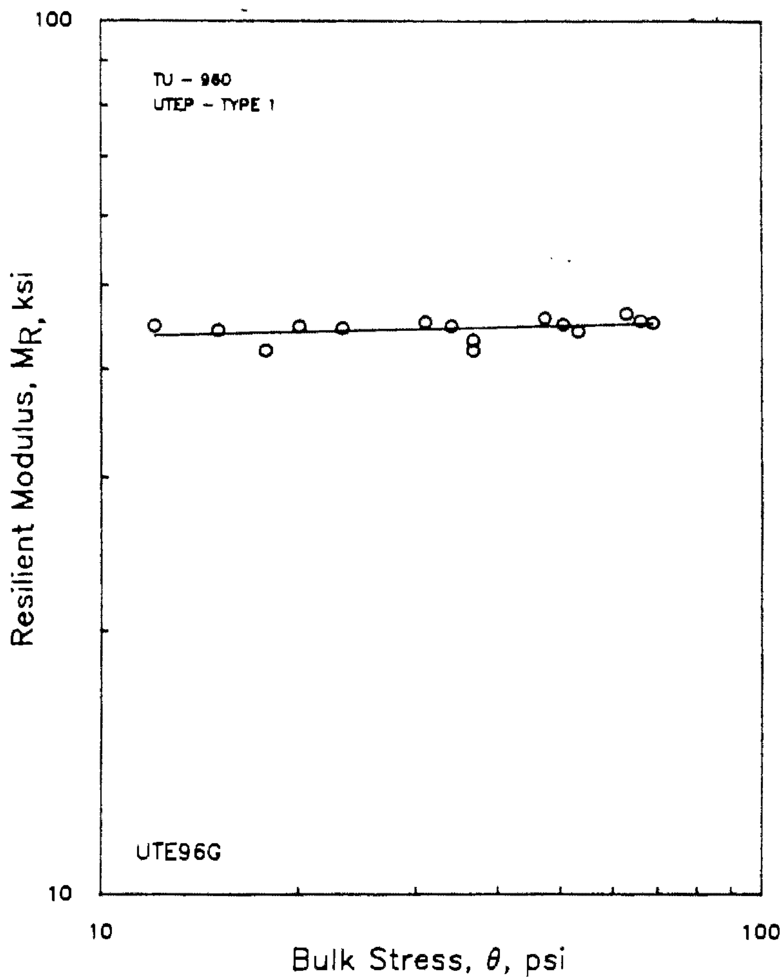

Figure B.23 - Variation in Resilient Modulus with Bulk Stress for Specimen TU-960 using UTEP Type 1 Procedure and Hydrostone.

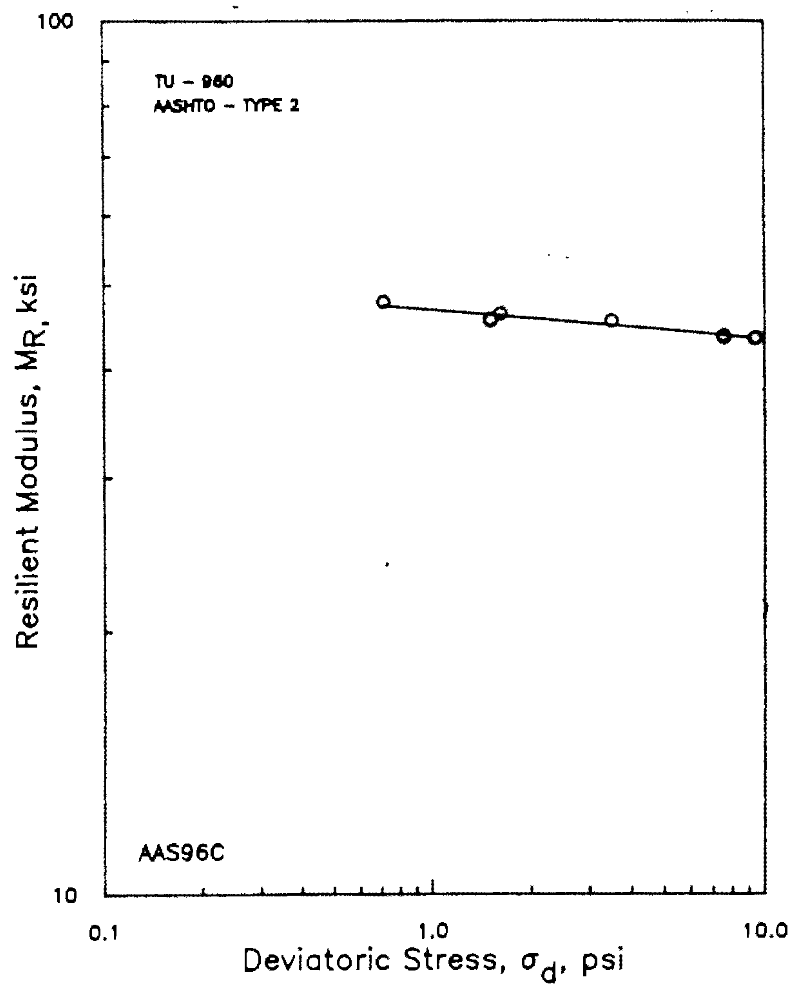

Figure B.24 - Variation in Resilient Modulus with Deviatoric Stress for Sample TU-960 using AASHTO Cohesive Procedure and Hydrostone.

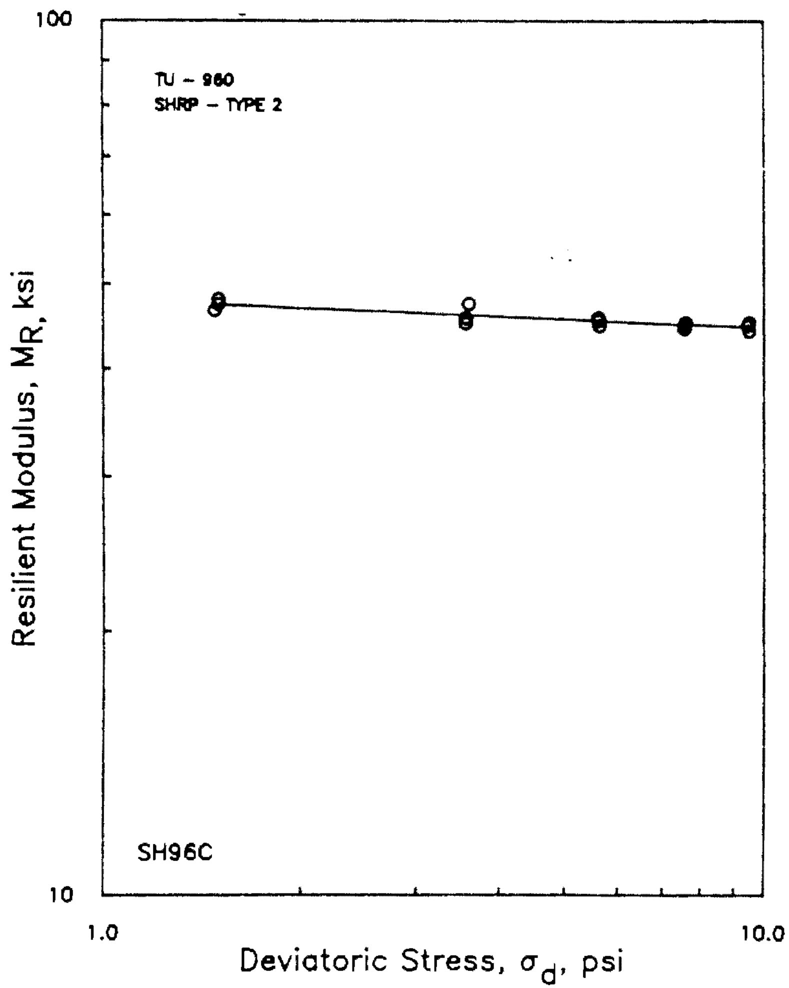

Figure B.25 - Variation in Resilient Modulus with Deviatoric Stress for Sample TU-960 using SHRP Type 2 Procedure and Hydrostone.

APPENDIX C

PLOTS FOR CLAY SPECIMENS

Table C.1 Regression Constants and R-squared for AASHTO/SHRP Model for Clay Specimens

SAMPLE ID	$M_R = k_1 \sigma_d^{k_2}$		
	k_1	k_2	R^2
CLAY2	1.012	0.009	0.59
CLAY4	0.968	0.029	0.86
CLAY5	1.234	-0.248	0.77
CLAY6	1.124	-0.454	0.22
CLAY7	1.104	-0.230	0.15
CLAY8	1.121	-0.277	0.12
CLAY9	1.103	-0.577	0.16
CLDRY1	1.088	0.031	0.14
CLDRY2	1.118	0.030	0.16
CLWET1	1.096	-0.103	0.52
CLWET2	1.182	-0.221	0.82
CLFIX1	1.256	-0.224	0.89
CLFIX2	1.269	-0.216	0.84
CLDFX1	0.977	-0.306	0.92
CLDFX2	1.202	-0.245	0.96
CLWFX1	0.673	-0.812	0.28
CLWFX2	0.755	-0.346	0.96

Table C.2 Regression Constants and R-squared for UTEP Model One for Clay Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CLAY2	0.541	0.196	-0.071	0.57
CLAY4	-0.193	0.613	-0.139	0.90
CLAY5	-0.206	0.297	-0.273	0.94
CLAY6	0.180	0.035	-0.158	0.96
CLAY7	0.416	0.276	-0.104	0.86
CLAY8	0.203	0.369	-0.138	0.96
CLAY9	-0.381	0.609	-0.220	0.93
CLDRY1	0.161	0.288	-0.157	0.90
CLDRY2	0.119	0.144	-0.219	0.84
CLWET1	0.325	0.404	-0.091	0.92
CLWET2	0.438	0.366	-0.080	0.88
CLFIX1	0.150	0.163	-0.220	0.95
CLFIX2	0.165	0.172	-0.217	0.91
CLDFX1	-0.162	0.104	-0.260	0.94
CLDFX2	0.205	0.086	-0.216	0.97
CLWFX1	0.374	-0.081	-0.114	0.29
CLWFX2	-0.118	-0.600	-0.250	0.96

Table C.3 Regression Constants and R-squared for UTEP Model One for Clay Specimens

SAMPLE ID	$M_R = k_1 \sigma_c^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CLAY2	0.886	0.161	-0.015	0.70
CLAY4	0.801	0.509	-0.027	0.88
CLAY5	0.263	0.223	-0.207	0.94
CLAY6	0.701	0.219	-0.081	0.92
CLAY7	0.908	0.209	-0.027	0.87
CLAY8	0.848	0.284	-0.038	0.97
CLAY9	0.618	0.441	-0.078	0.81
CLDRY1	1.045	0.319	-0.024	0.93
CLDRY2	1.098	0.287	-0.025	0.91
CLWET1	0.620	0.221	-0.091	0.91
CLWET2	0.324	0.117	-0.192	0.85
CLFIX1	0.399	0.123	-0.185	0.96
CLFIX2	0.417	0.136	-0.183	0.93
CLDFX1	-0.006	0.056	-0.241	0.93
CLDFX2	0.332	0.066	-0.198	0.98
CLWFX1	0.248	-0.067	-0.136	0.90
CLWFX2	-0.188	-0.060	-0.261	0.97

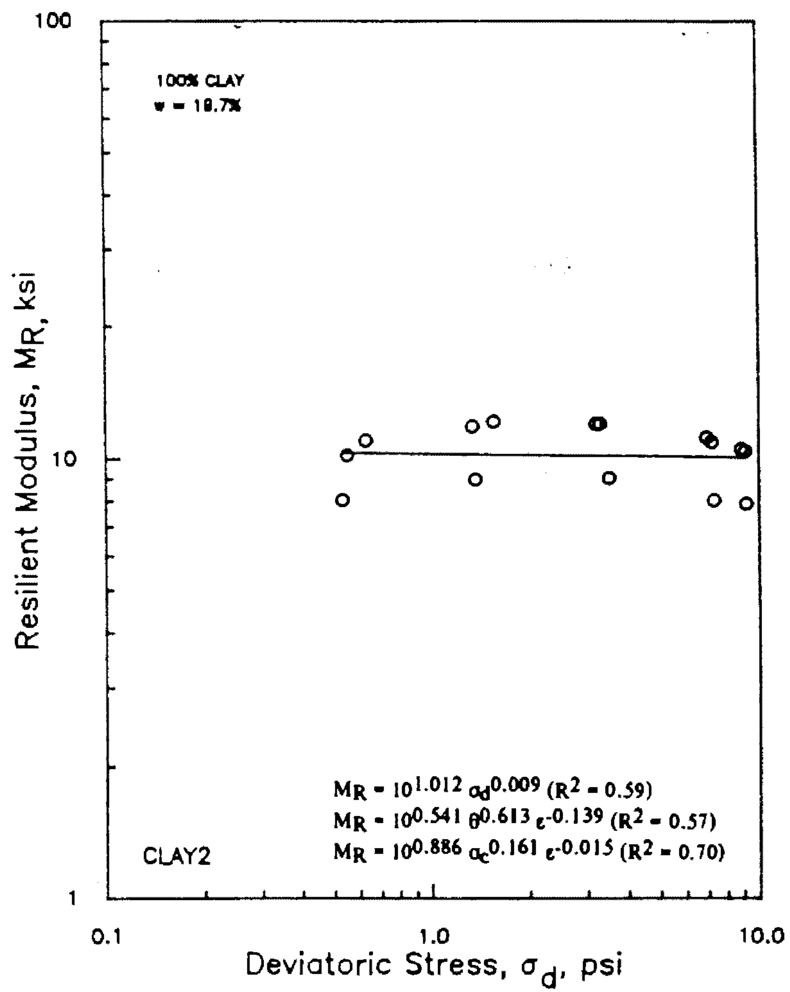

Figure C.1 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY2 using AASHTO Cohesive Procedure.

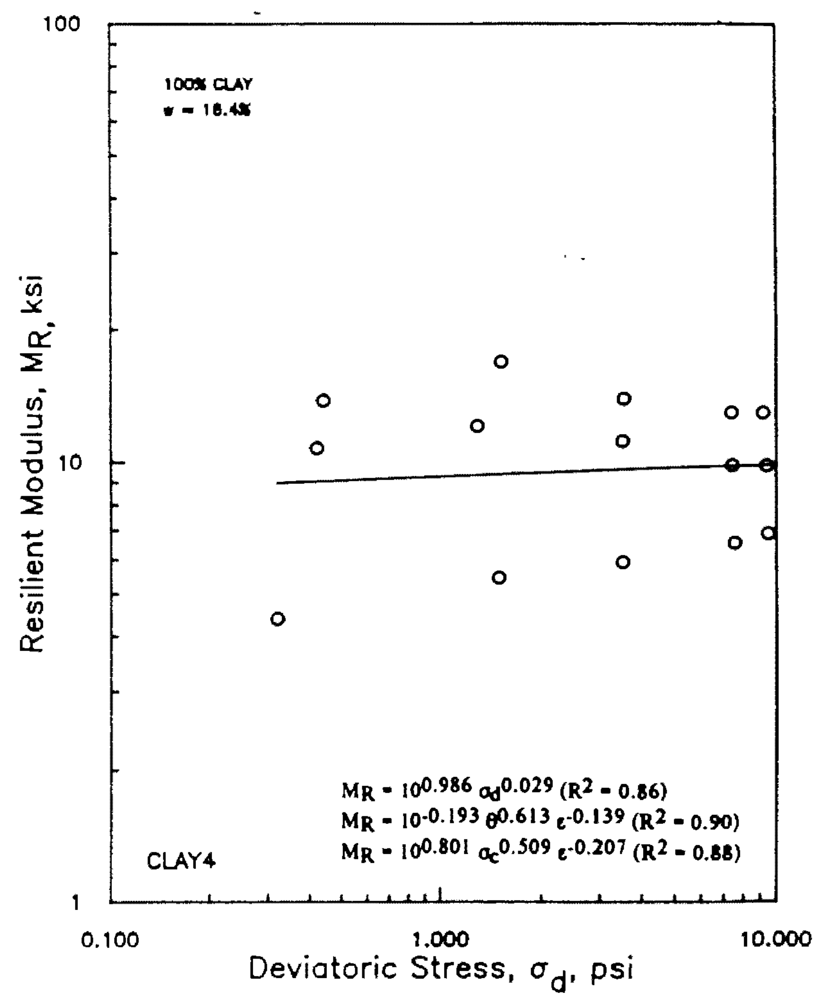

Figure C.2 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY4 using AASHTO Cohesive Procedure.

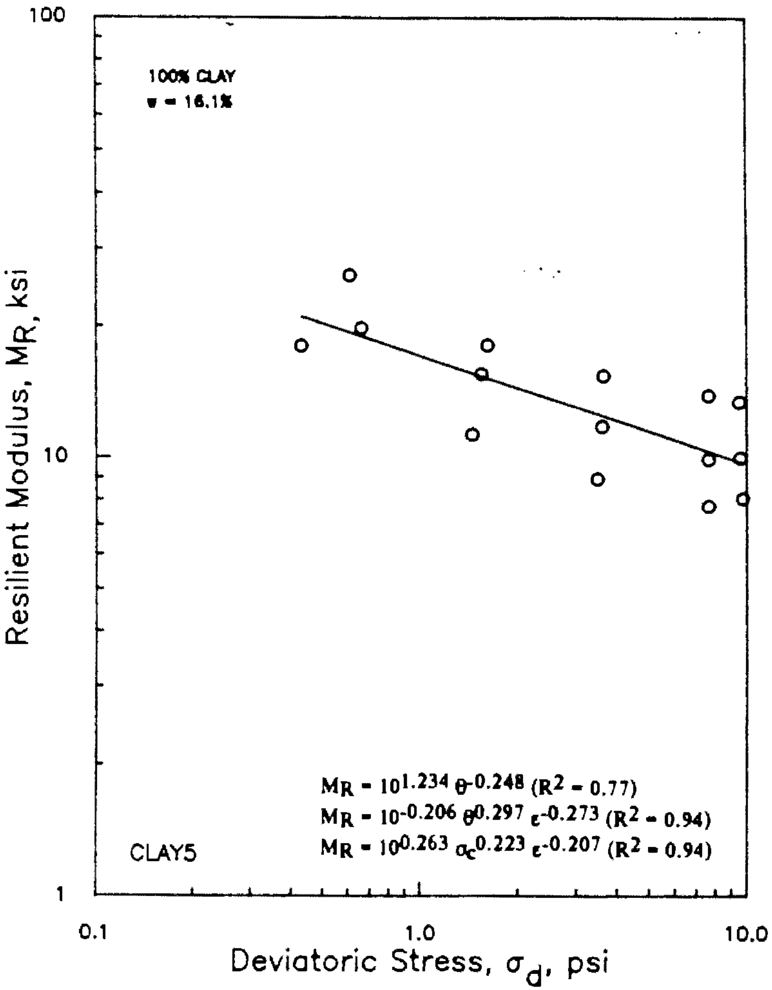

Figure C.3 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY5 using AASHTO Cohesive Procedure.

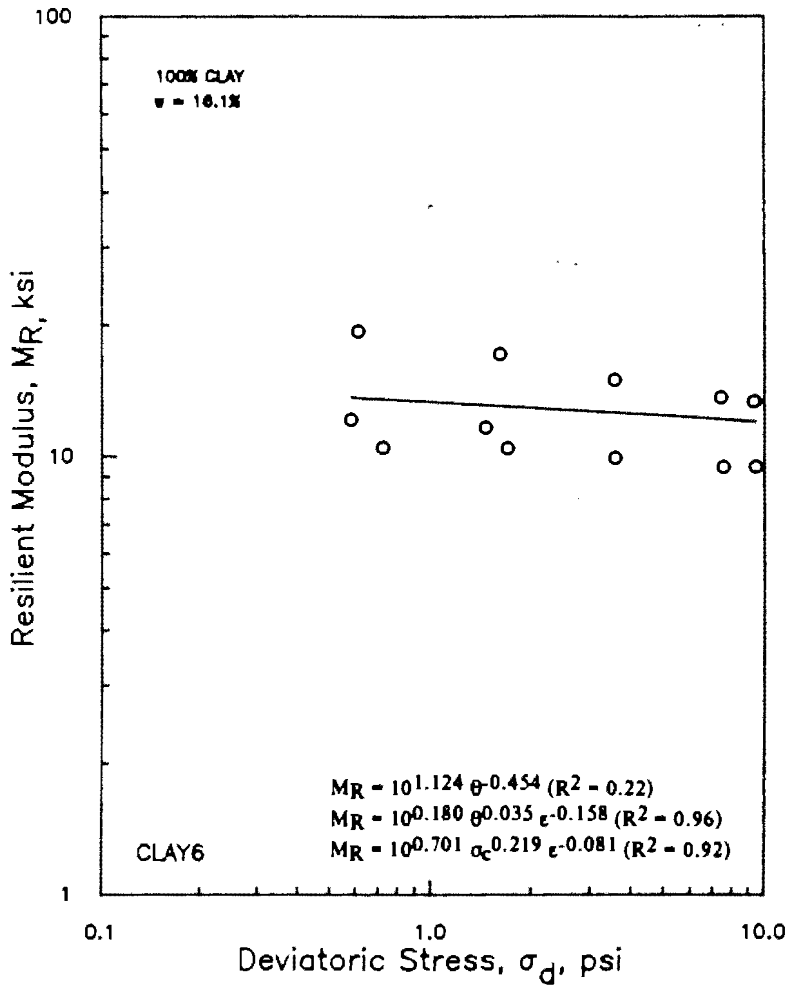

Figure C.4 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY6 using AASHTO Cohesive Procedure.

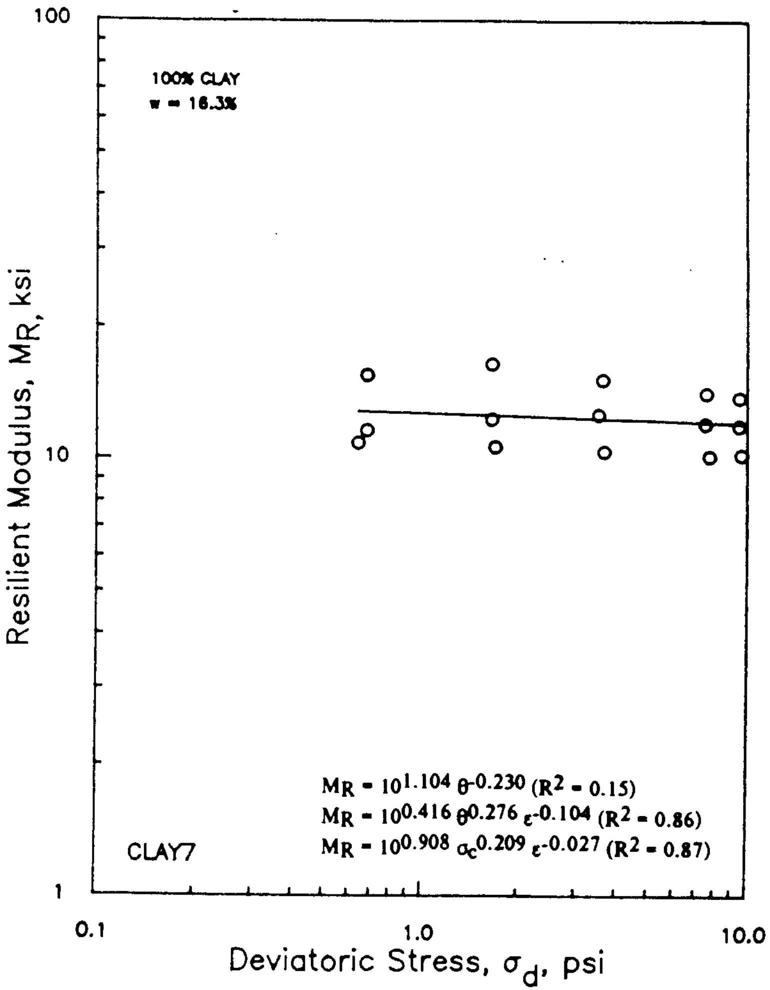

Figure C.5 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY7 using AASHTO Cohesive Procedure.

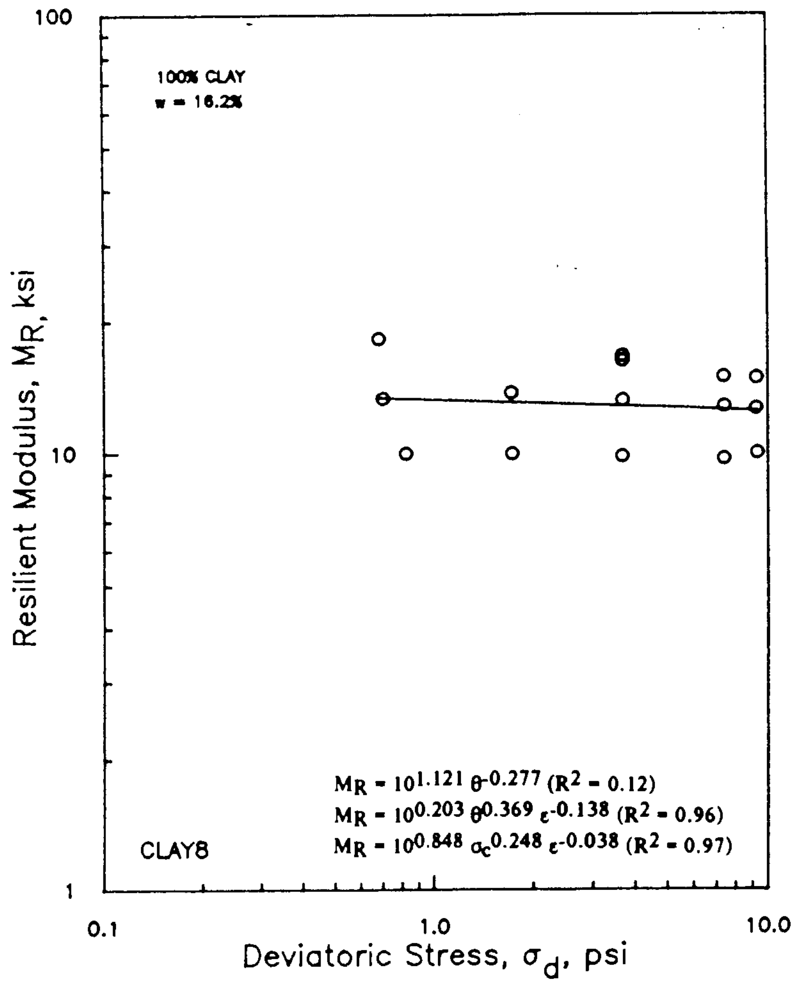

Figure C.6 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY8 using AASHTO Cohesive Procedure.

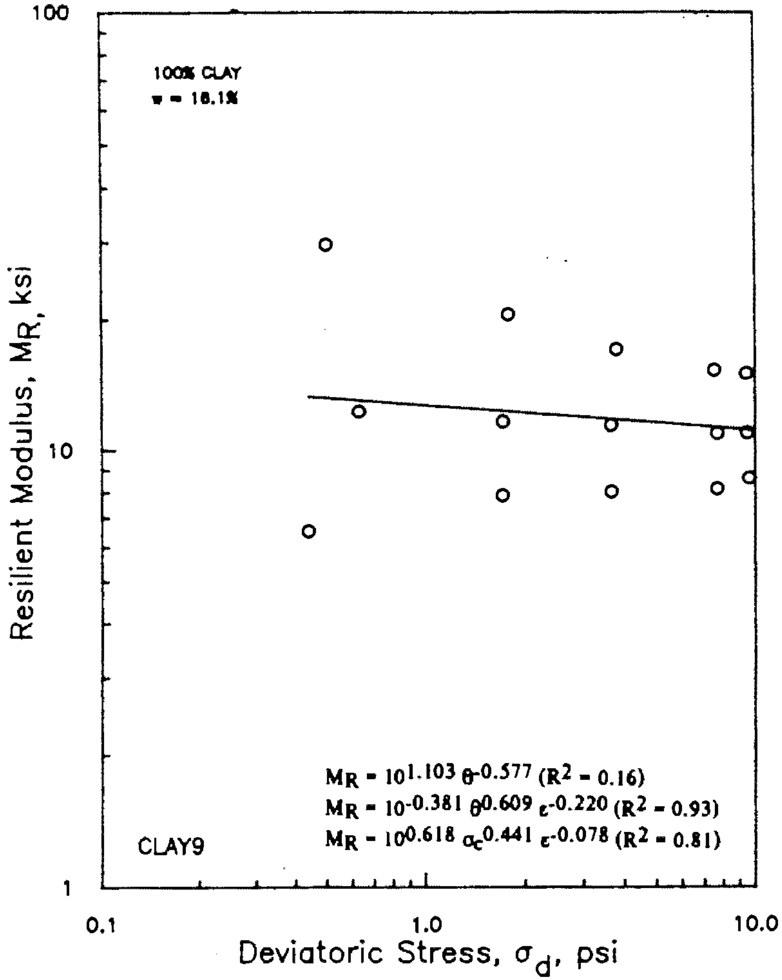

Figure C.7 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLAY9 using AASHTO Cohesive Procedure.

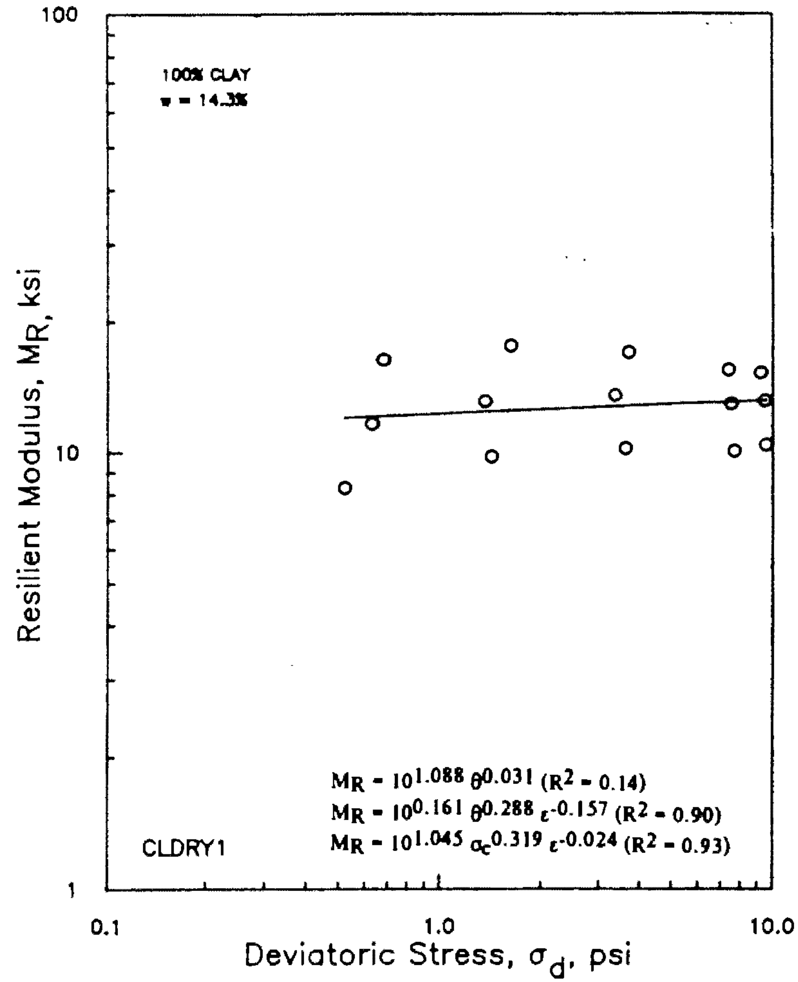

Figure C.8 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLDRY1 using AASHTO Cohesive Procedure.

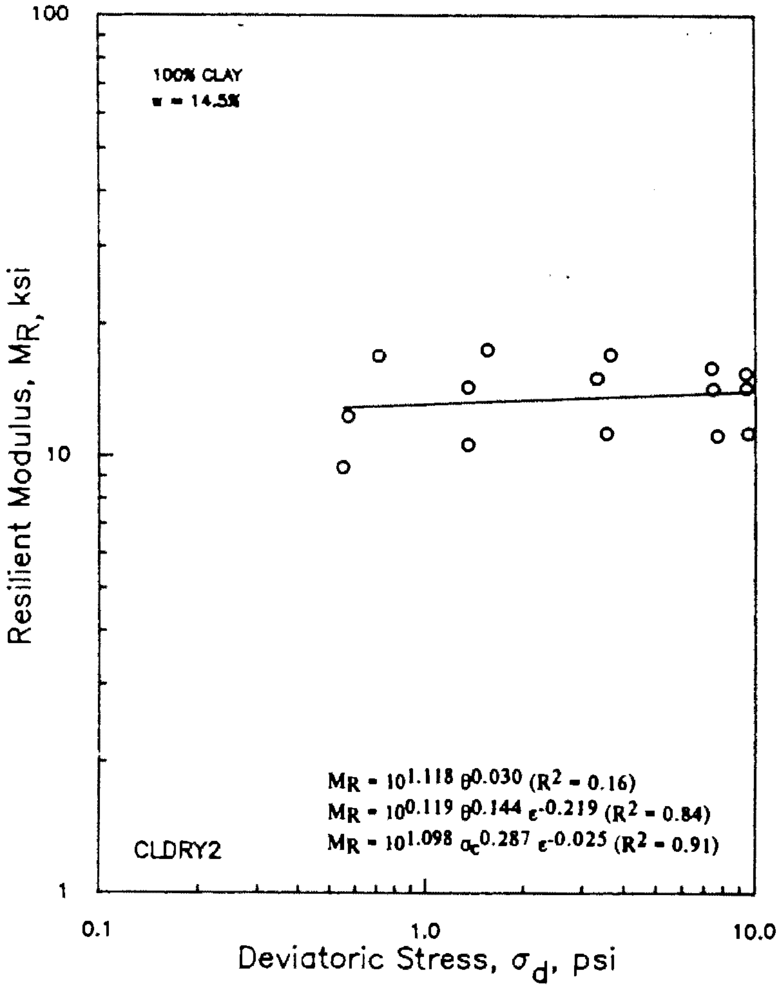

Figure C.9 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLDRY2 using AASHTO Cohesive Procedure.

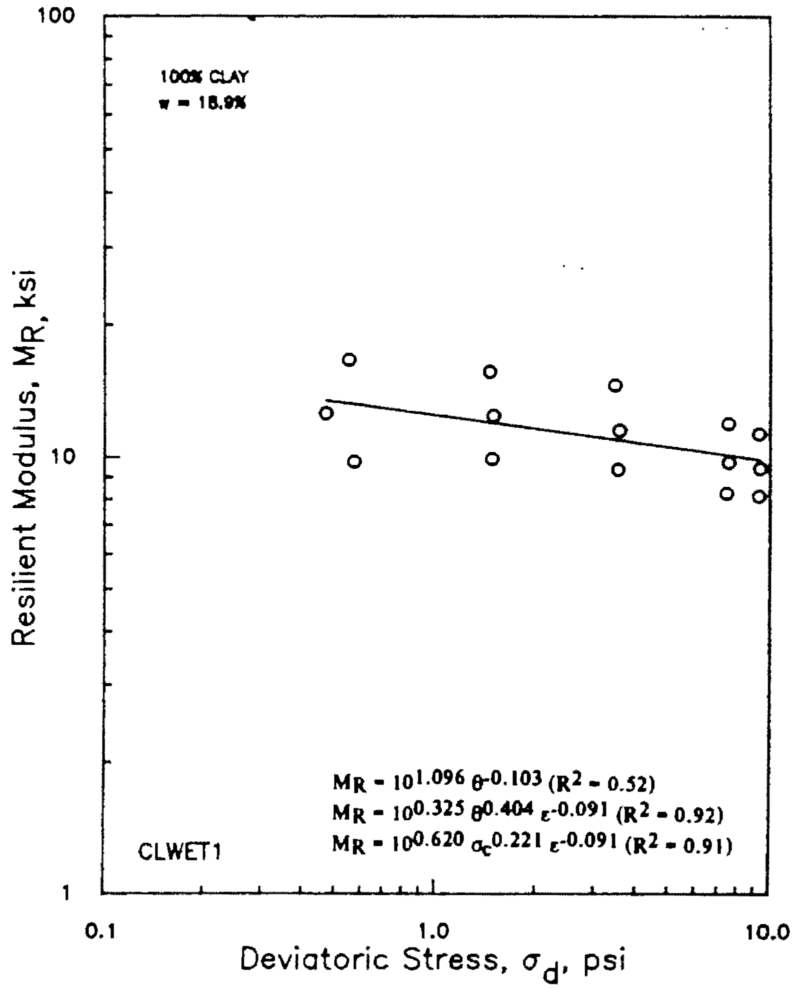

Figure C.10 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLWET1 using AASHTO Cohesive Procedure.

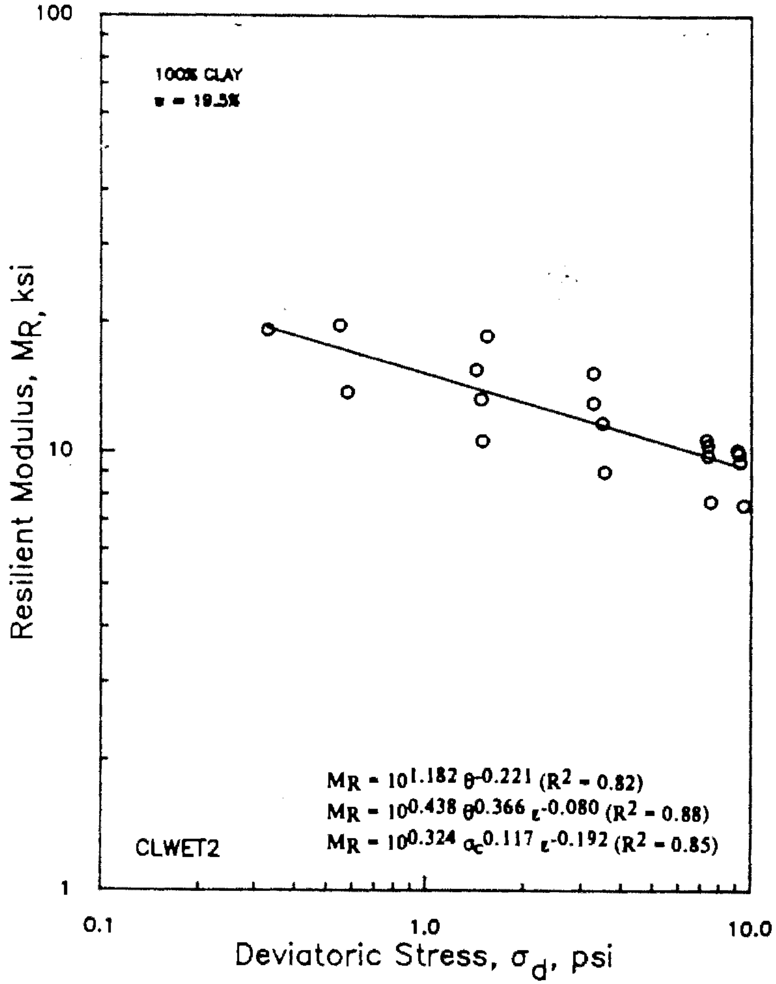

Figure C.11 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLWET2 using AASHTO Cohesive Procedure.

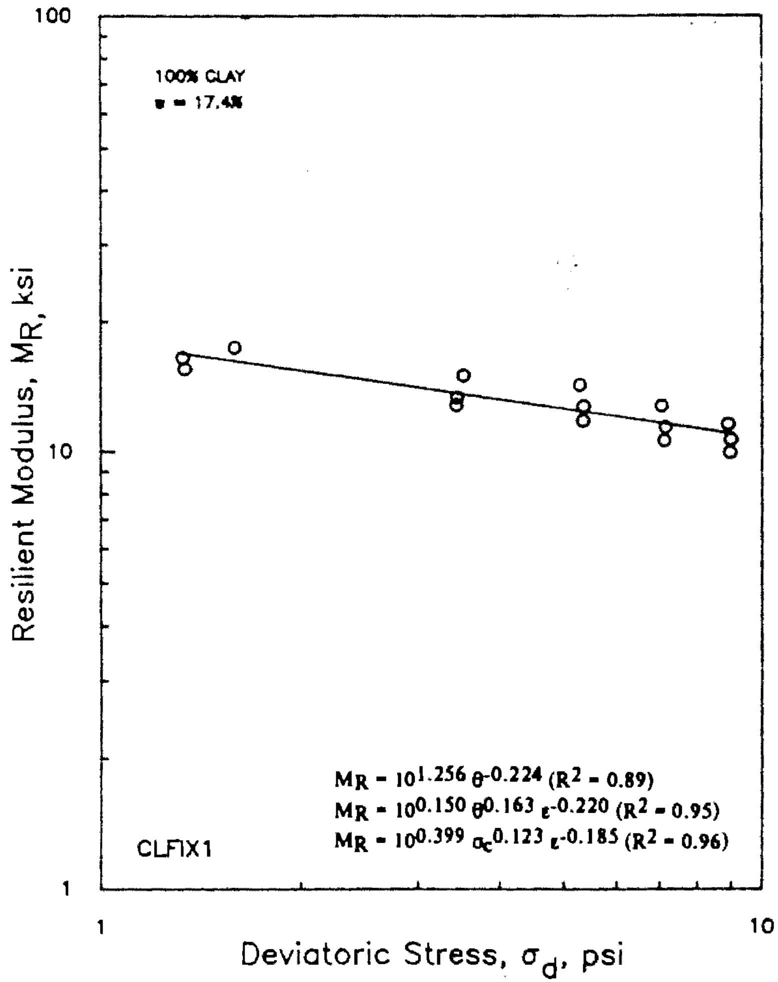

Figure C.12 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLFIX1 using SHRP Type 2 Procedure and Hydrostone.

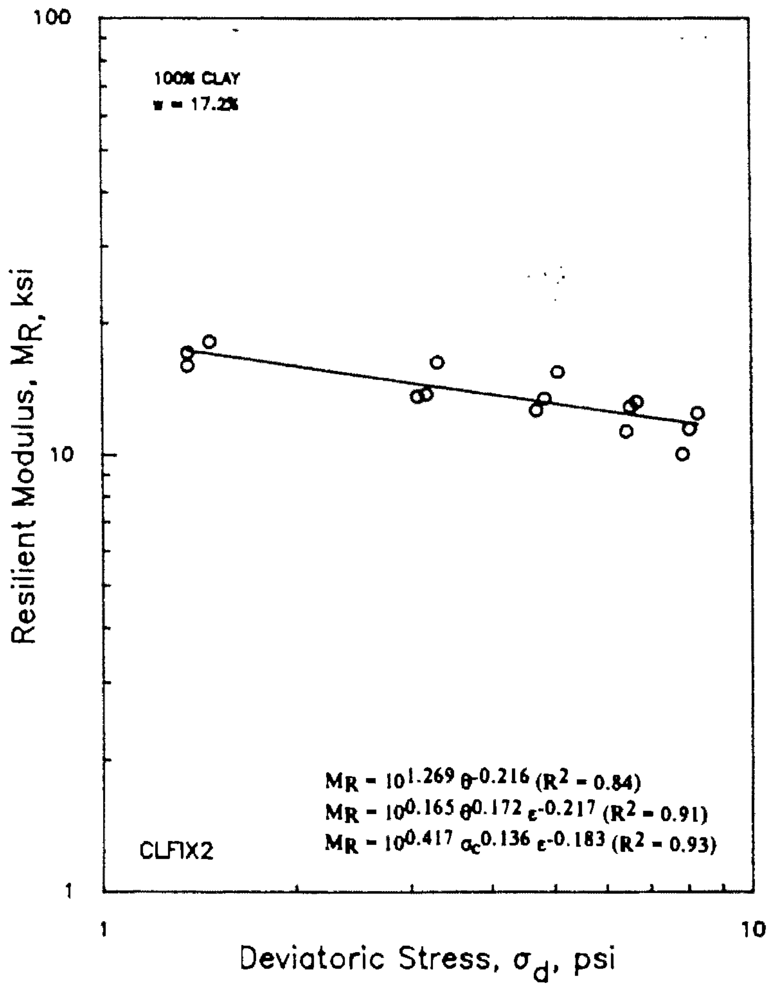

Figure C.13 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLFIX2 using SHRP Type 2 Procedure and Hydrostone.

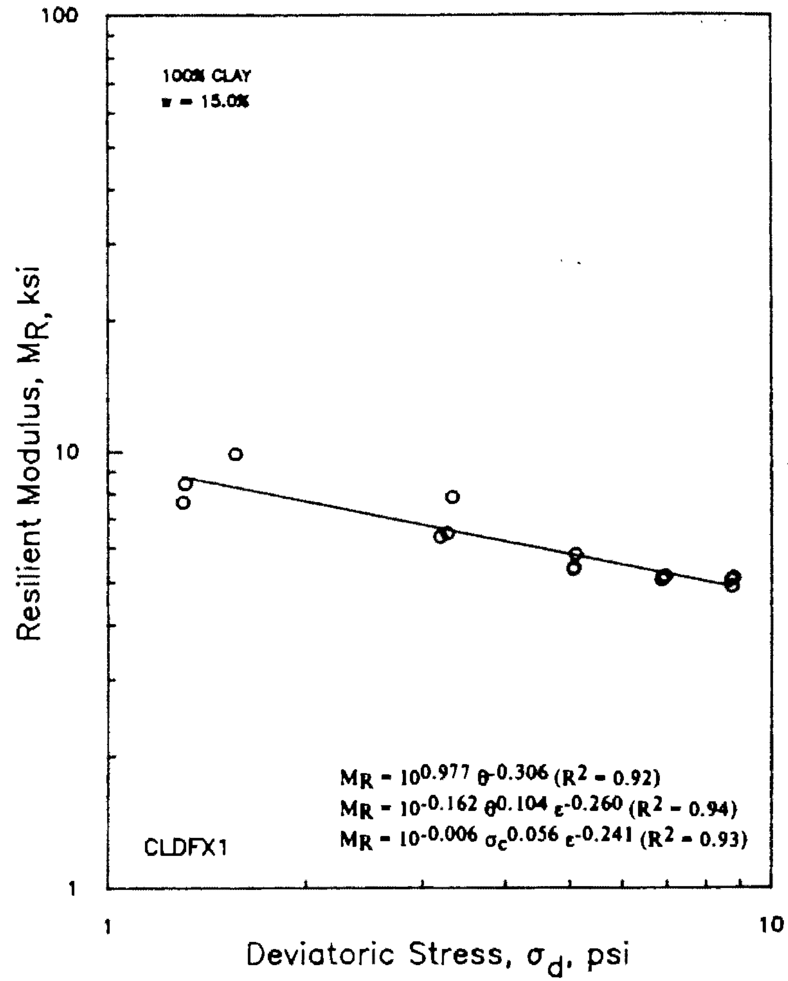

Figure C.14 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLDFX1 using SHRP Type 2 Procedure and Hydrostone.

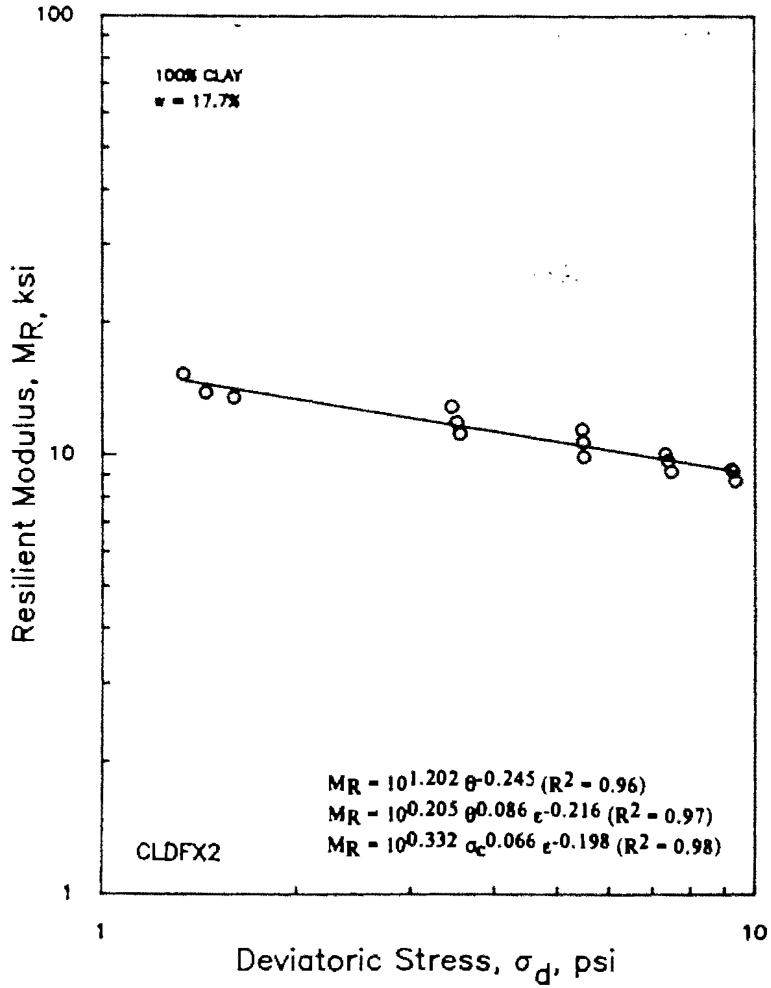

Figure C.15 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLDFX2 using SHRP Type 2 Procedure and Hydrostone.

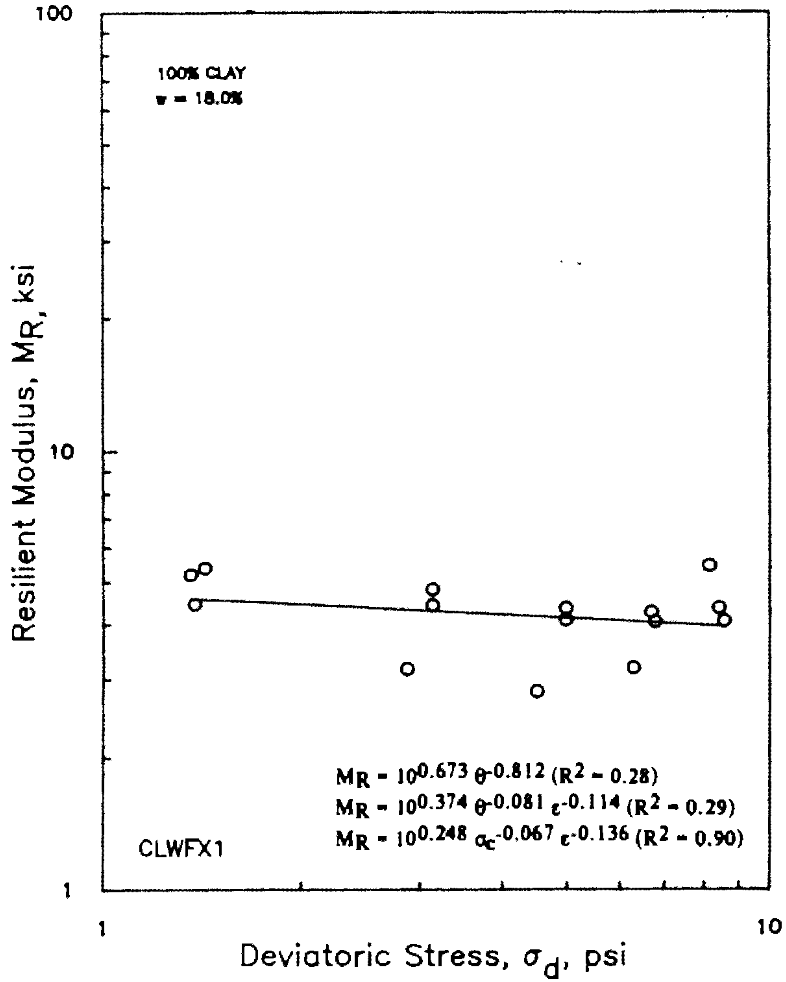

Figure C.16 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLWFX1 using SHRP Type 2 Procedure and Hydrostone.

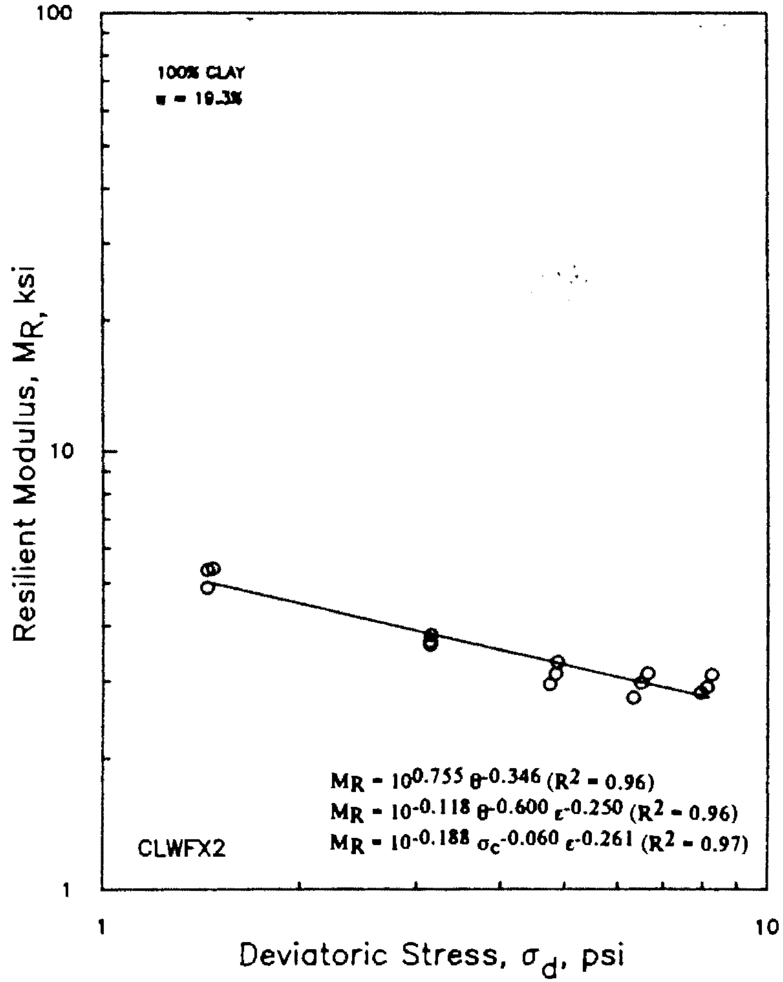

Figure C.17 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CLWFX2 using SHRP Type 2 Procedure and Hydrostone.

APPENDIX D

PLOTS FOR SAND SPECIMENS

Table D.1 Regression Constants and R-squared for AASHTO/SHRP Model for Sand Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2}$		
	k_1	k_2	R^2
SAND4	0.399	0.581	0.95
SAND5	0.780	0.401	0.86
SAND6	0.517	0.511	0.92
SADIS1	0.229	0.745	0.97
SADIS2	0.261	0.752	0.98
SADIS3	0.084	0.838	0.98
UTEP1	0.354	0.713	0.81
UTEP2	0.460	0.577	0.87
UTEP3	0.455	0.632	0.78
UTEP4	0.368	0.692	0.79
UT701	0.253	0.664	0.84
UT702	0.523	0.532	0.88
UT703	0.530	0.555	0.93

Table D.2 Regression Constants and R-squared for UTEP Model One for Sand Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
SAND4	-0.628	0.700	-0.255	0.95
SAND5	-0.471	0.564	-0.294	1.00
SAND6	-0.564	0.639	-0.267	0.99
SADIS1	-0.131	0.668	-0.128	0.98
SADIS2	-0.266	0.753	0.002	0.99
SADIS3	-1.548	0.243	-0.731	1.00
UTEP1	-0.659	0.494	-0.354	0.96
UTEP2	-0.279	0.452	-0.251	0.99
UTEP3	-0.560	0.450	-0.342	0.99
UTEP4	-0.633	0.476	-0.352	0.96
UT701	-0.445	0.618	-0.207	0.81
UT702	-0.187	0.467	-0.217	0.97
UT703	-0.044	0.473	-0.186	0.99

Table D.3 Regression Constants and R-squared for UTEP Model One for Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_c^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
SAND4	0.525	0.621	-0.062	1.00
SAND5	0.462	0.473	-0.149	0.95
SAND6	0.479	0.553	-0.098	0.99
SADIS1	-0.036	0.141	-0.756	0.99
SADIS2	1.234	0.138	-0.125	0.97
SADIS3	-1.549	0.432	-0.802	1.00
UTEP1	-0.144	0.398	-0.307	0.95
UTEP2	0.221	0.398	-0.199	0.99
UTEP3	-0.093	0.391	-0.300	0.98
UTEP4	-0.142	0.409	-0.310	0.95
UT701	0.078	0.558	-0.174	0.90
UT702	0.333	0.412	-0.161	0.95
UT703	0.502	0.423	-0.123	0.99

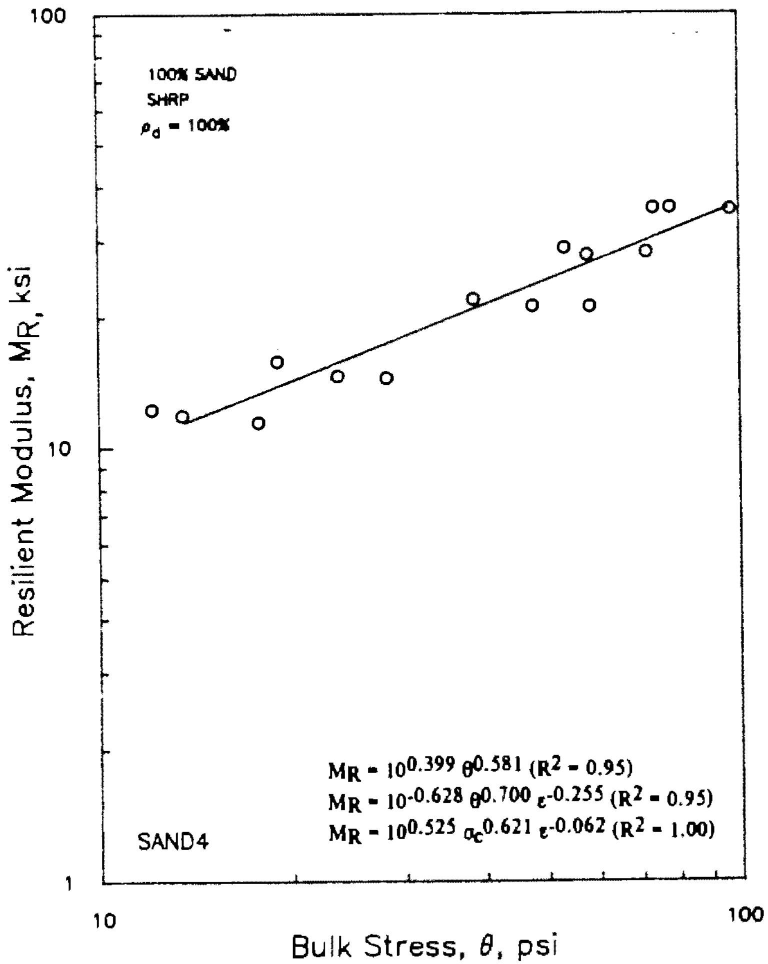

Figure D.1 - Variation in Resilient Modulus with Bulk Stress for Specimen SAND4.

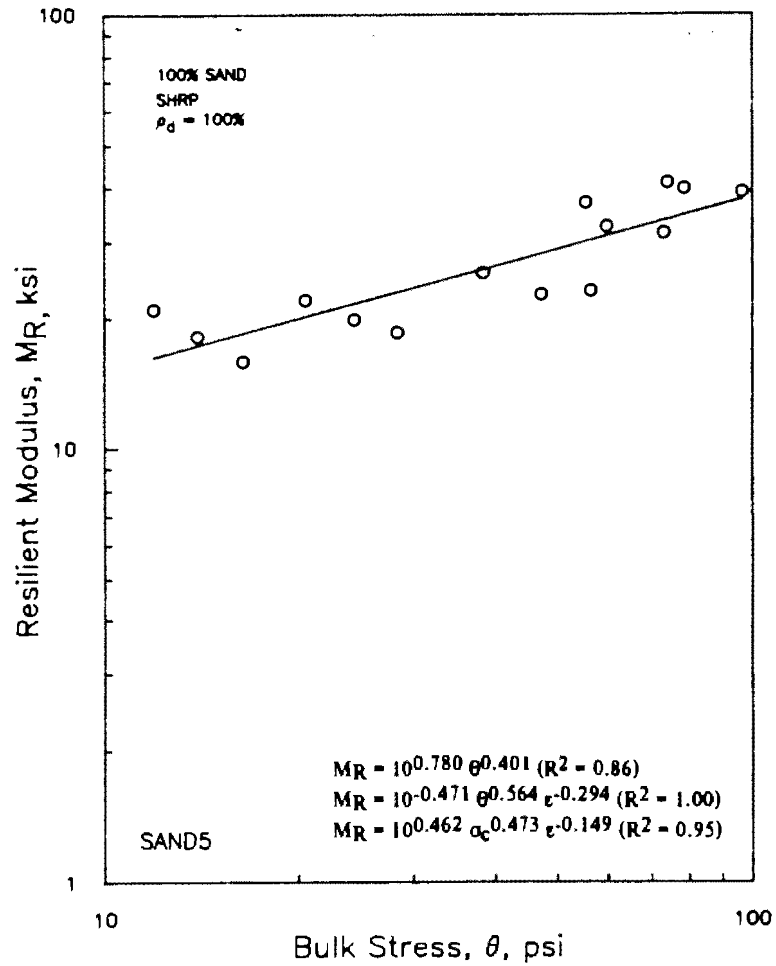

Figure D.2 - Variation in Resilient Modulus with Bulk Stress for Specimen SAND5.

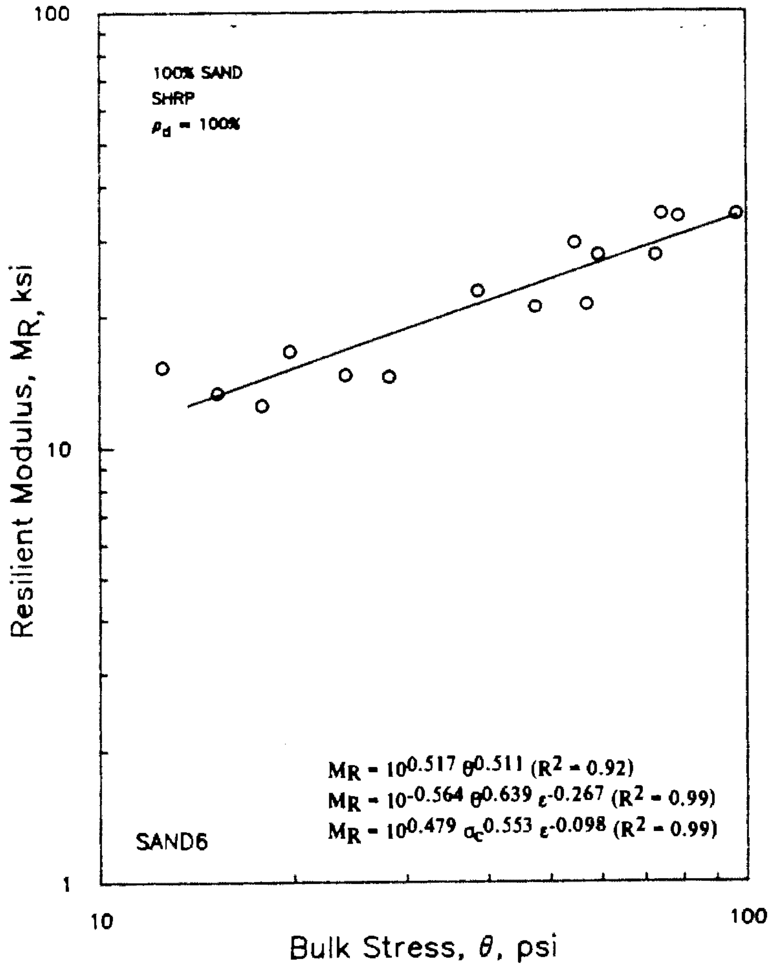

Figure D.3 - Variation in Resilient Modulus with Bulk Stress for Specimen SAND6.

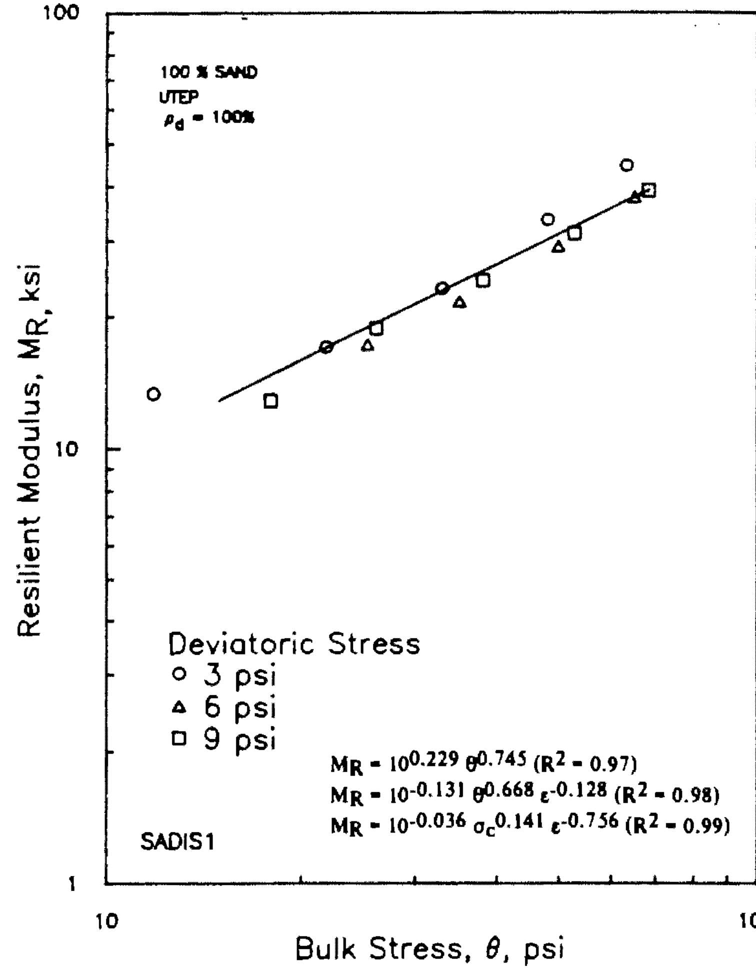

Figure D.4 - Variation in Resilient Modulus with Bulk Stress for Specimen SADIS1.

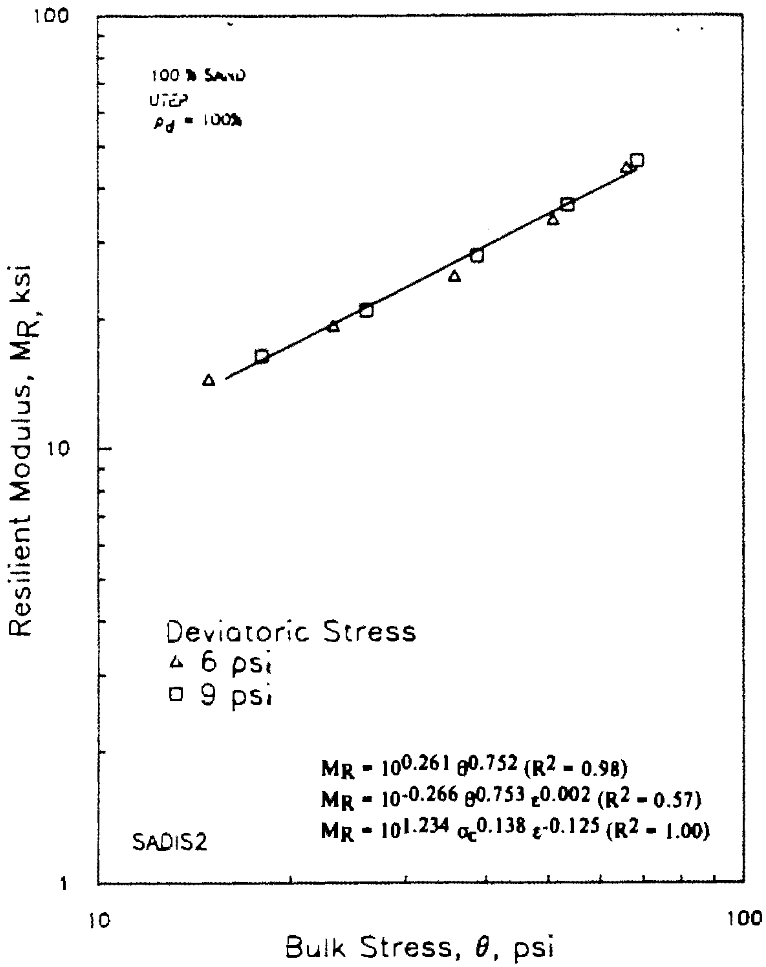

Figure D.5 - Variation in Resilient Modulus with Bulk Stress for Specimen SADIS2.

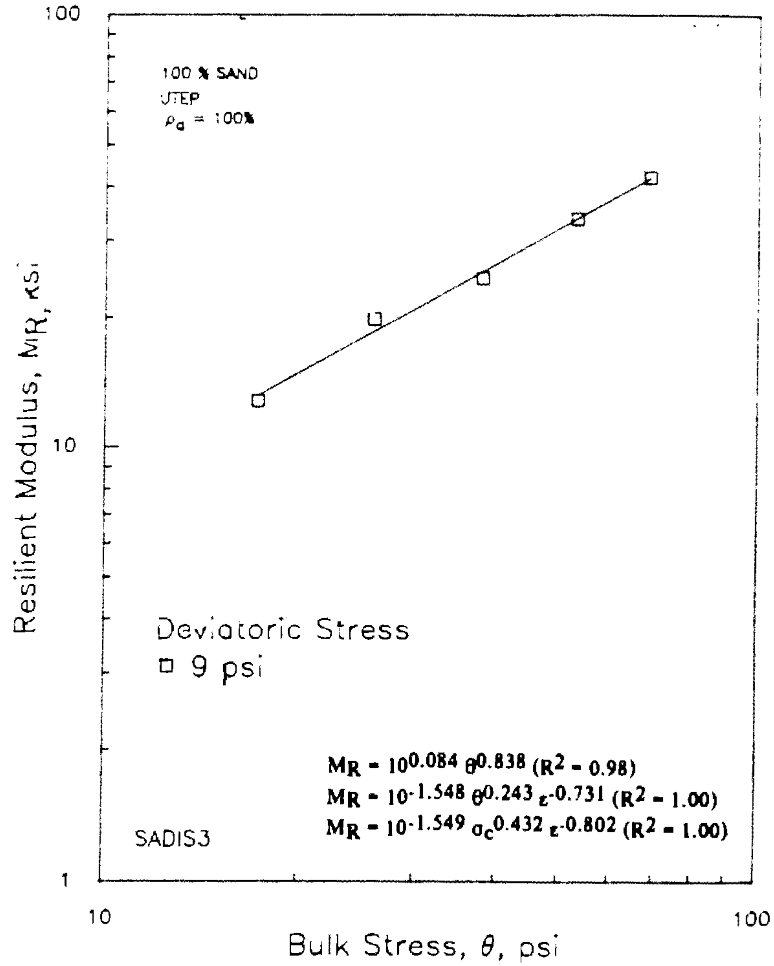

Figure D.6 - Variation in Resilient Modulus with Bulk Stress for Specimen SADIS3.

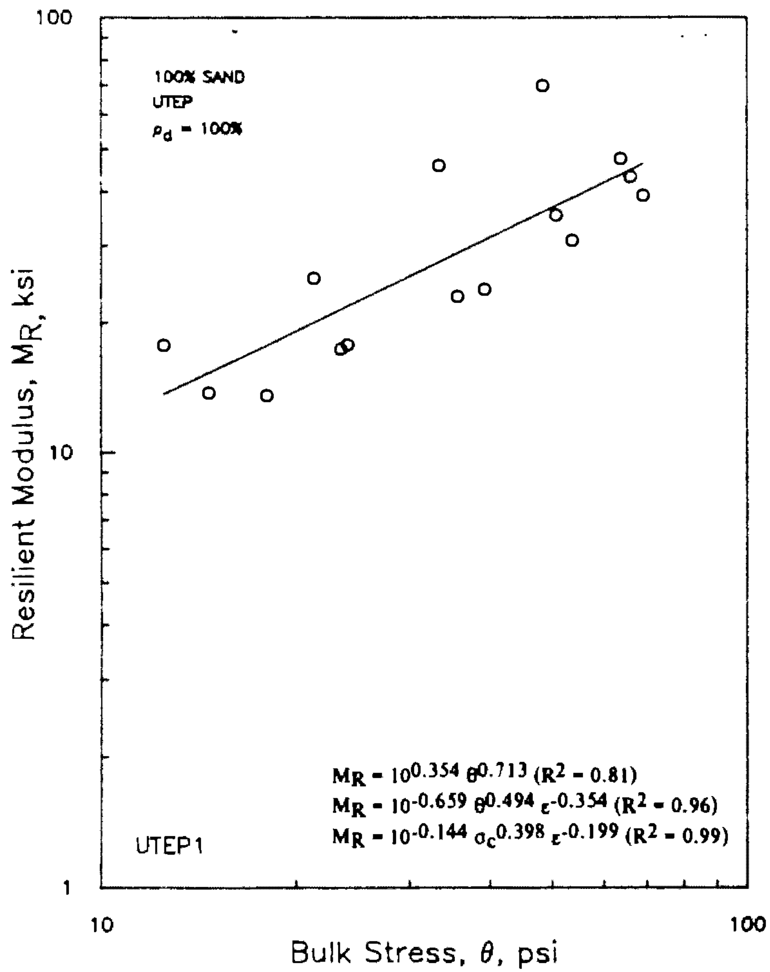

Figure D.7 - Variation in Resilient Modulus with Bulk Stress for Specimen UTEP1.

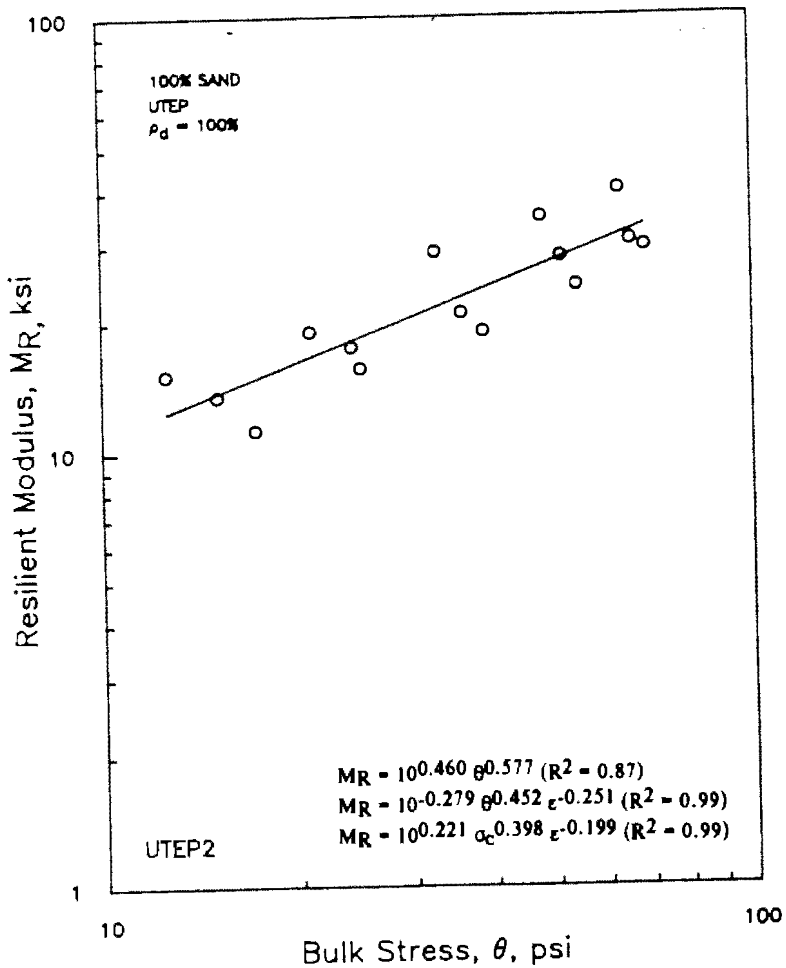

Figure D.8 - Variation in Resilient Modulus with Bulk Stress for Specimen UTEP2.

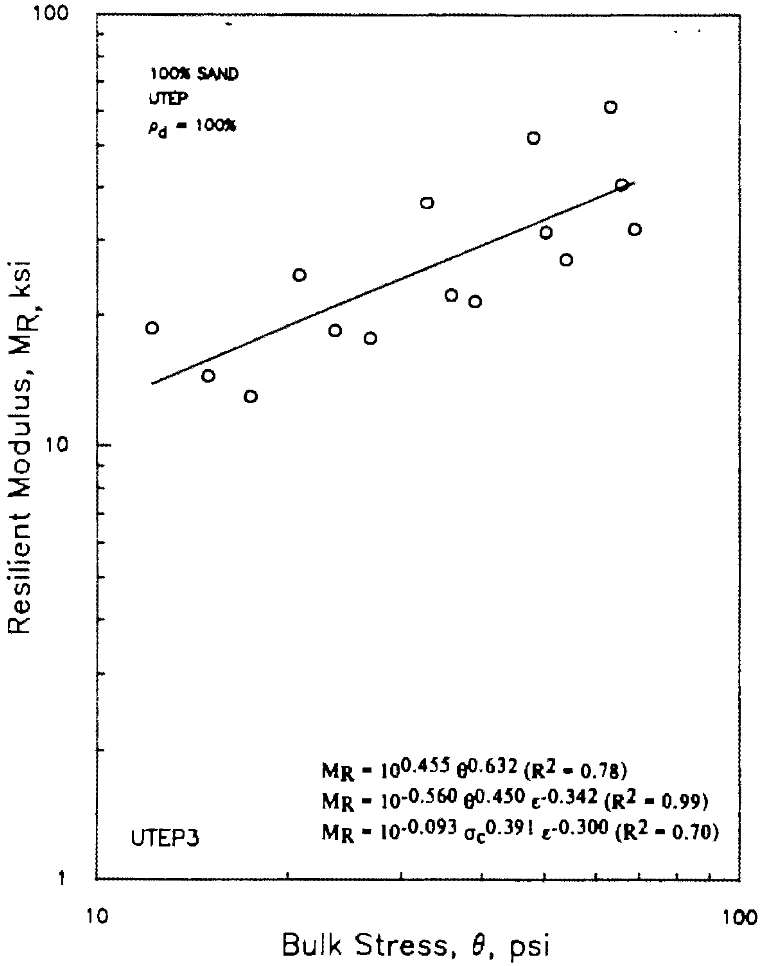

Figure D.9 - Variation in Resilient Modulus with Bulk Stress for Specimen UTEP3.

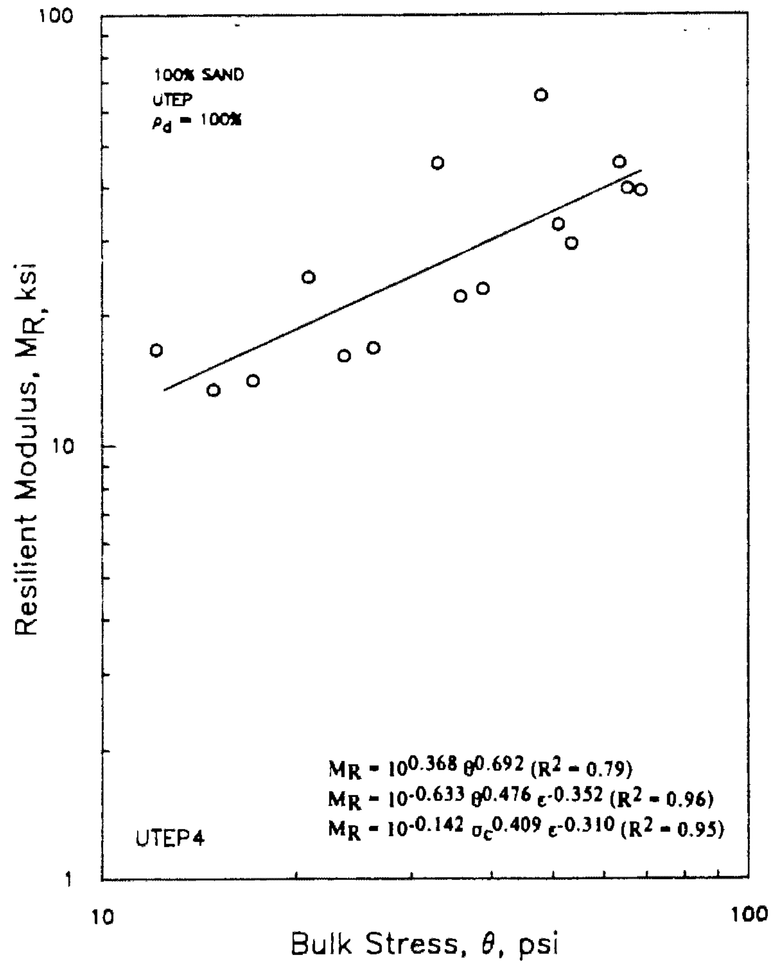

Figure D.10 - Variation in Resilient Modulus with Bulk Stress for Specimen UTEP4.

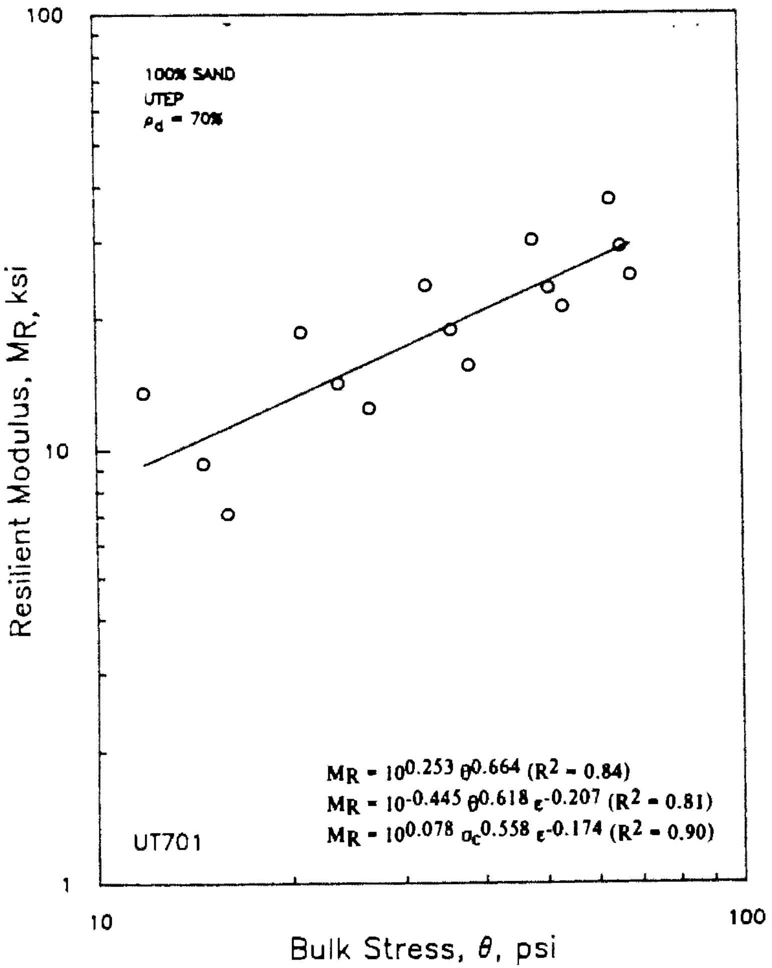

Figure D.11 - Variation in Resilient Modulus with Bulk Stress for Specimen UT701.

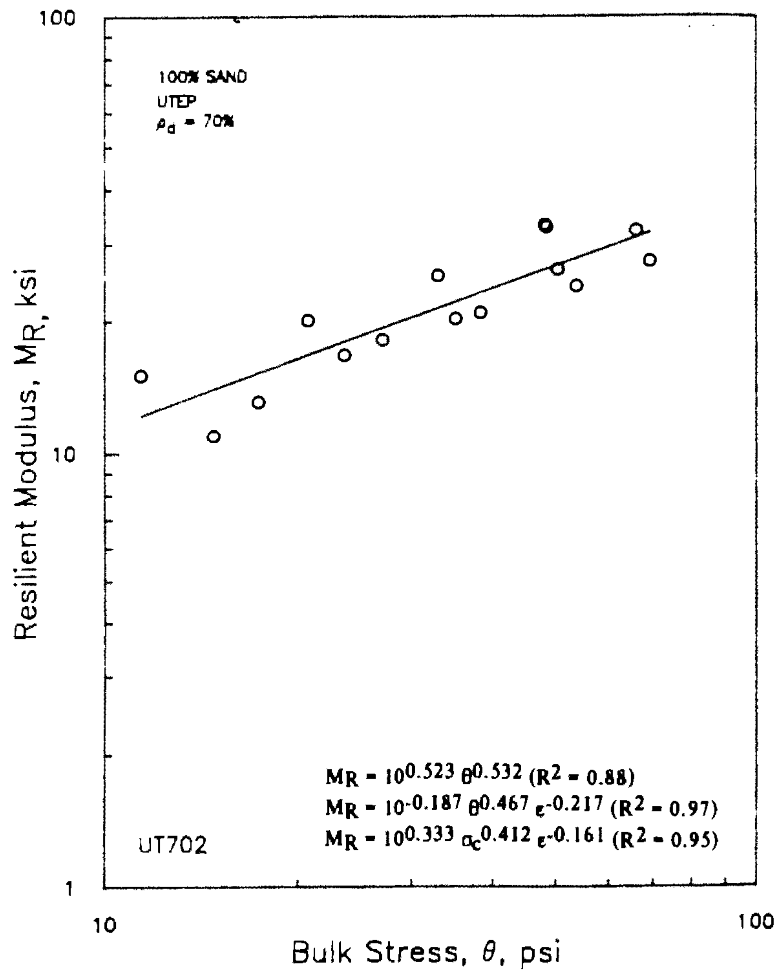

Figure D.12 - Variation in Resilient Modulus with Bulk Stress for Specimen UT702.

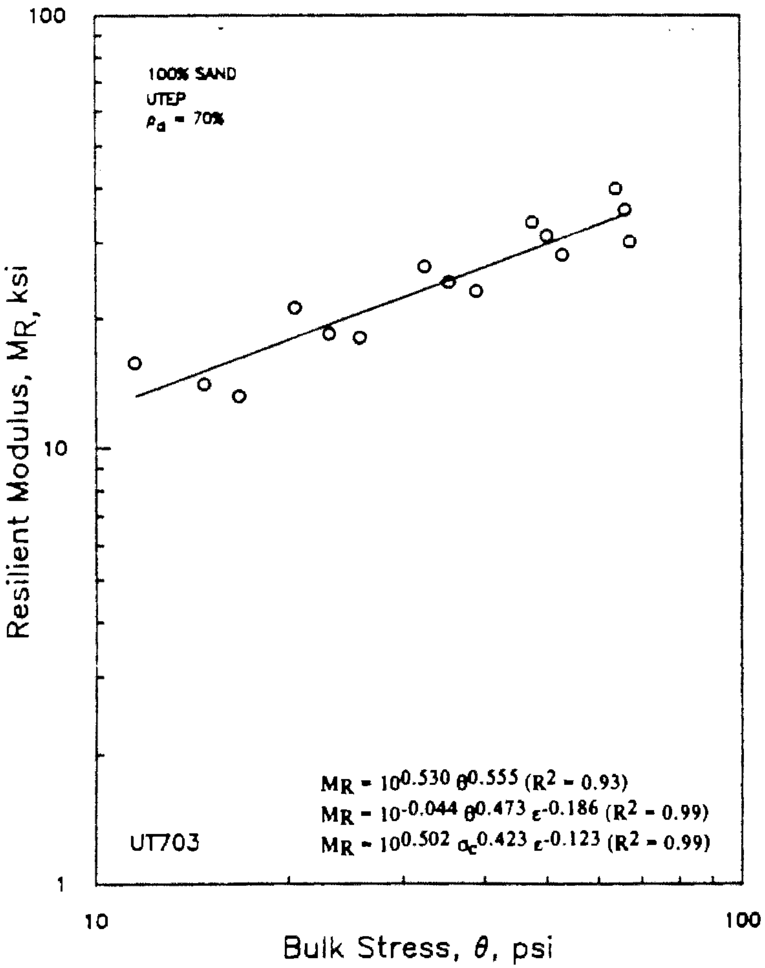

Figure D.13 - Variation in Resilient Modulus with Bulk Stress for Specimen UT703.

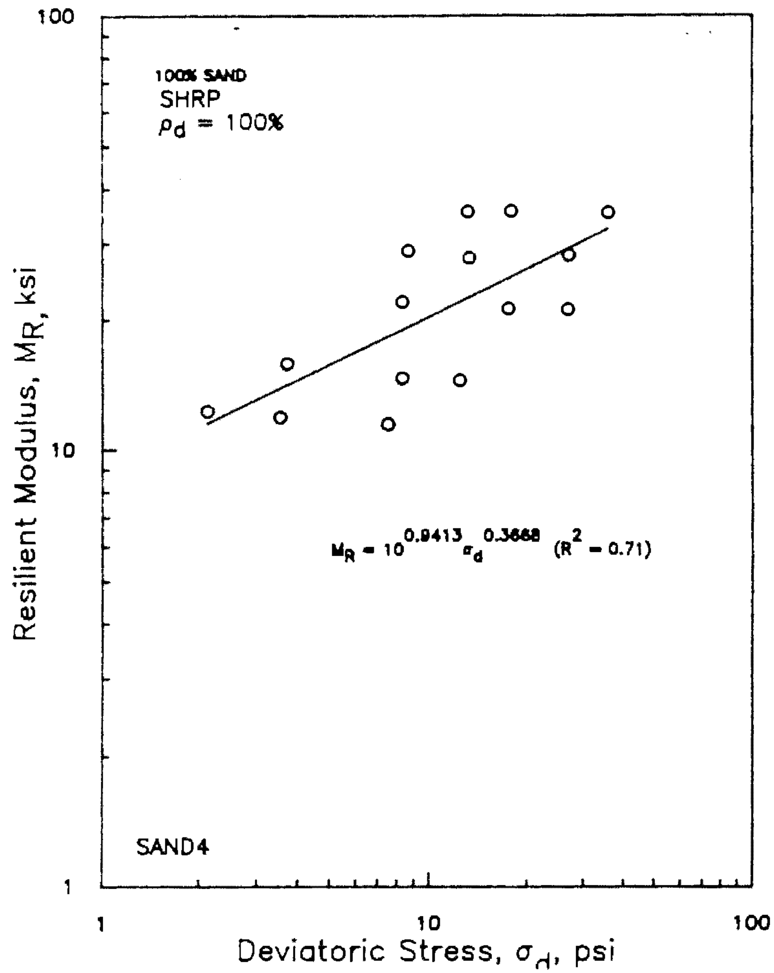

Figure D.14 - Variation in Resilient Modulus with Deviatoric Stress for Specimen SAND4.

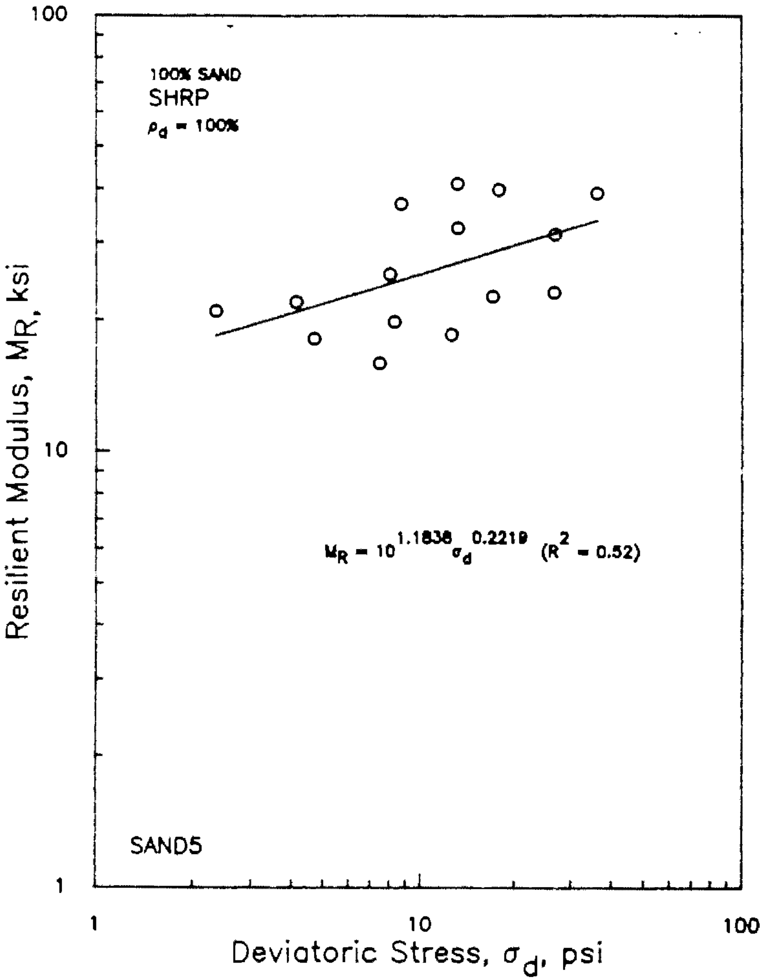

Figure D.15 - Variation in Resilient Modulus with Deviatoric Stress for Specimen SAND5.

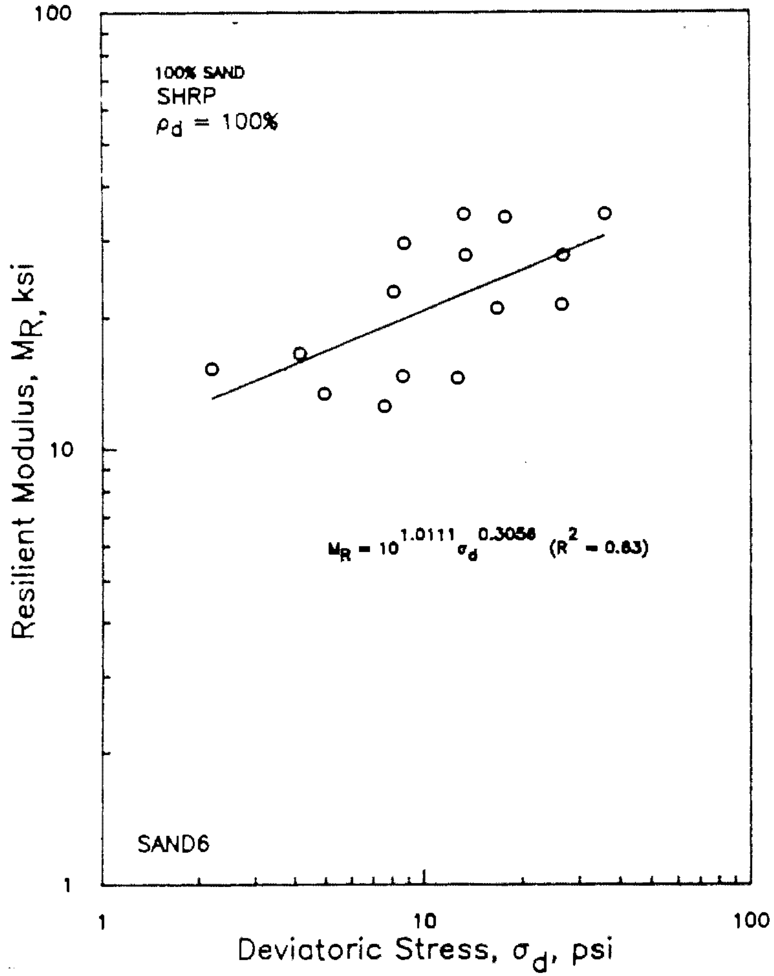

Figure D.16 - Variation in Resilient Modulus with Deviatoric Stress for Specimen SAND6.

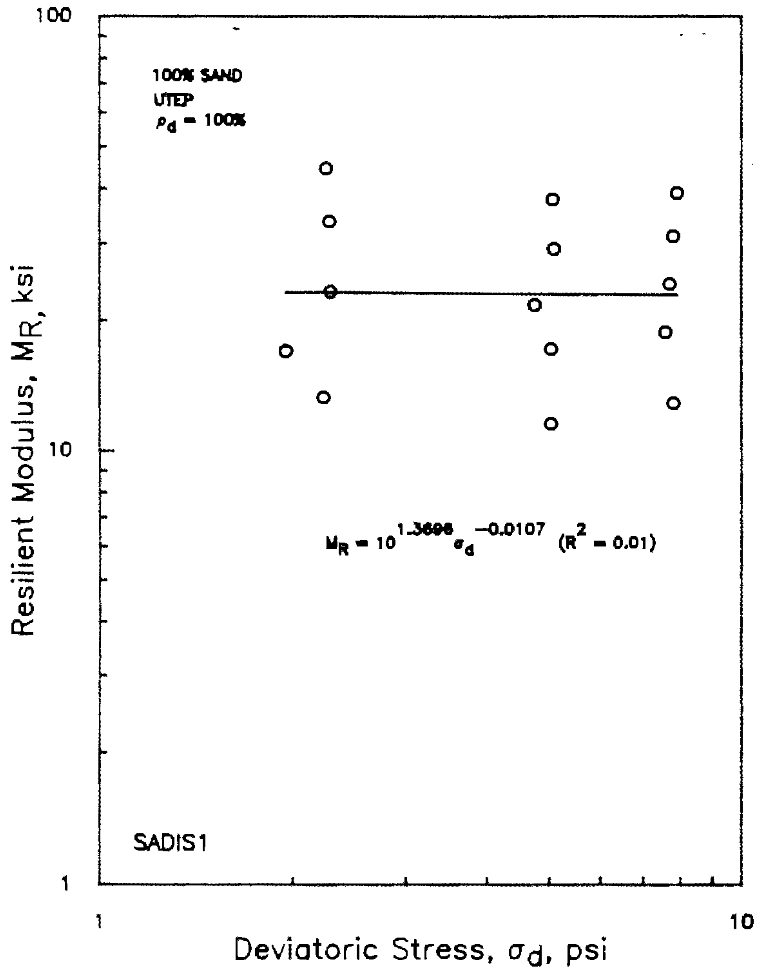

Figure D.17 - Variation in Resilient Modulus with Deviatoric Stress for Specimen SADIS1.

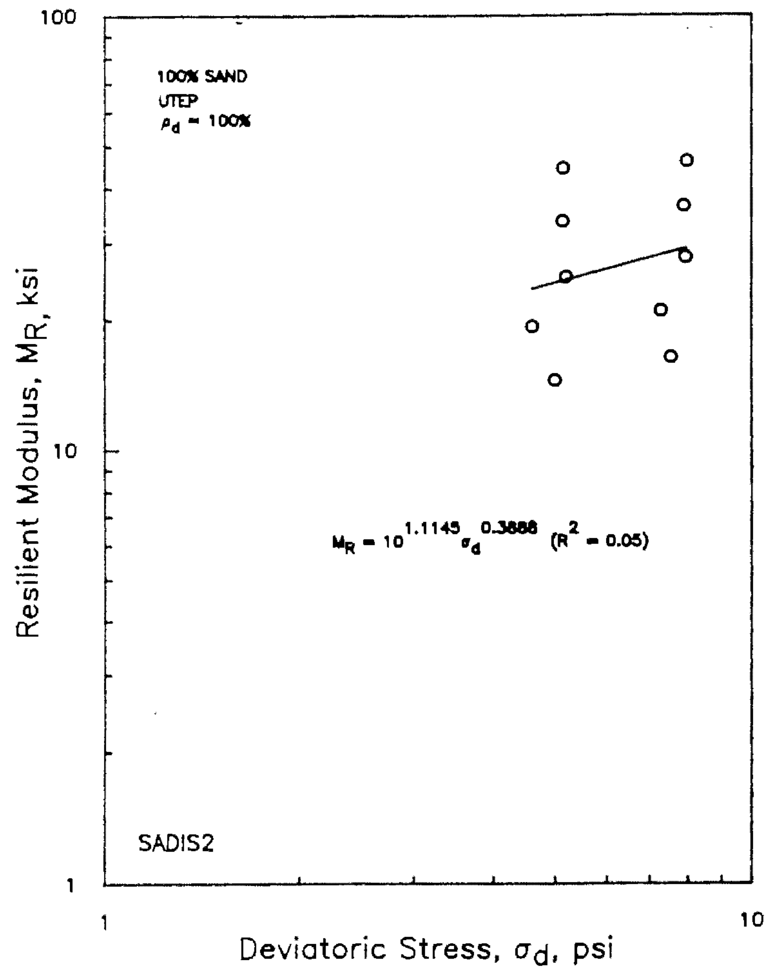

Figure D.18 - Variation in Resilient Modulus with Deviatoric Stress for Specimen SADIS2.

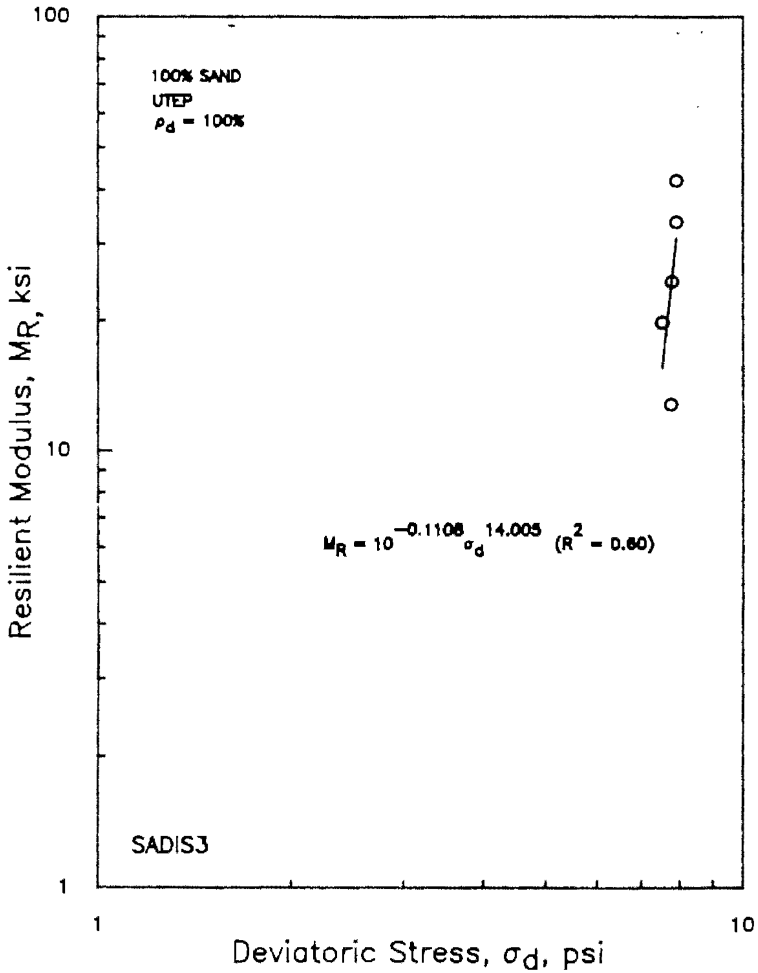

Figure D.19 - Variation in Resilient Modulus with Deviatoric Stress for Specimen SADIS3.

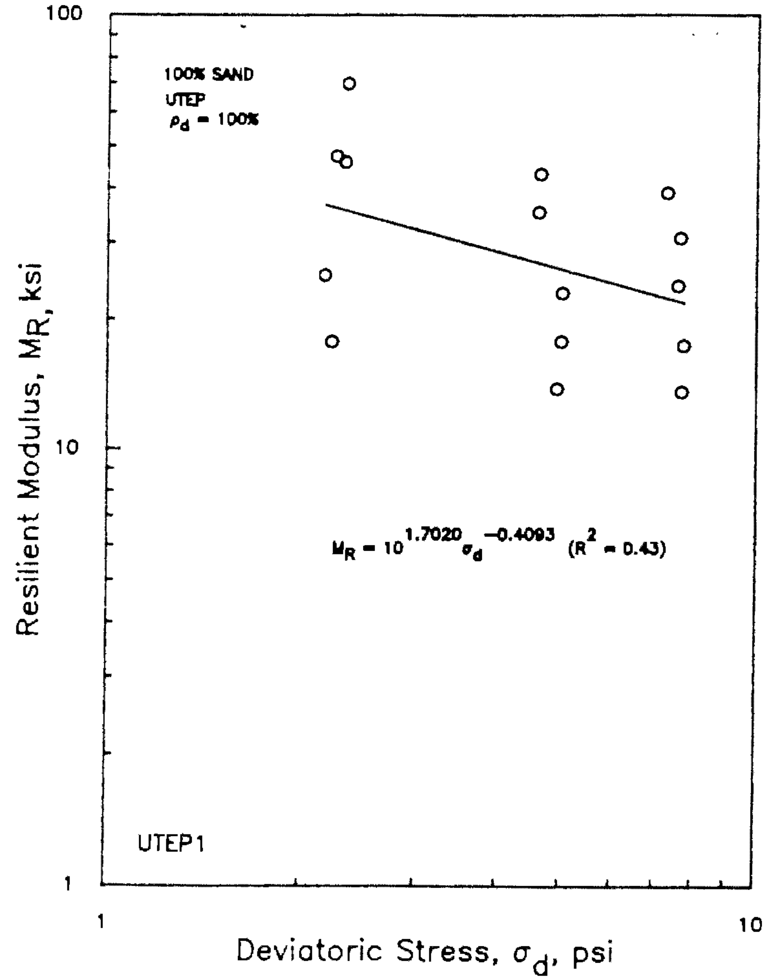

Figure D.20 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UTEP1.

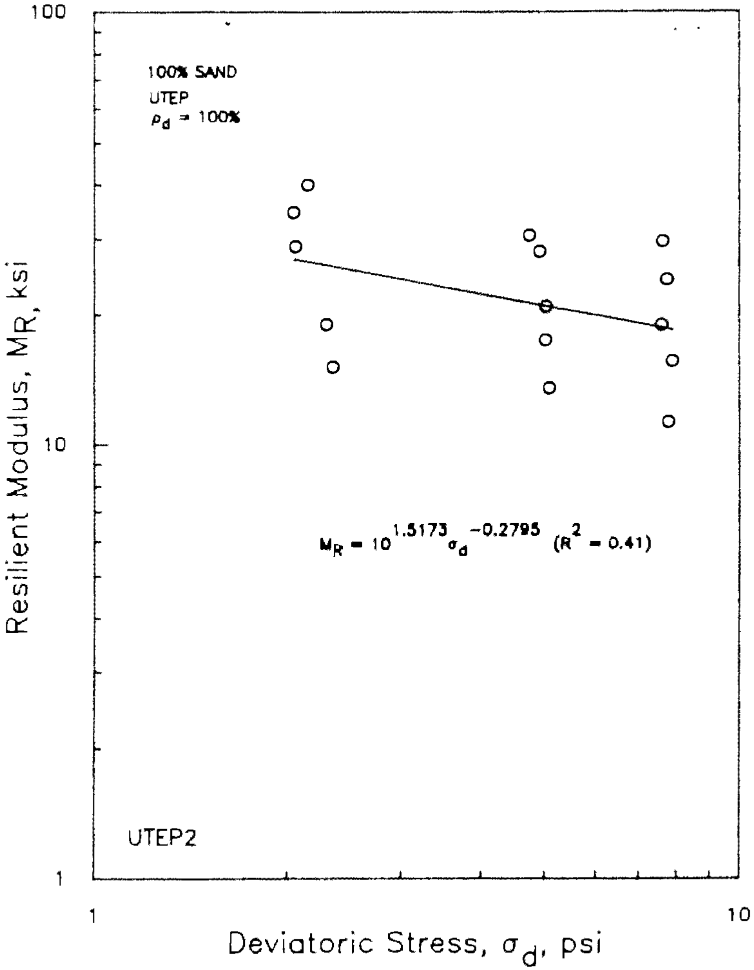

Figure D.21 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UTEP2.

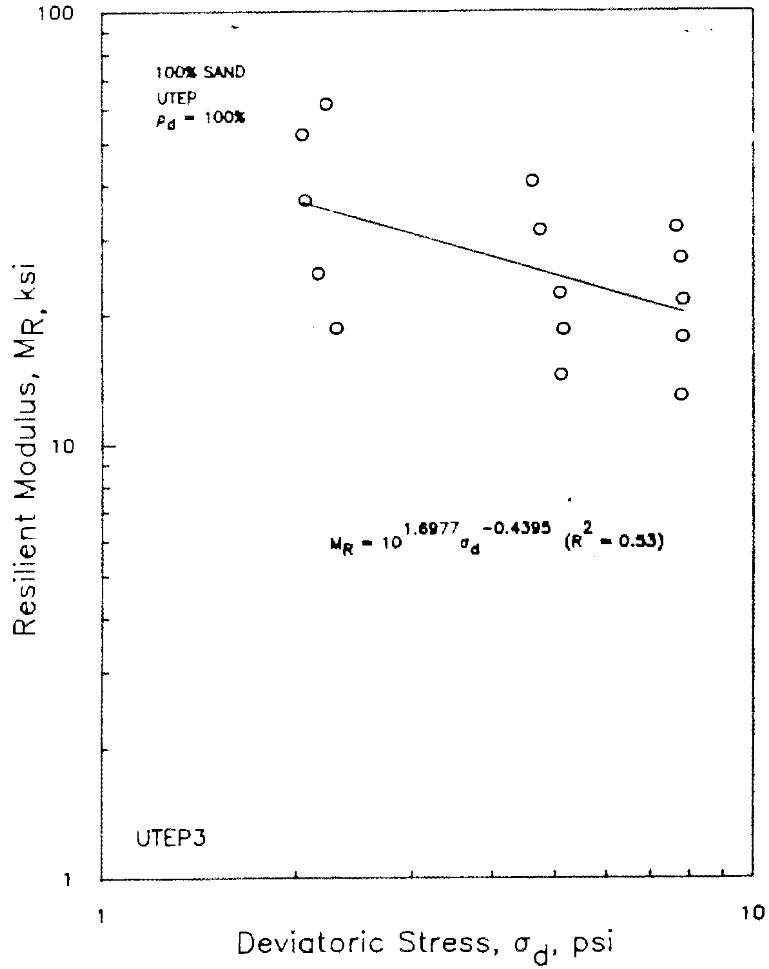

Figure D.22 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UTEP3.

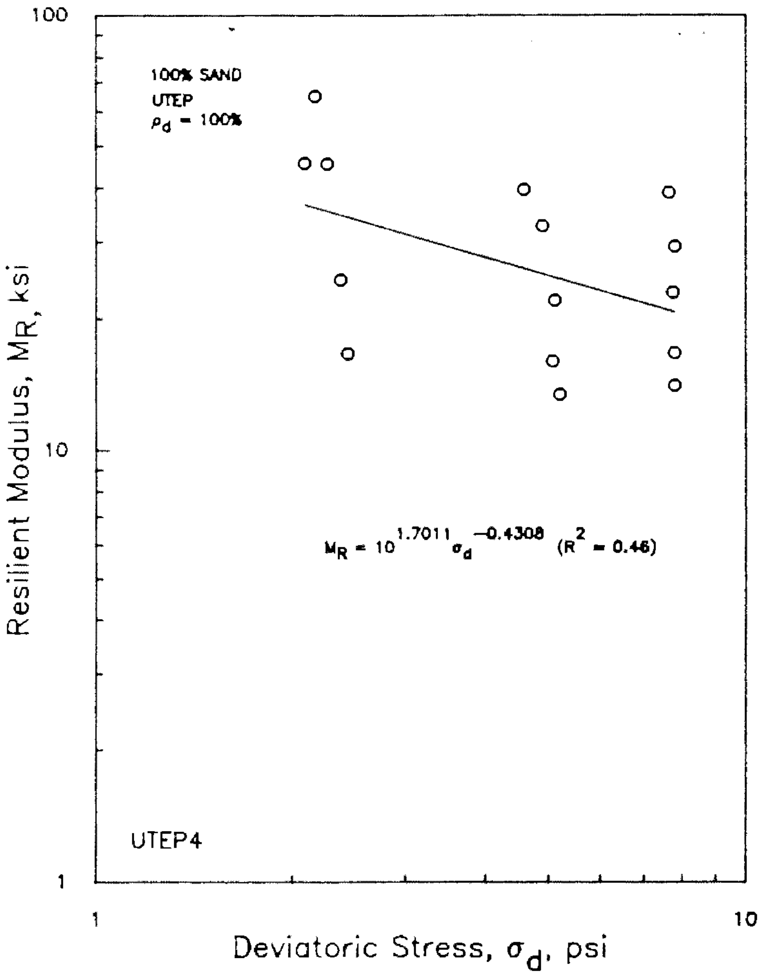

Figure D.23 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UTEP4.

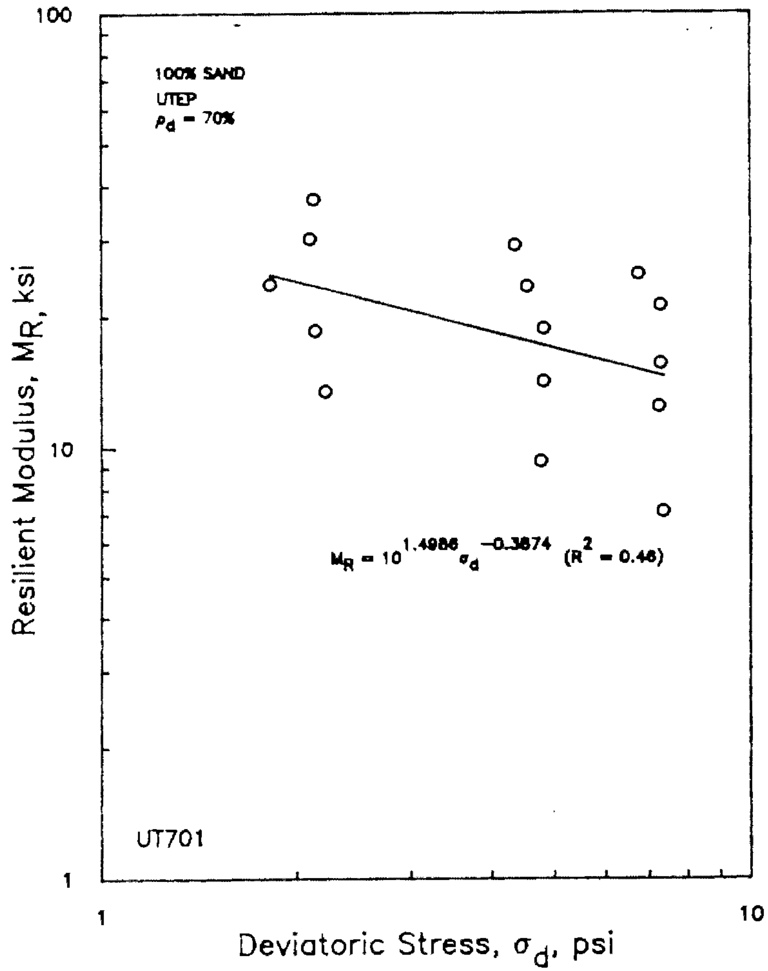

Figure D.24 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UT701.

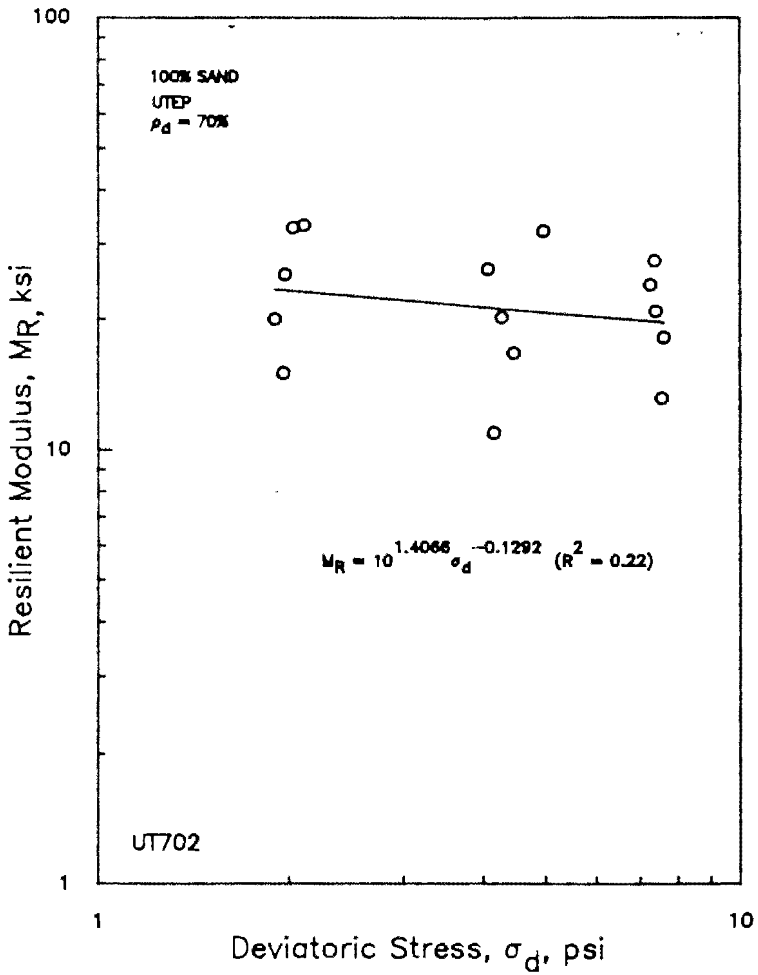

Figure D.25 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UT702.

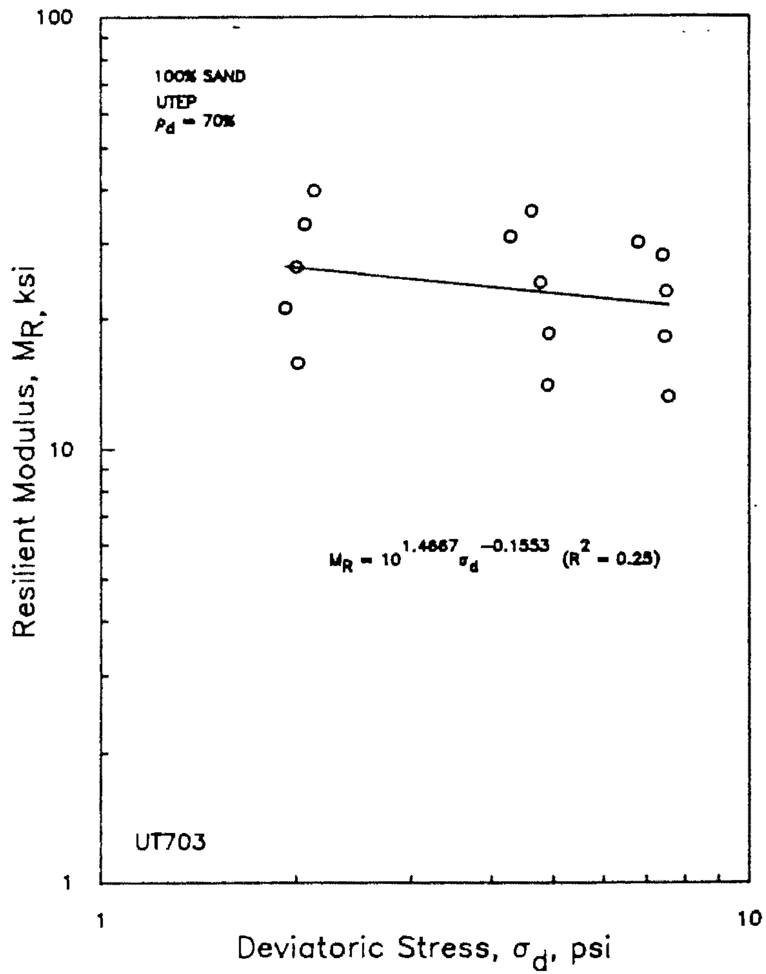

Figure D.26 - Variation in Resilient Modulus with Deviatoric Stress for Specimen UT703.

APPENDIX E

PLOTS FOR CLAY-SAND SPECIMENS

Table E.1 Regression Constants and R-squared for AASHTO/SHRP Model for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_d^{k_2}$		
	k_1	k_2	R^2
CL90O1	1.109	-0.244	0.93
CL90O2	1.153	-0.196	0.98
CL90O3	1.161	-0.204	0.86
CL90D1	1.293	-0.159	0.93
CL90D2	1.186	-0.168	0.86
CL90D3	1.767	-0.150	0.84
CL90W1	1.142	-0.506	0.92
CL90W2	1.016	-0.548	0.86
CL90W3	1.210	-0.577	0.95
CL70O1	1.165	-0.309	0.93
CL70O2	1.127	-0.325	0.93
CL70O3	1.130	-0.368	0.93
CL70D1	1.219	-0.170	0.89
CL70D2	1.230	-0.136	0.78
CL70D3	1.225	-0.224	0.91
CL70W1	0.958	-0.557	0.94
CL70W2	0.930	-0.579	0.97
CL70W3	0.903	-0.569	0.92

Table E.1 Contd Regression Constants and R-squared for AASHTO/SHRP Model for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_d^{k_2}$		
	k_1	k_2	R^2
CL50O1	1.105	-0.362	0.80
CL50O2	1.170	-0.513	0.88
CL50O3	1.174	-0.463	0.88
CL50D1	1.352	-0.357	0.96
CL50D2	1.341	-0.327	0.97
CL50D3	1.372	-0.401	0.98
CL50W1	0.926	-0.419	0.91
CL50W2	0.990	-0.500	0.89
CL50W3	0.950	-0.462	0.93
CL30O1	1.172	-0.309	0.93
CL30O2	1.215	-0.248	0.92
CL30O3	1.152	-0.215	0.89
CL30D1	1.353	-0.329	0.93
CL30D2	1.290	-0.333	0.95
CL30D3	1.340	-0.332	0.95
CL30W1	1.235	-0.311	0.88
CL30W2	1.144	-0.297	0.84
CL30W3	1.143	-0.297	0.86

Table E.1 Contd Regression Constants and R-squared for AASHTO/SHRP Model for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2}$		
	k_1	k_2	R^2
CL15O1	0.189	0.722	0.82
CL15O2	0.345	0.661	0.77
CL15O3	0.236	0.703	0.88
CL15D1	0.233	0.692	0.81
CL15D2	0.292	0.641	0.85
CL15D3	0.272	0.645	0.75
CL15W1	0.310	0.624	0.83
CL15W2	0.321	0.636	0.85
CL15W3	0.421	0.580	0.80
CL10O1	0.419	0.558	0.95
CL10O2	0.417	0.577	0.93
CL10O3	0.363	0.551	0.93
CL10D1	0.243	0.644	0.94
CL10D2	0.413	0.538	0.84
CL10D3	0.412	0.544	0.86
CL10W1	0.482	0.478	0.84
CL10W2	0.437	0.549	0.94
CL10W3	0.627	0.394	0.77

Table E.1 Contd Regression Constants and R-squared for AASHTO/SHRP Model for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2}$		
	k_1	k_2	R^2
CL05O1	0.330	0.612	0.98
CL05O2	0.393	0.591	0.90
CL05O3	0.443	0.547	0.92
CL05D1	0.393	0.614	0.80
CL05D2	0.340	0.648	0.82
CL05D3	0.452	0.560	0.92
CL05W1	0.421	0.600	0.80
CL05W2	0.262	0.675	0.85
CL05W3	0.324	0.643	0.79

Table E.2 Regression Constants and R-squared for UTEP Model One for Clay Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL90O1	0.122	0.092	-0.217	0.95
CL90O2	0.466	0.002	-0.165	0.97
CL90O3	0.132	0.164	-0.206	0.95
CL90D1	0.435	0.139	-0.166	0.98
CL90D2	0.303	0.139	-0.177	0.95
CL90D3	0.384	0.118	-0.161	0.86
CL90W1	-0.650	0.216	-0.379	0.98
CL90W2	-0.952	0.304	-0.413	0.97
CL90W3	-0.714	0.216	-0.405	0.99
CL70O1	0.488	-0.169	-0.207	0.97
CL70O2	-0.208	0.172	-0.279	0.98
CL70O3	-0.344	0.197	-0.306	0.99
CL70D1	0.362	0.119	-0.175	0.93
CL70D2	0.324	0.194	-0.169	0.94
CL70D3	0.198	0.127	-0.213	0.96
CL70W1	-0.838	0.219	-0.397	0.99
CL70W2	-0.719	0.123	-0.387	0.99
CL70W3	-0.908	0.235	-0.401	0.98

Table E.2 Contd Regression Constants and R-squared for UTEP Model One for Clay Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL50O1	-0.564	0.289	-0.337	0.93
CL50O2	-0.819	0.311	-0.401	0.98
CL50O3	-0.666	0.280	-0.372	0.98
CL50D1	-0.074	0.148	-0.292	0.99
CL50D2	0.052	0.113	-0.270	0.99
CL50D3	-0.110	0.121	-0.311	1.00
CL50W1	-0.530	0.155	-0.331	0.95
CL50W2	-0.731	0.207	-0.380	0.96
CL50W3	-0.608	0.167	-0.608	0.97
CL30O1	0.101	0.121	-0.227	0.95
CL30O2	0.119	0.130	-0.228	0.97
CL30O3	0.072	0.173	-0.217	0.97
CL30D1	-0.120	0.204	-0.290	0.97
CL30D2	-0.103	0.167	-0.284	0.99
CL30D3	-0.41	0.153	-0.281	0.98
CL30W1	-0.177	0.205	-0.283	0.95
CL30W2	-0.280	0.241	-0.284	0.95
CL30W3	-0.238	0.218	-0.279	0.94

Table E.2 Contd Regression Constants and R-squared for UTEP Model One for Clay Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL15O1	-0.727	0.516	-0.340	0.98
CL15O2	-0.561	0.477	-0.319	0.99
CL15O3	-0.519	0.529	-0.281	0.99
CL15D1	-0.713	0.496	-0.344	0.99
CL15D2	-0.547	0.472	-0.305	0.99
CL15D3	-0.752	0.450	-0.369	0.98
CL15W1	-0.520	0.464	-0.299	0.99
CL15W2	-0.497	0.486	-0.289	0.99
CL15W3	-0.479	0.431	-0.310	0.99
CL10O1	-0.081	0.481	-0.172	1.00
CL10O2	-0.145	0.484	-0.194	1.00
CL10O3	-0.159	0.466	-0.184	1.00
CL10D1	-0.290	0.537	-0.196	1.00
CL10D2	-0.386	0.421	-0.274	1.00
CL10D3	-0.327	0.432	-0.254	1.00
CL10W1	-0.298	0.439	-0.235	1.00
CL10W2	-0.150	0.491	-0.184	1.00
CL10W3	-0.237	0.397	-0.240	1.00

Table E.2 Contd Regression Constants and R-squared for UTEP Model One for Clay Specimens

SAMPLE ID	$M_R = k_1 \theta^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL05O1	-0.012	0.558	-0.122	1.00
CL05O2	-0.296	0.472	-0.241	1.00
CL05O3	-0.139	0.458	-0.139	1.00
CL05D1	-0.603	0.451	-0.340	1.00
CL05D2	-0.586	0.459	-0.333	1.00
CL05D3	-0.115	0.470	-0.194	1.00
CL05W1	-0.512	0.454	-0.315	0.99
CL05W2	-0.558	0.505	-0.298	0.99
CL05W3	-0.654	0.470	-0.342	1.00

Table E.3 Regression Constants and R-squared for UTEP Model Two for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_c^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL90O1	0.257	0.071	-0.198	0.95
CL90O2	0.468	0.003	-0.165	0.97
CL90O3	0.387	0.120	-0.170	0.95
CL90D1	0.660	0.099	-0.135	0.98
CL90D2	0.525	0.099	-0.145	0.95
CL90D3	0.568	0.089	-0.135	0.87
CL90W1	-0.363	0.162	-0.343	0.98
CL90W2	-0.565	0.224	-0.365	0.96
CL90W3	-0.427	0.157	-0.369	0.99
CL70O1	0.236	-0.106	-0.239	0.96
CL70O2	0.027	0.134	-0.247	0.98
CL70O3	-0.077	0.148	-0.271	0.98
CL70D1	0.553	0.85	-0.148	0.94
CL70D2	0.650	0.140	-0.120	0.94
CL70D3	0.405	0.090	-0.184	0.97
CL70W1	-0.564	0.164	-0.362	0.99
CL70W2	-0.567	0.085	-0.369	0.99
CL70W3	-0.620	0.163	-0.368	0.97

Table E.3 Contd Regression Constants and R-squared for UTEP Model Two for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_c^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL50O1	-0.147	0.206	-0.280	0.93
CL50O2	-0.405	0.227	-0.385	0.98
CL50O3	-0.282	0.205	-0.322	0.98
CL50D1	0.144	0.103	-0.264	0.98
CL50D2	0.222	0.083	-0.247	0.99
CL50D3	0.068	0.085	-0.288	0.98
CL50W1	-0.312	0.090	-0.305	0.94
CL50W2	-0.451	0.130	-0.346	0.95
CL50W3	-0.381	0.102	-0.324	0.96
CL30O1	0.292	0.072	-0.202	0.94
CL30O2	0.323	0.088	-0.200	0.97
CL30O3	0.347	0.112	-0.179	0.95
CL30D1	0.193	0.125	-0.251	0.96
CL30D2	0.144	0.110	-0.253	0.98
CL30D3	0.191	0.098	-0.252	0.97
CL30W1	0.134	0.124	-0.245	0.92
CL30W2	0.082	0.150	-0.237	0.92
CL30W3	0.093	0.128	-0.238	0.91

Table E.3 Contd Regression Constants and R-squared for UTEP Model Two for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_c^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL15O1	-0.195	0.443	-0.293	0.96
CL15O2	-0.055	0.413	-0.271	0.98
CL15O3	0.052	0.461	-0.224	0.97
CL15D1	-0.193	0.429	-0.295	0.97
CL15D2	-0.033	0.410	-0.253	0.99
CL15D3	-0.272	0.397	-0.320	0.98
CL15W1	-0.017	0.398	-0.250	0.98
CL15W2	0.027	0.423	-0.237	0.98
CL15W3	-0.018	0.372	-0.266	0.97
CL10O1	0.492	0.422	-0.104	0.99
CL10O2	0.427	0.427	-0.127	1.00
CL10O3	0.388	0.408	-0.120	0.99
CL10D1	0.330	0.475	-0.124	0.99
CL10D2	0.090	0.365	-0.222	0.99
CL10D3	0.166	0.376	-0.200	0.99
CL10W1	0.136	0.401	-0.191	0.97
CL10W2	0.356	0.455	-0.129	1.00
CL10W3	0.168	0.360	-0.198	0.96

Table E.3 Contd Regression Constants and R-squared for UTEP Model Two for Clay-Sand Specimens

SAMPLE ID	$M_R = k_1 \sigma_c^{k_2} \varepsilon^{k_3}$			
	k_1	k_2	k_3	R^2
CL05O1	0.654	0.488	-0.044	0.97
CL05O2	0.245	0.411	-0.182	0.99
CL05O3	0.390	0.398	-0.141	0.98
CL05D1	-0.117	0.398	-0.299	0.97
CL05D2	-0.084	0.396	-0.284	0.97
CL05D3	0.434	0.405	-0.134	0.97
CL05W1	-0.024	0.395	-0.267	0.98
CL05W2	-0.012	0.419	-0.241	0.99
CL05W3	-0.154	0.417	-0.291	0.99

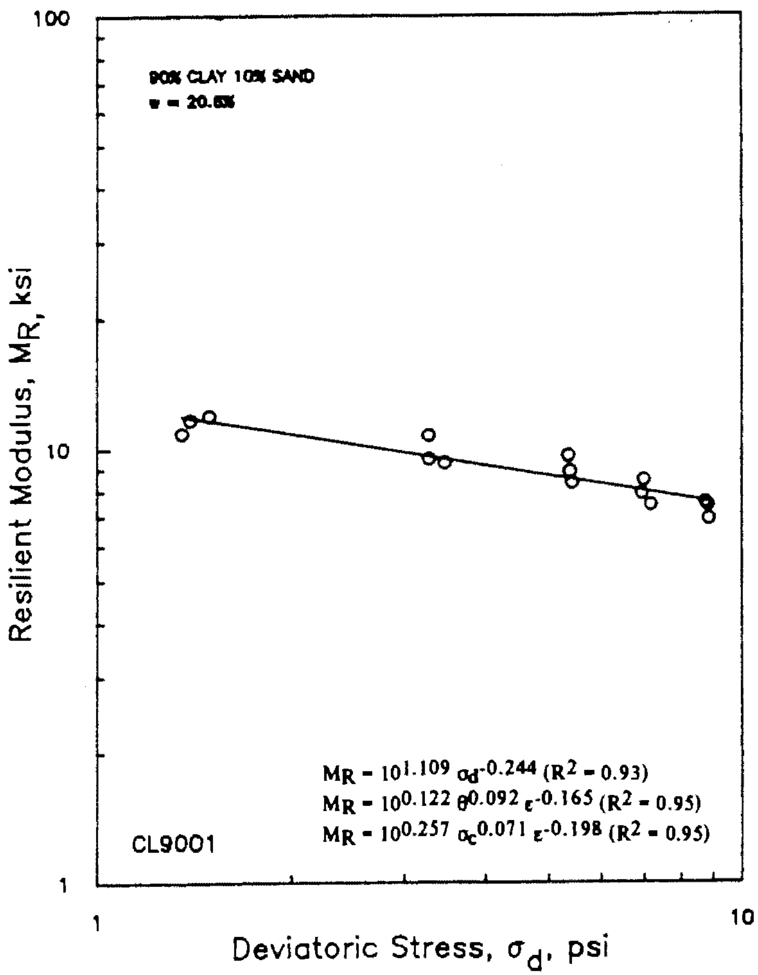

Figure E.1 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90O1.

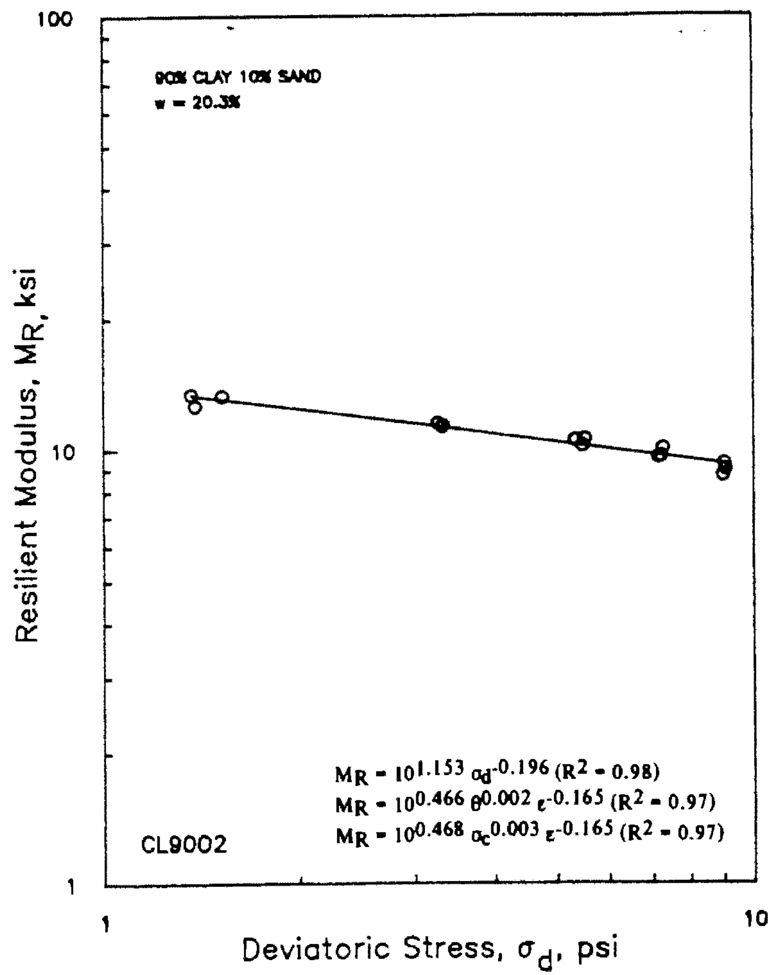

Figure E.2 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90O2.

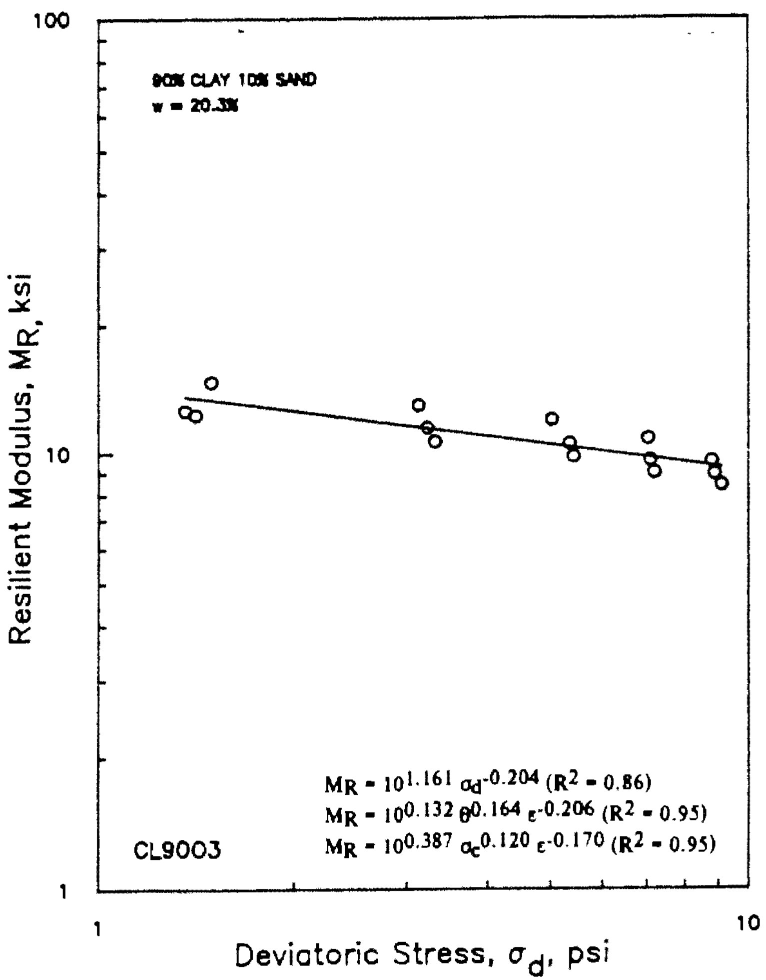

Figure E.3 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90O3.

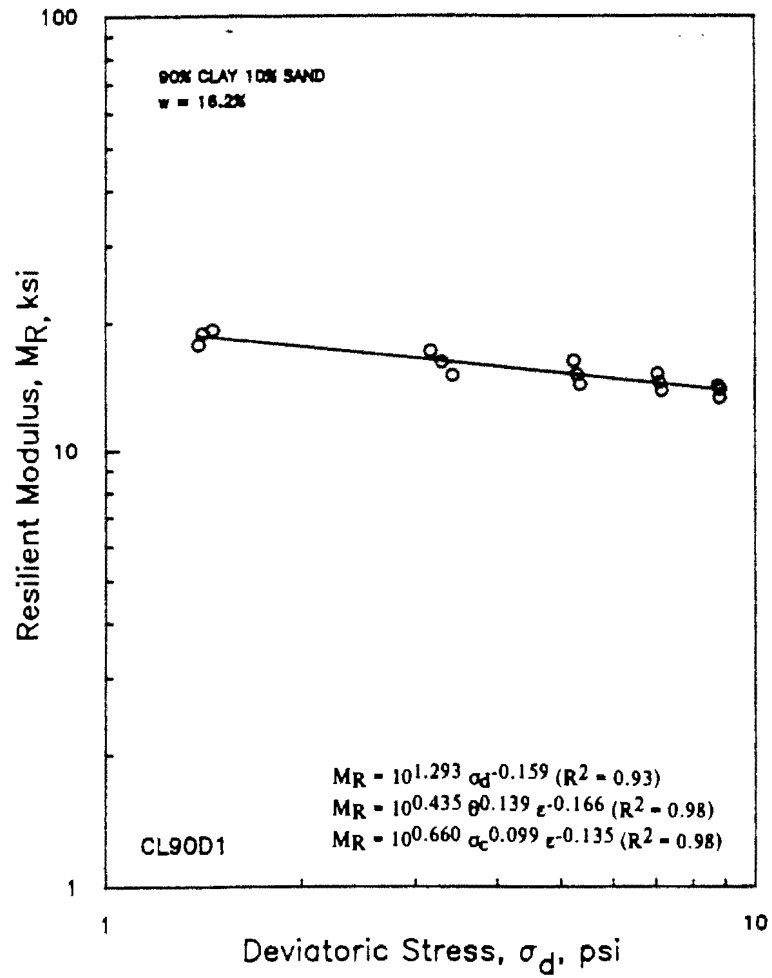

Figure E.4 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90D1.

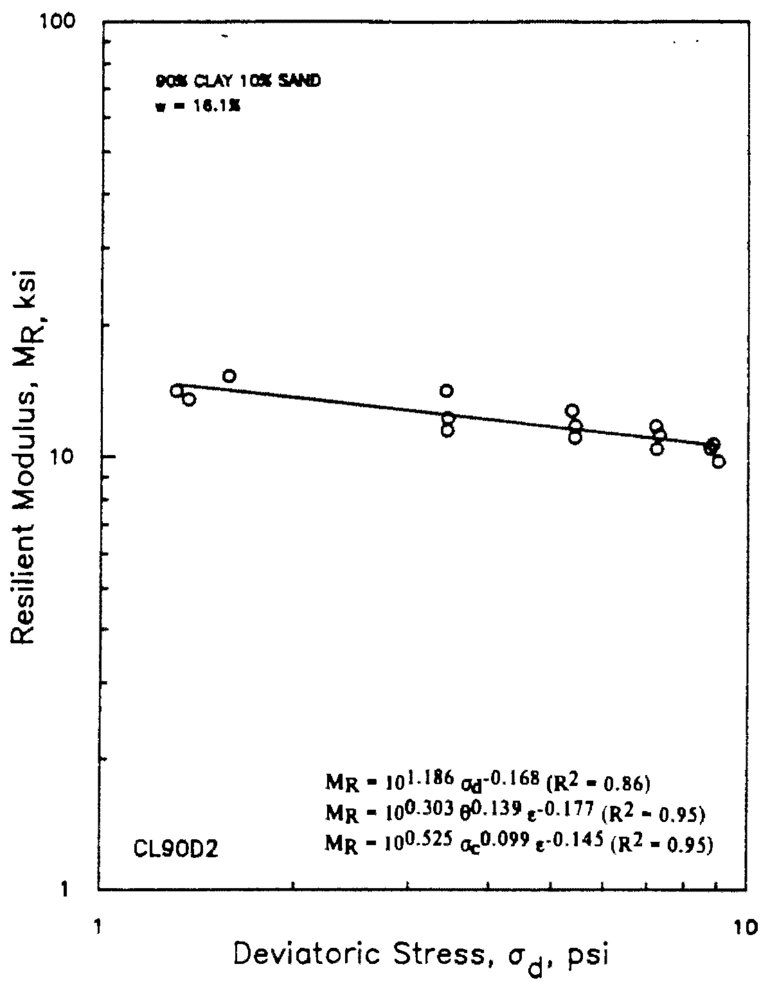

Figure E.5 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90D2.

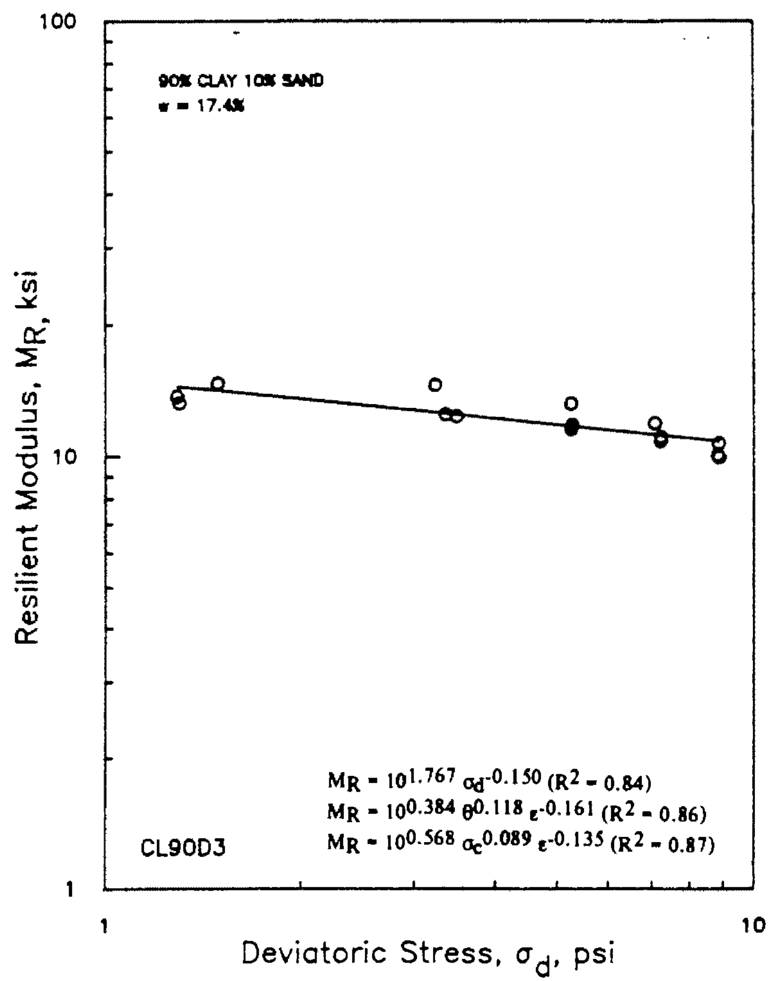

Figure E.6 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90D3.

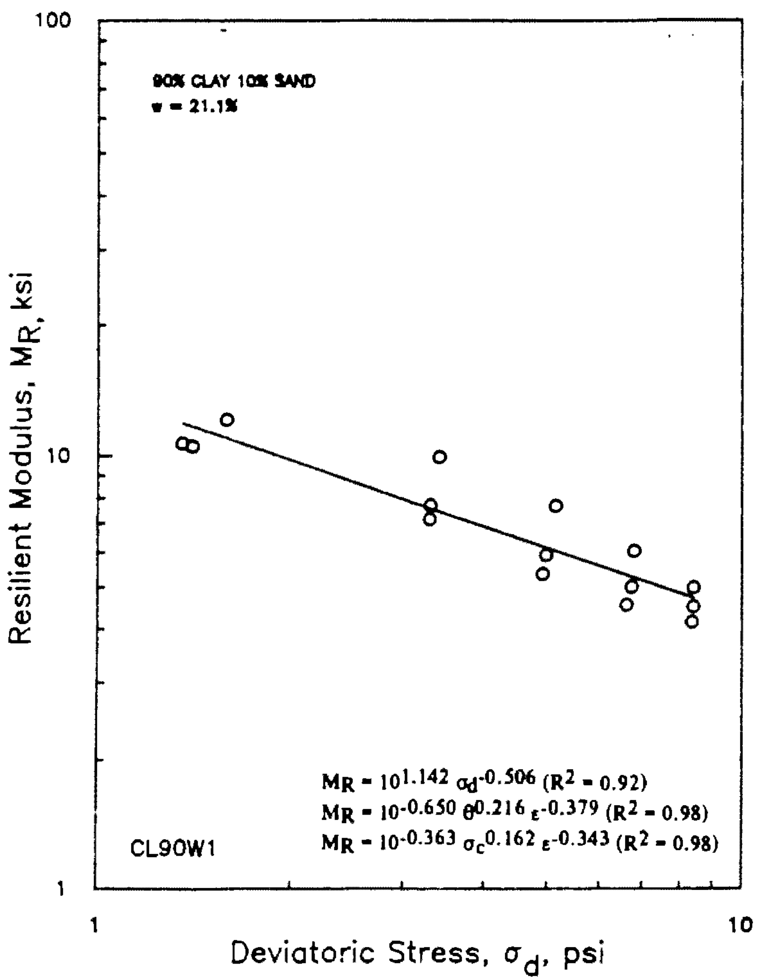

Figure E.7 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90W1.

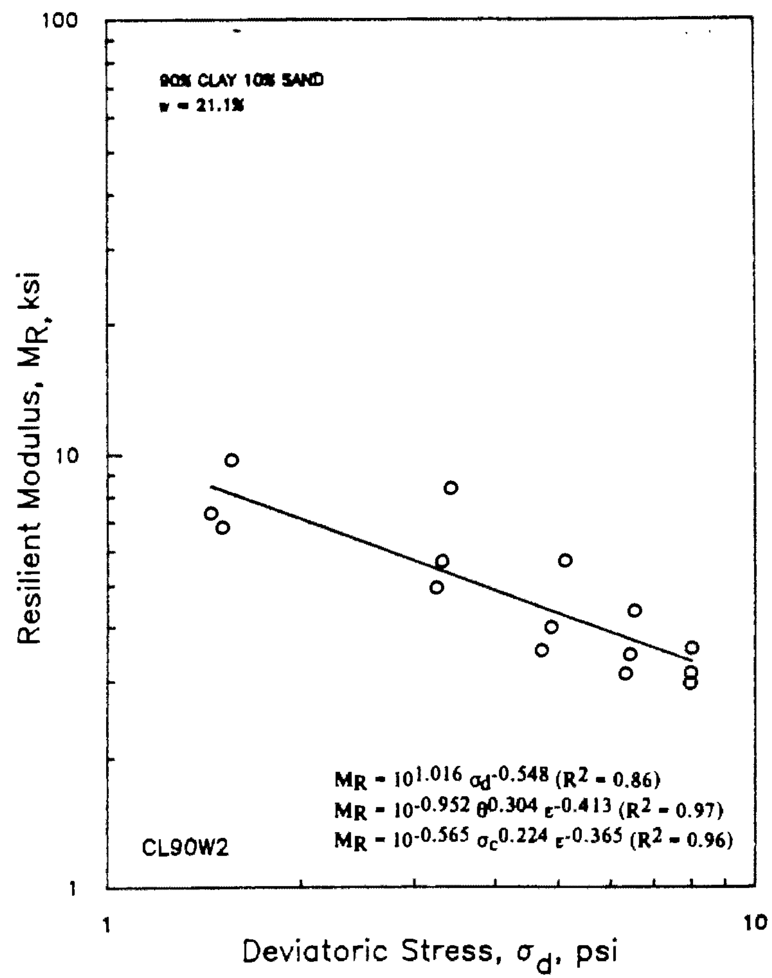

Figure E.8 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90W2.

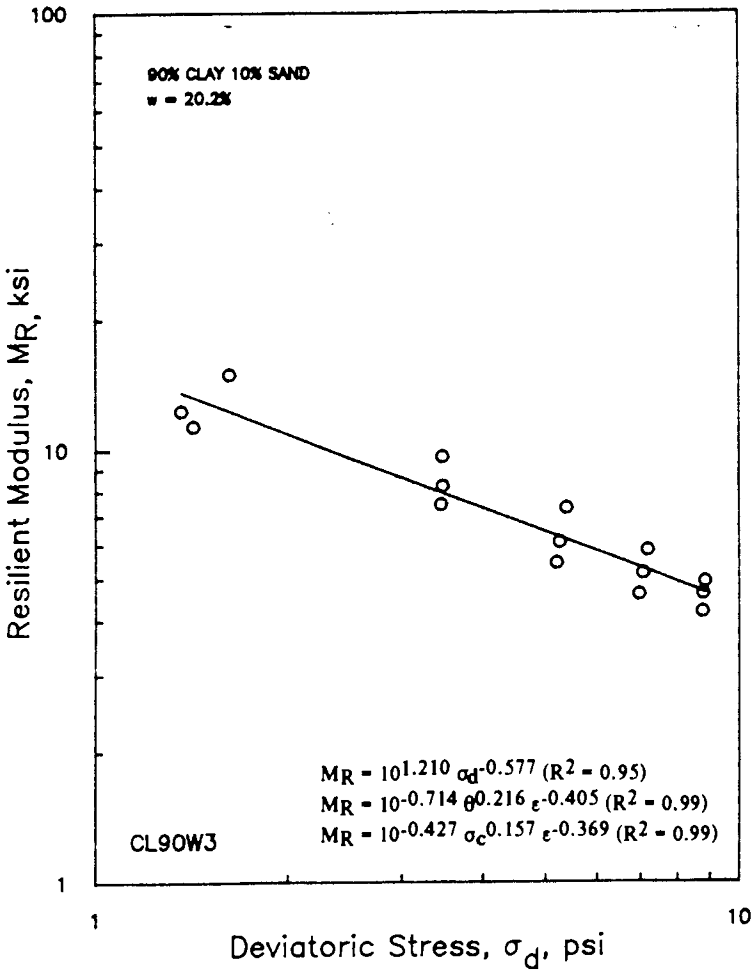

Figure E.9 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL90W3.

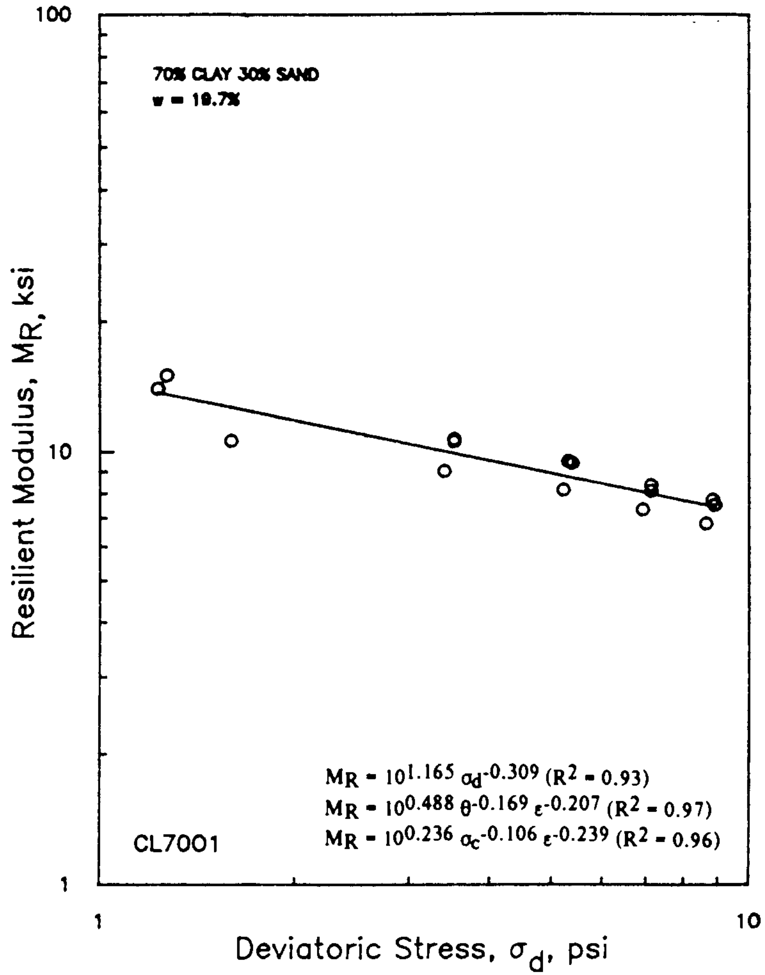

Figure E.10 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70O1.

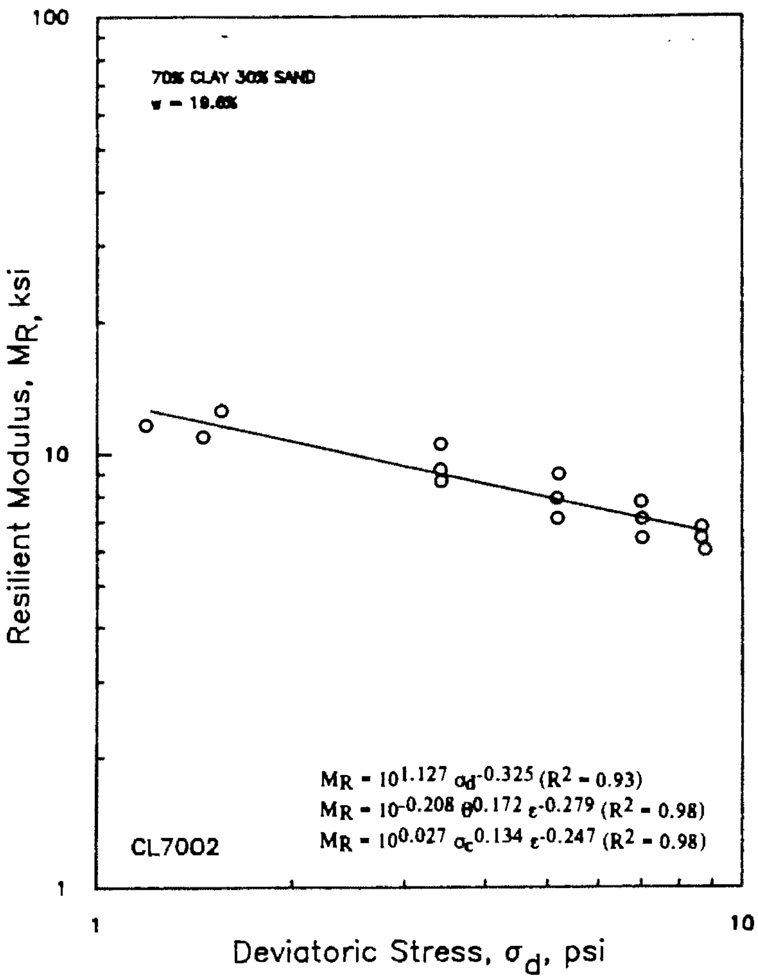

Figure E.11 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70O2.

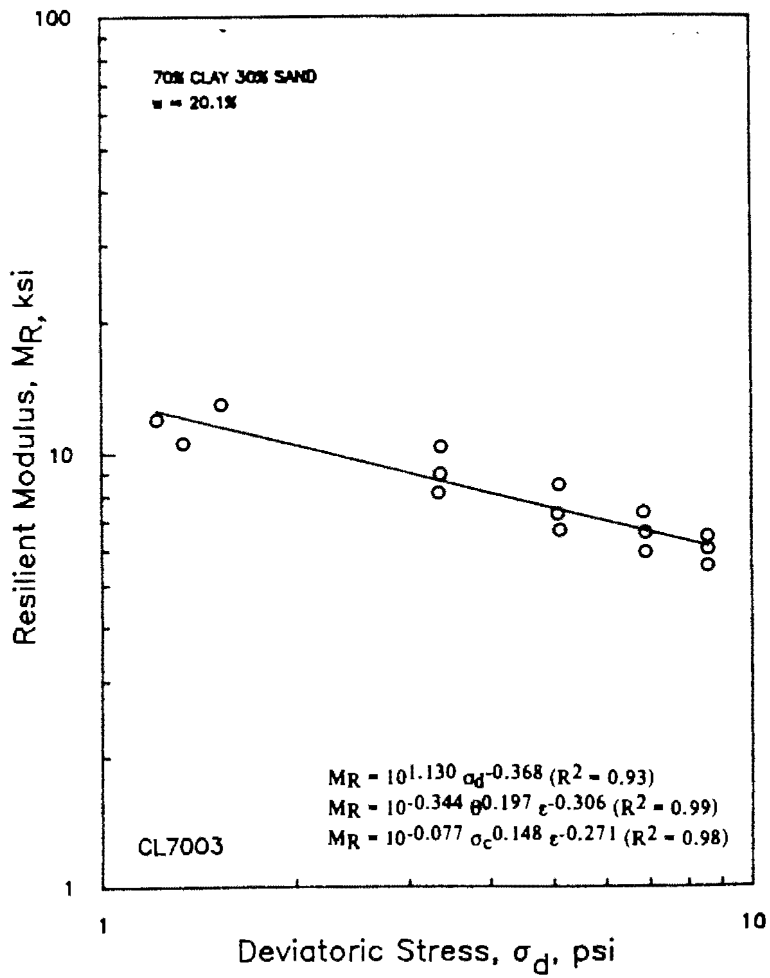

Figure E.12 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70O3.

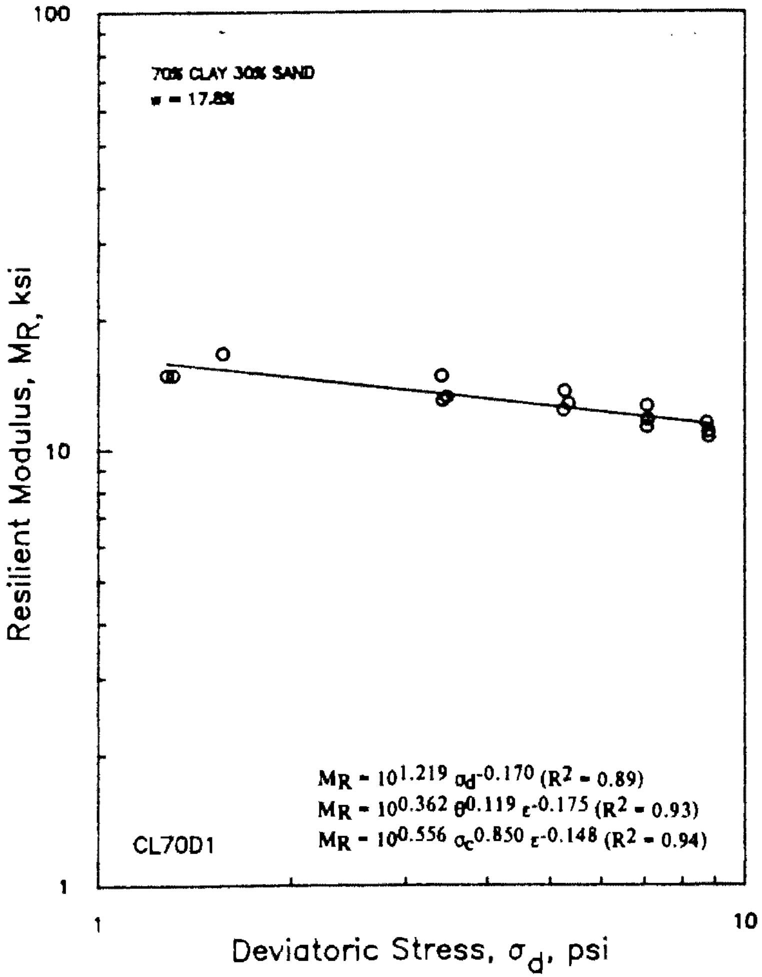

Figure E.13 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70D1.

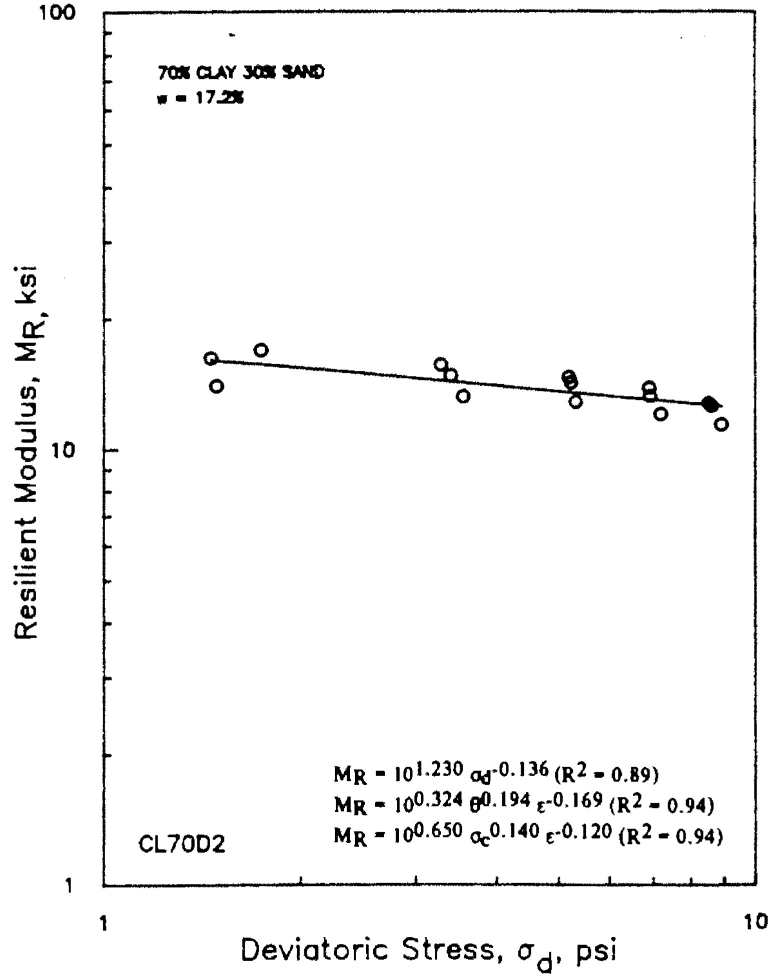

Figure E.14 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70D2.

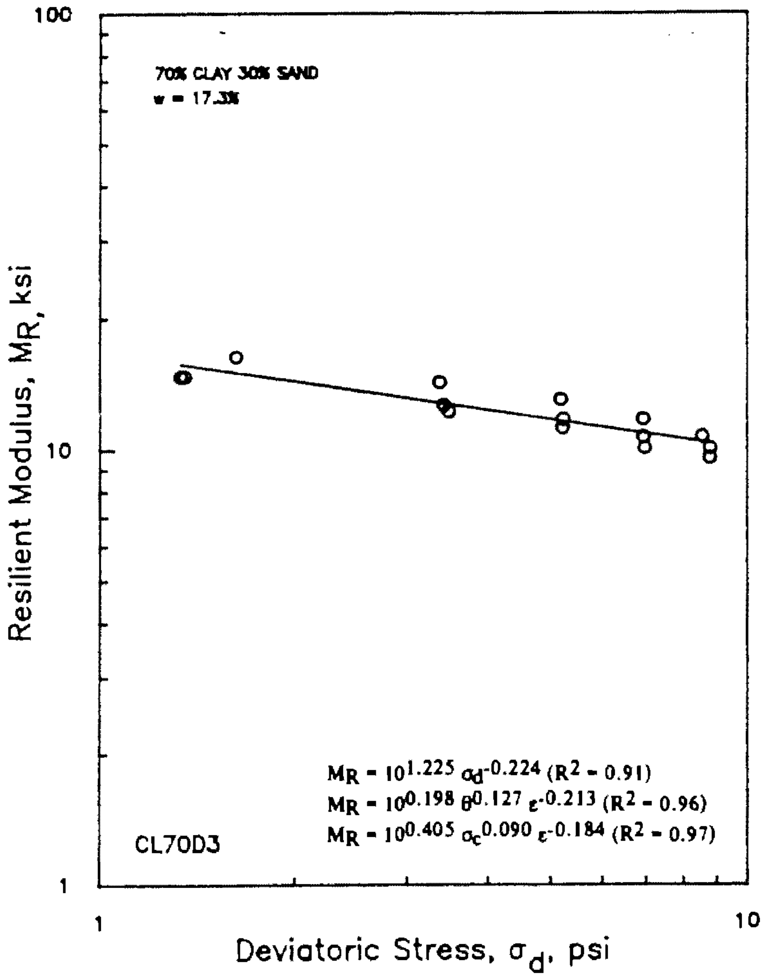

Figure E.15 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70D3.

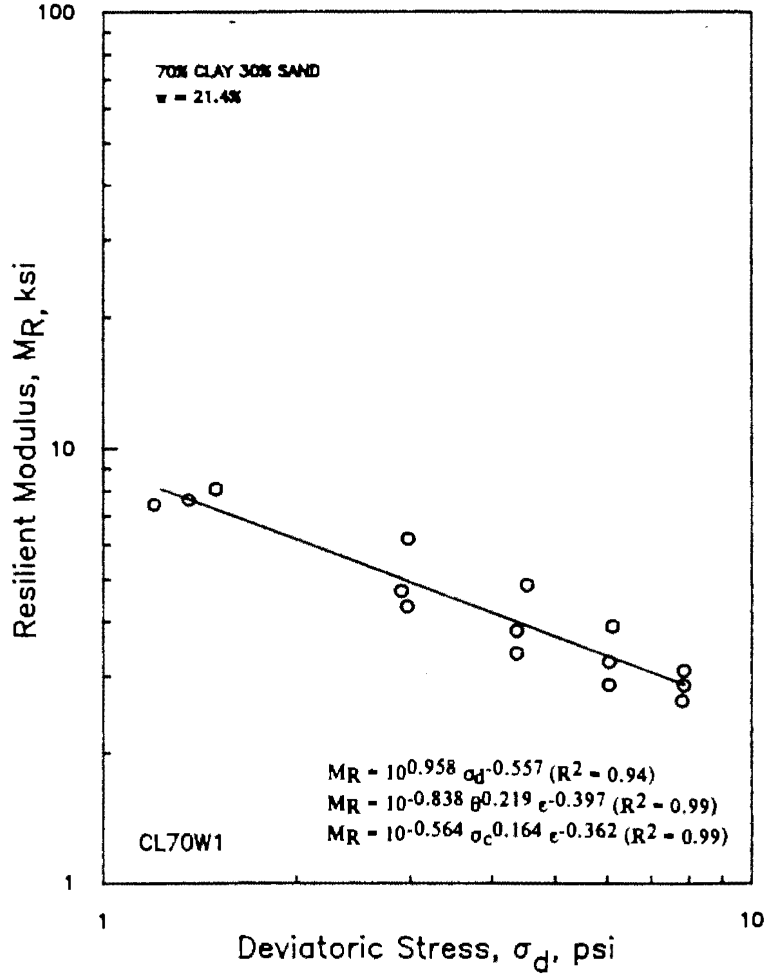

Figure E.16 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70W1.

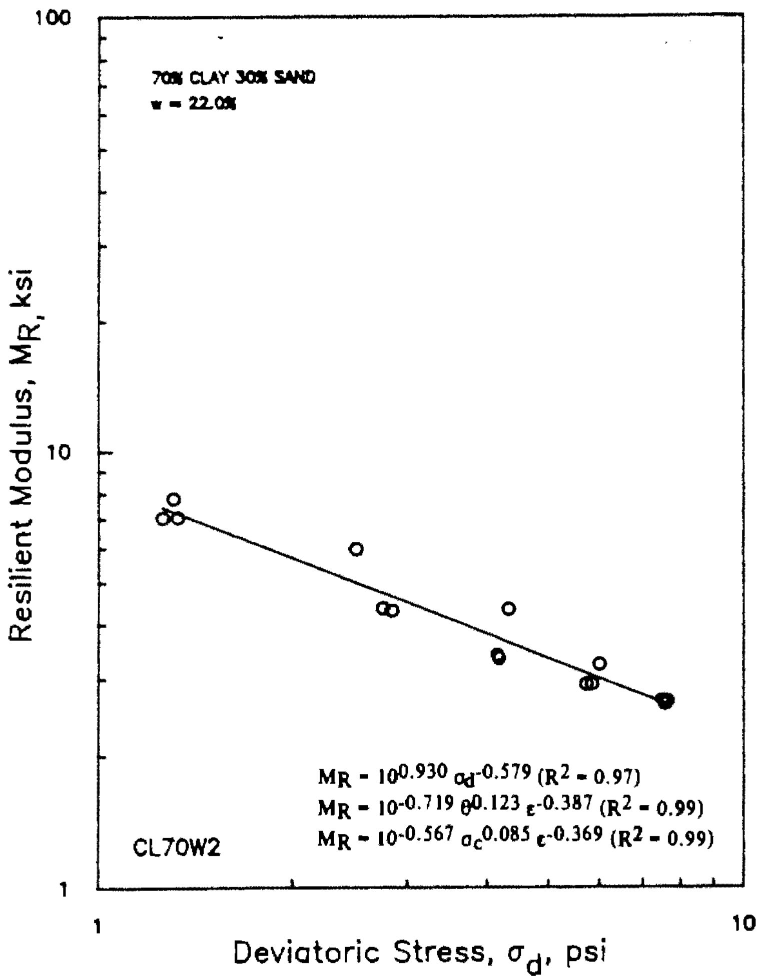

Figure E.17 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70W2.

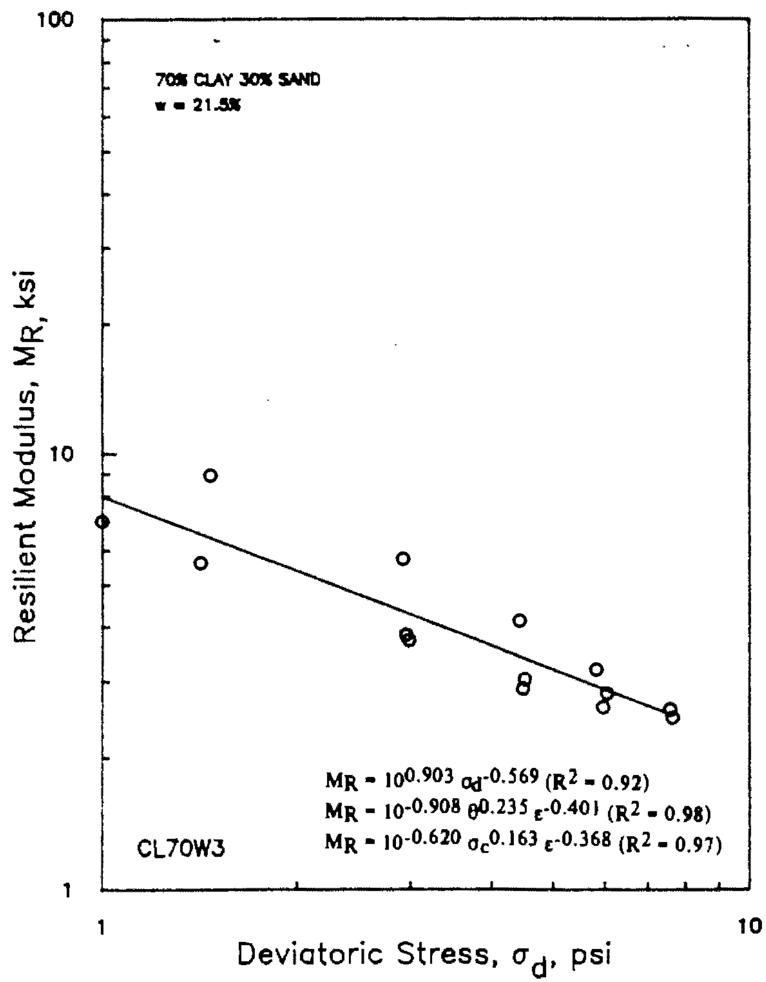

Figure E.18 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL70W2.

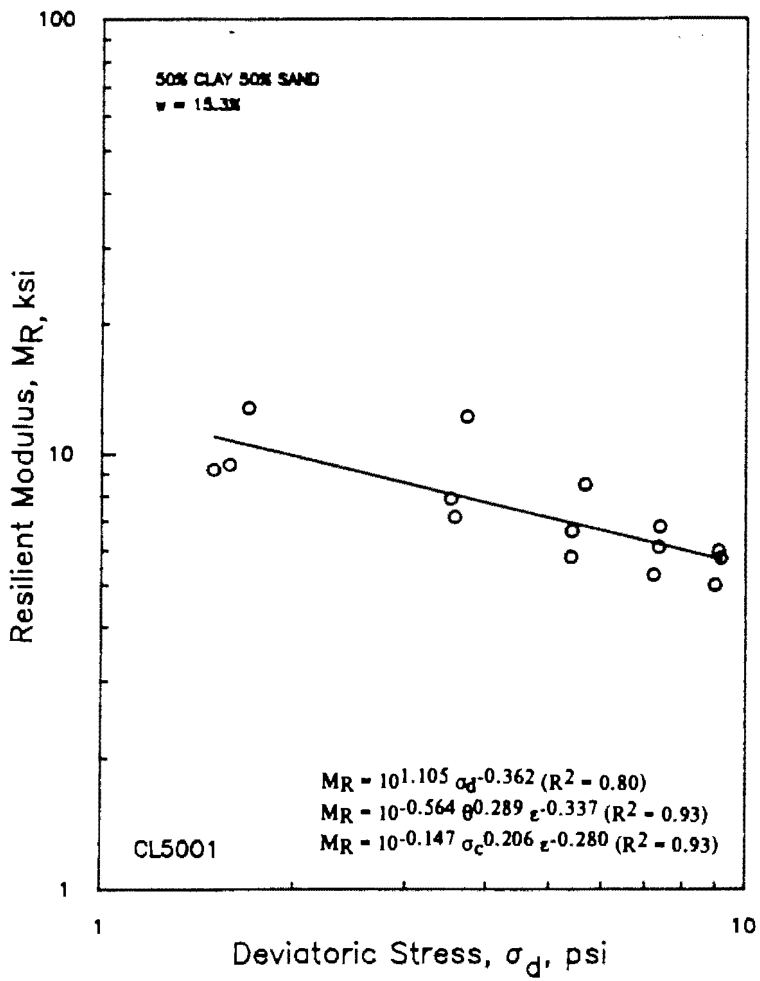

Figure E.19 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50O1.

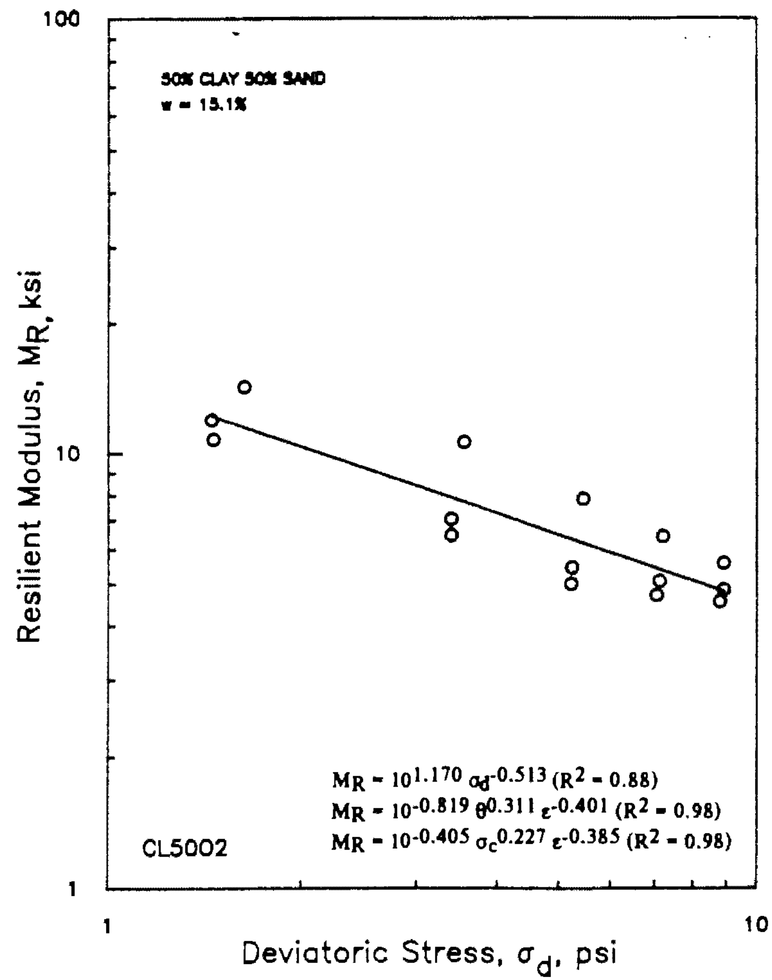

Figure E.20 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50O2.

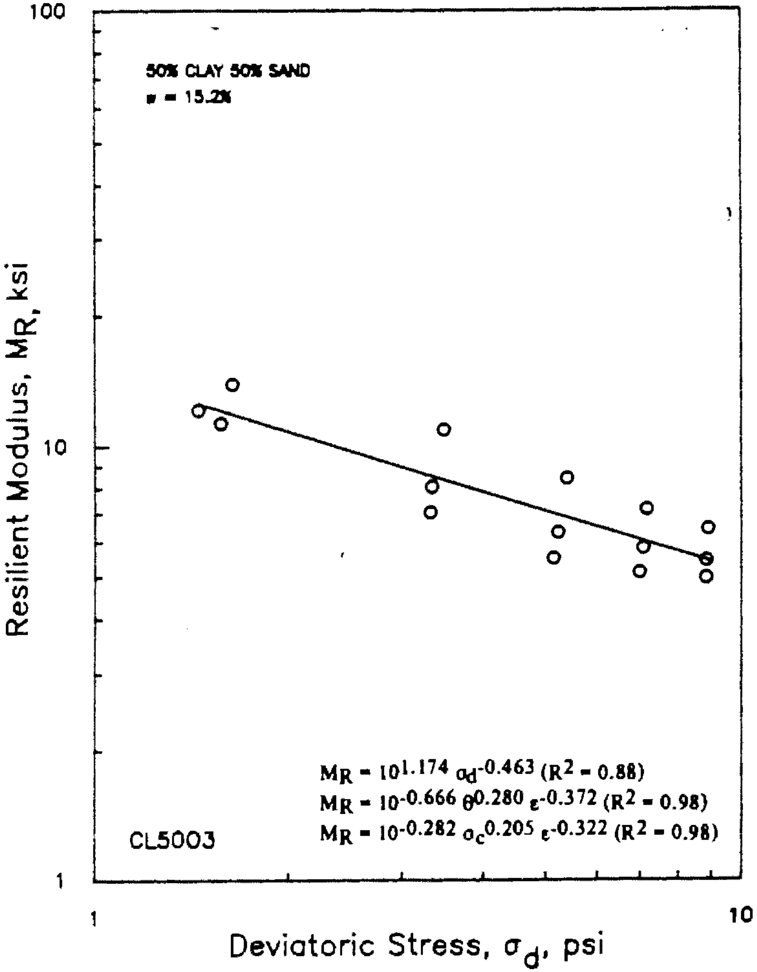

Figure E.21 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50O3.

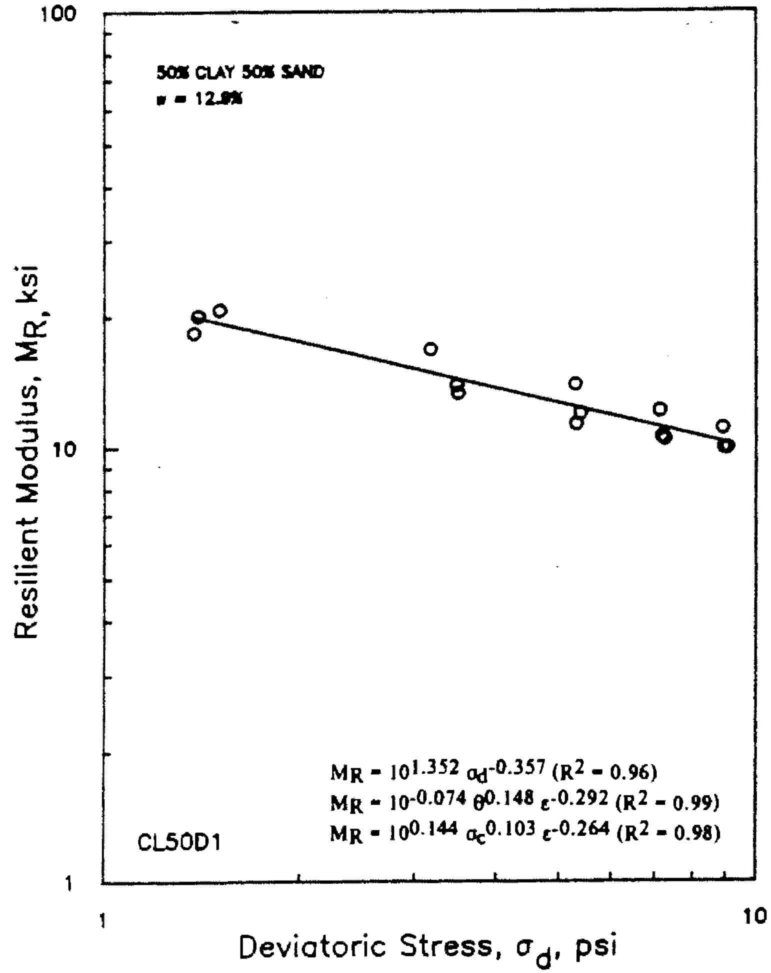

Figure E.22 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50D1.

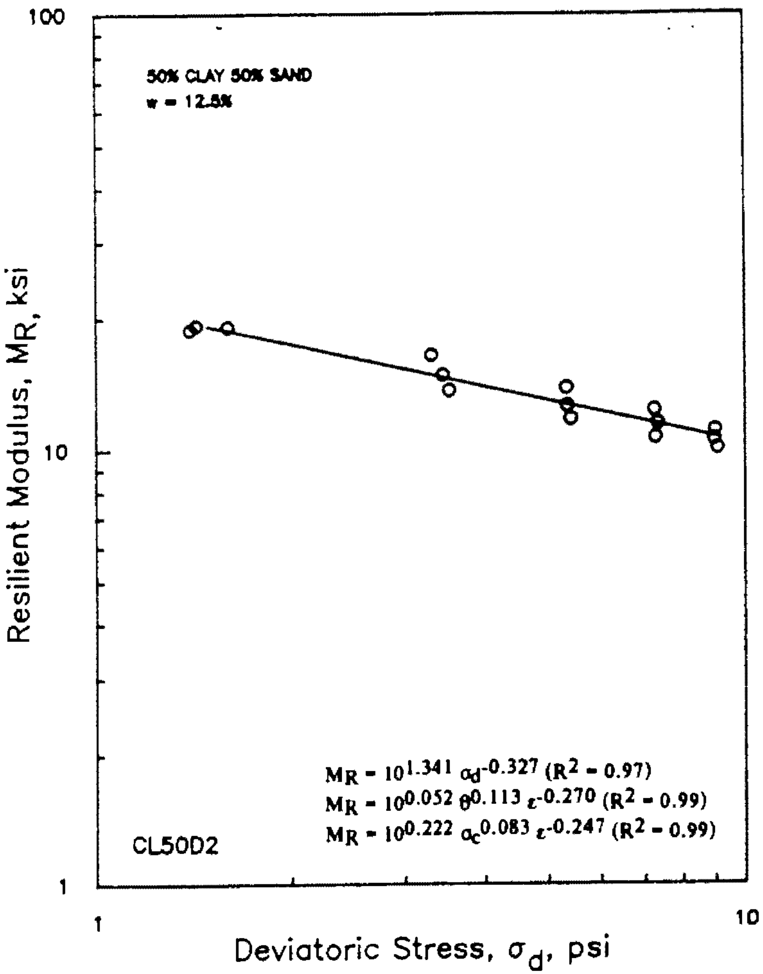

Figure E.23 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50D2.

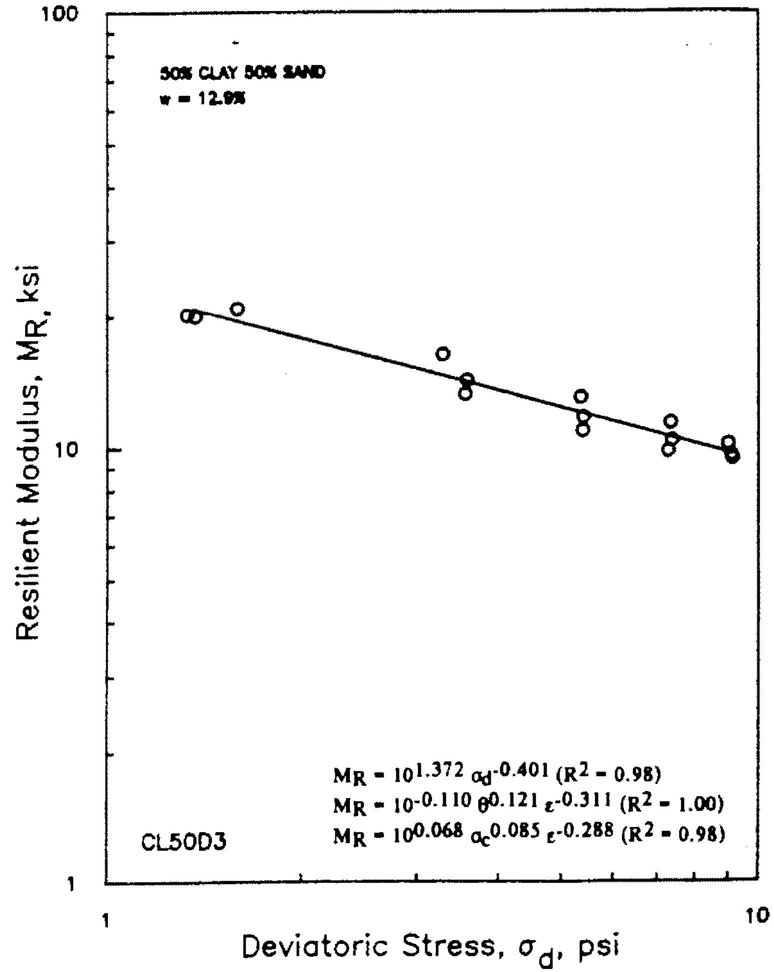

Figure E.24 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50D3.

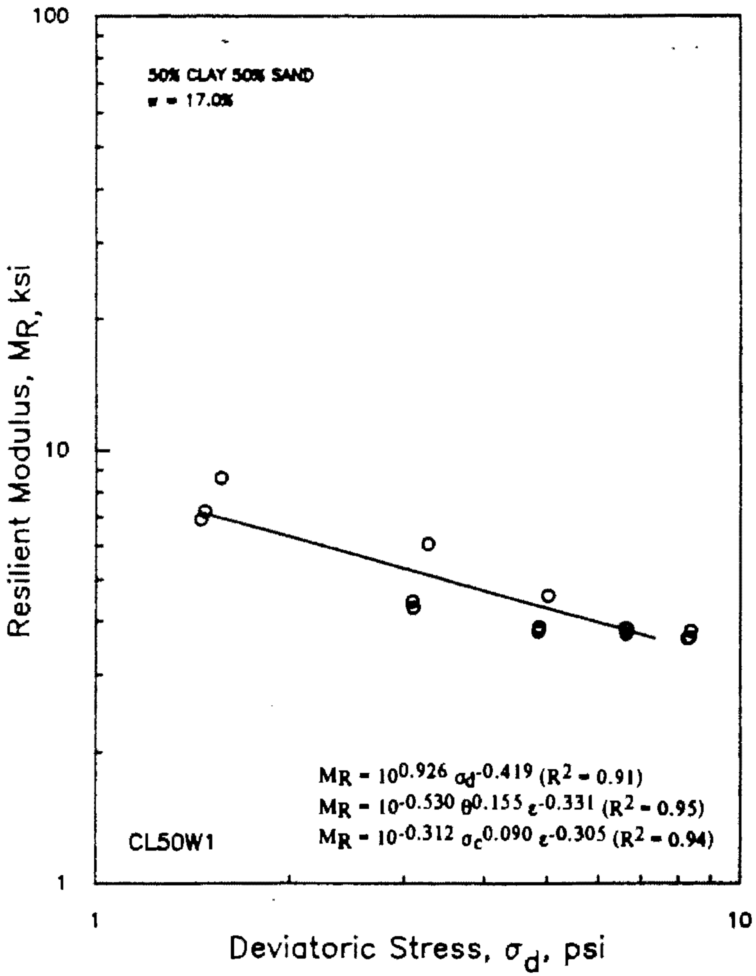

Figure E.25 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50W1.

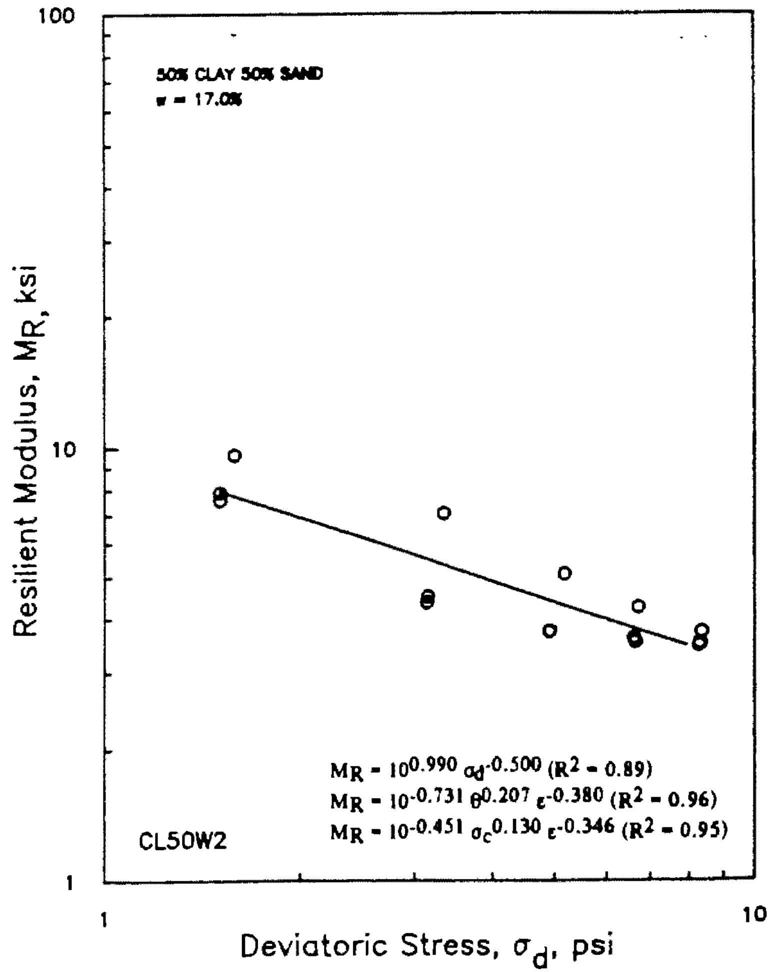

Figure E.26 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50W2.

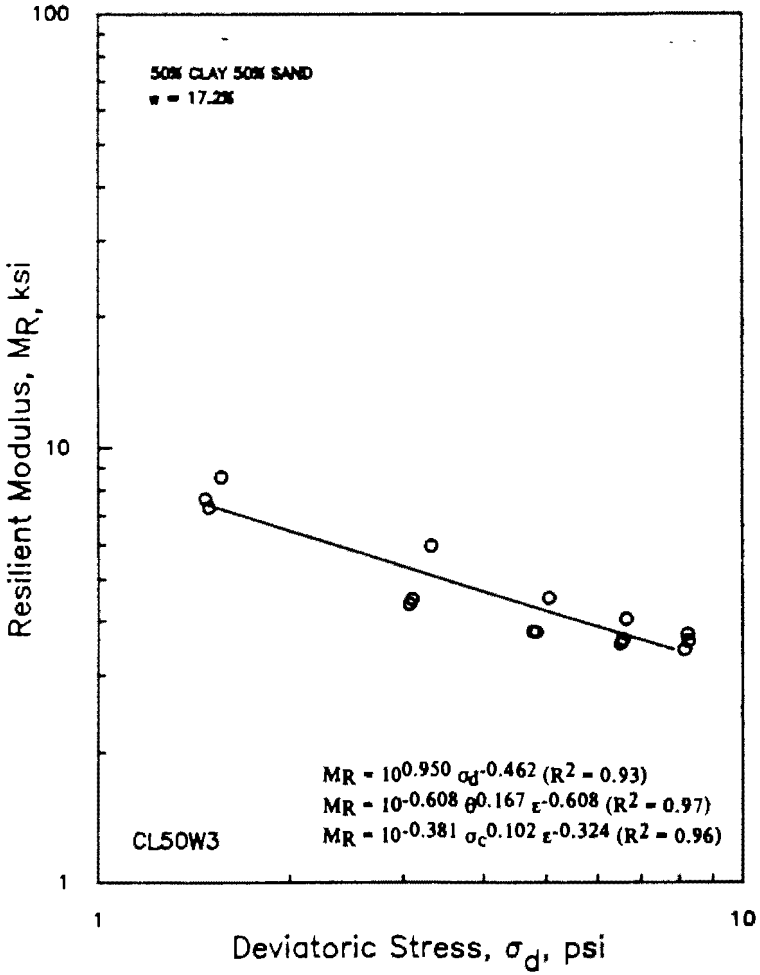

Figure E.27 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL50W3.

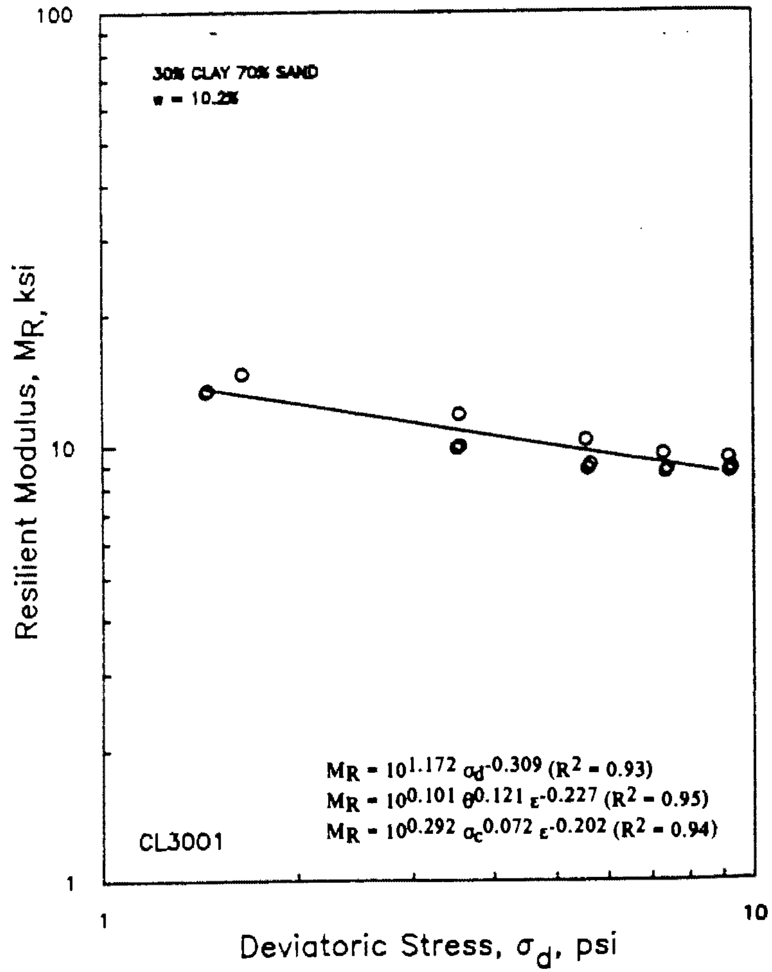

Figure E.28 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30O1.

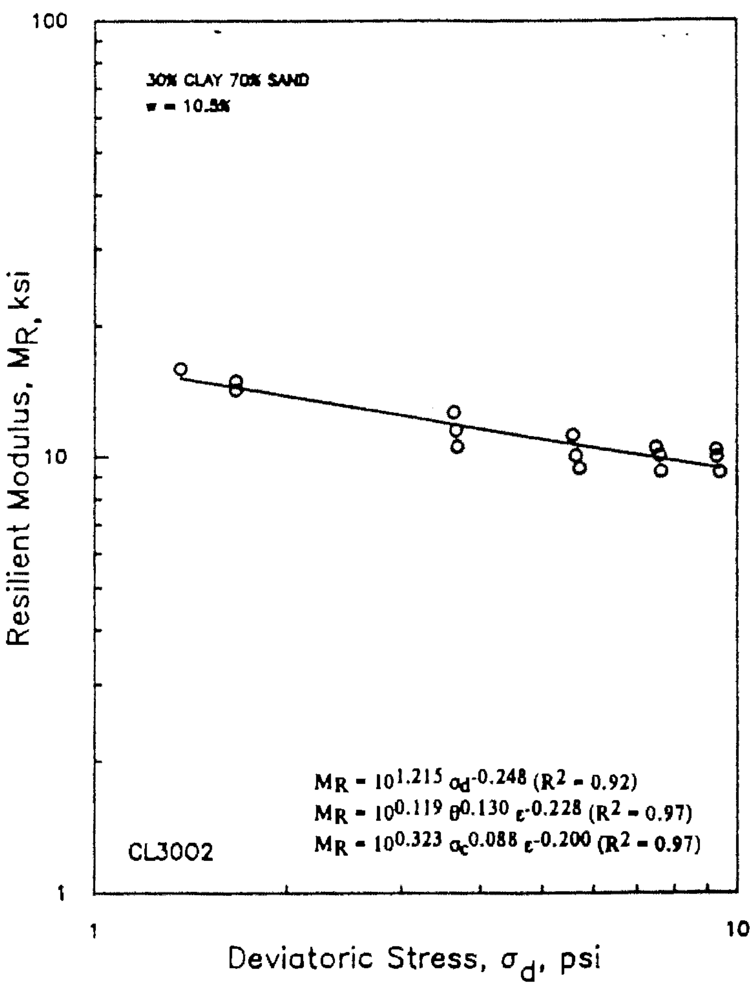

Figure E.29 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30O2.

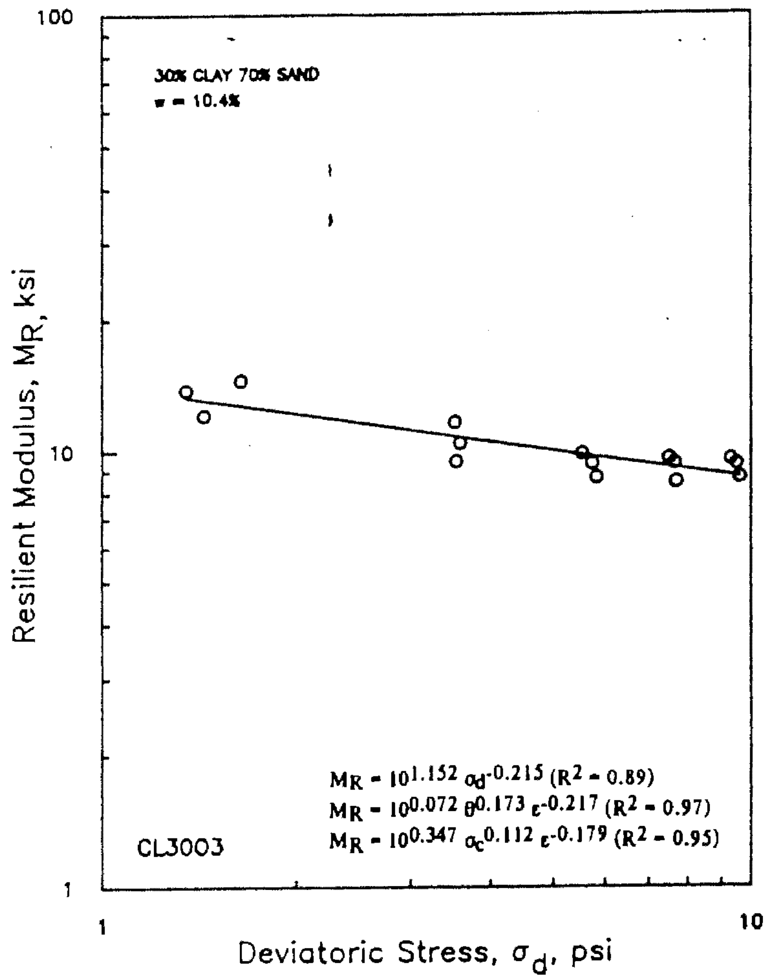

Figure E.30 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30O3.

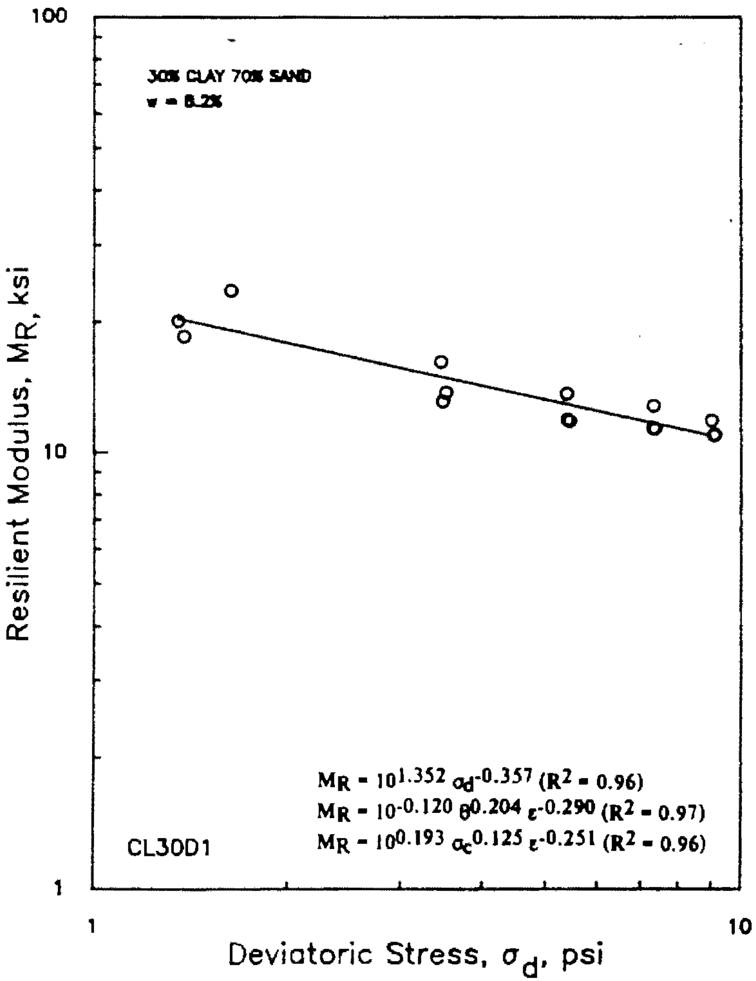

Figure E.31 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30D1.

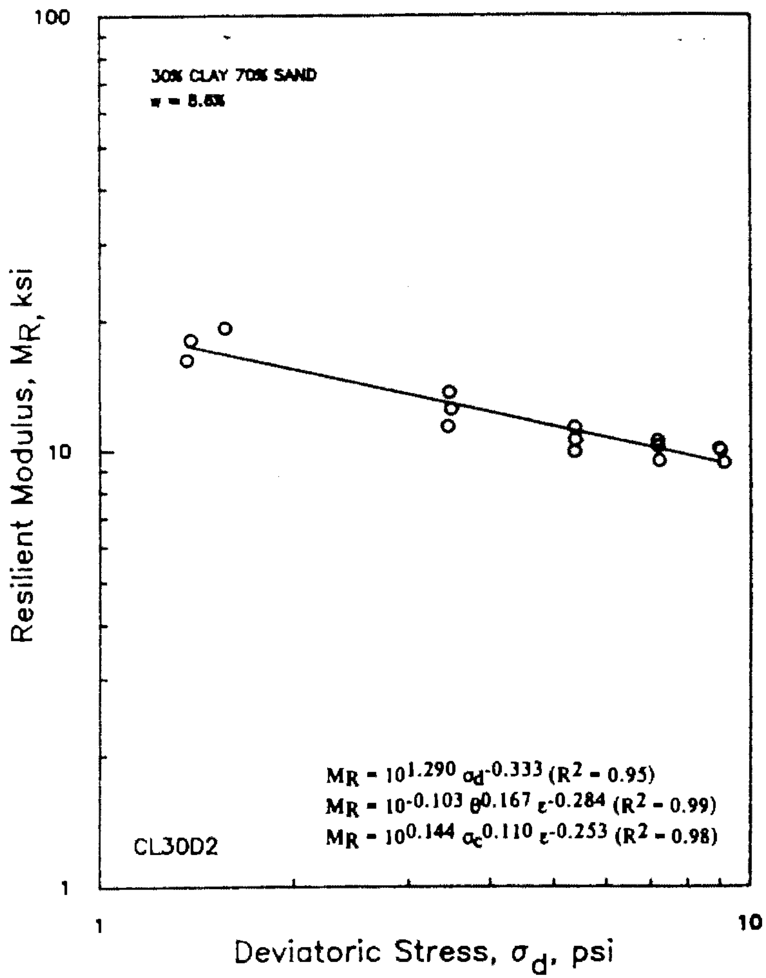

Figure E.32 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30D2.

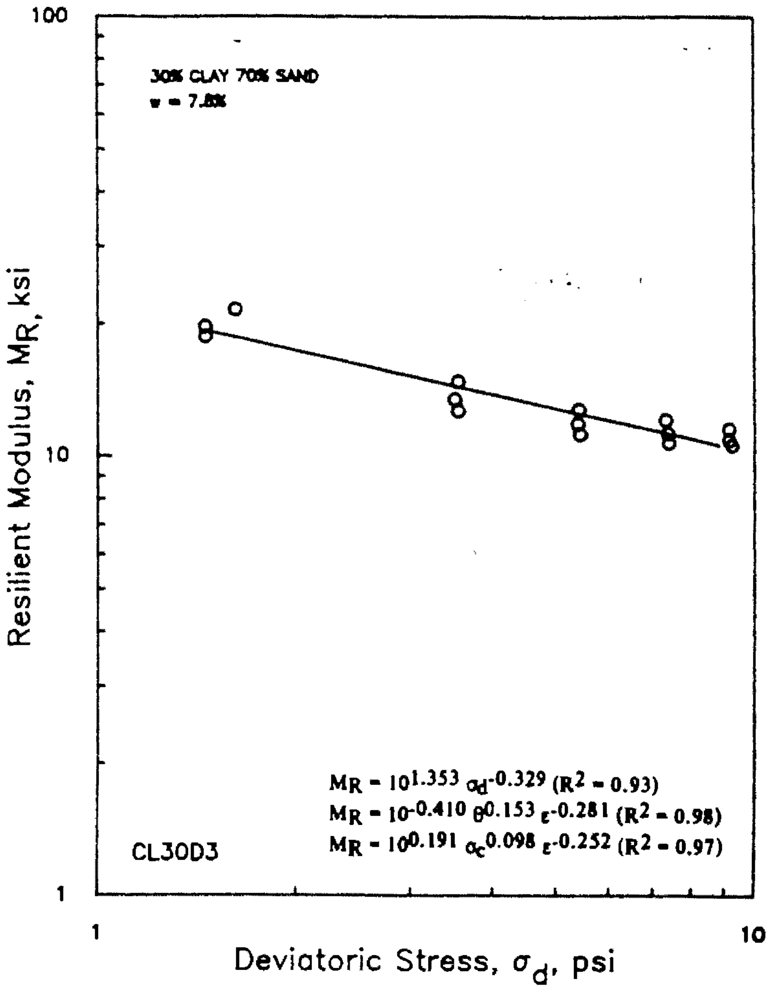

Figure E.33 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30D3.

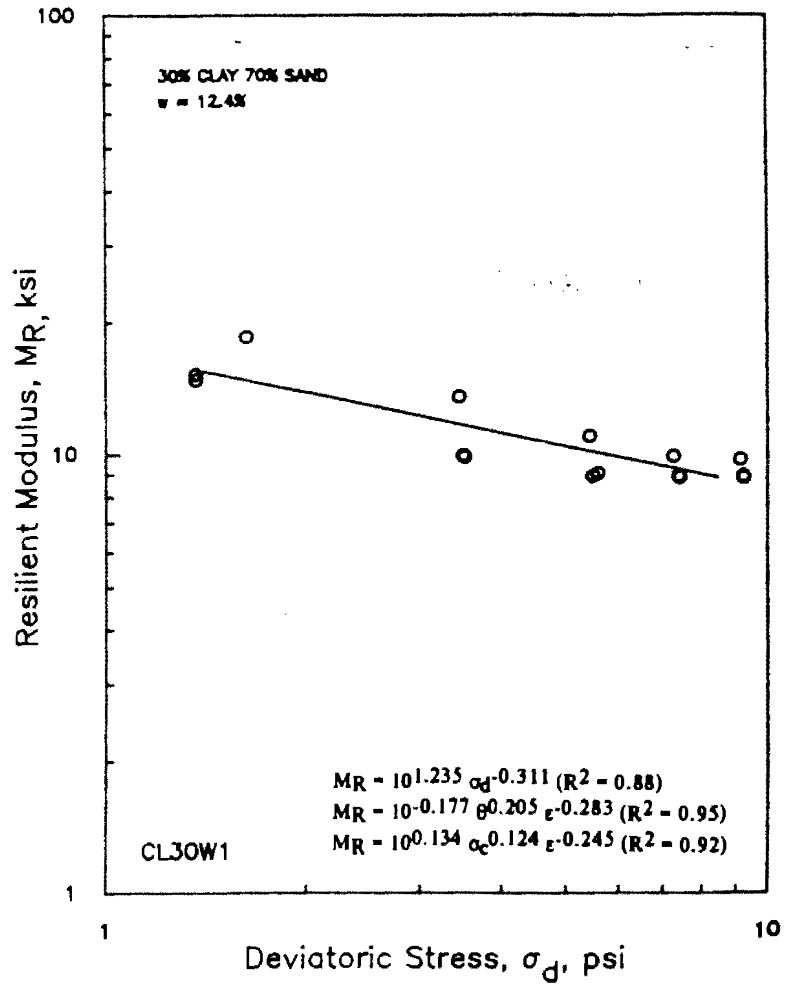

Figure E.34 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30W1.

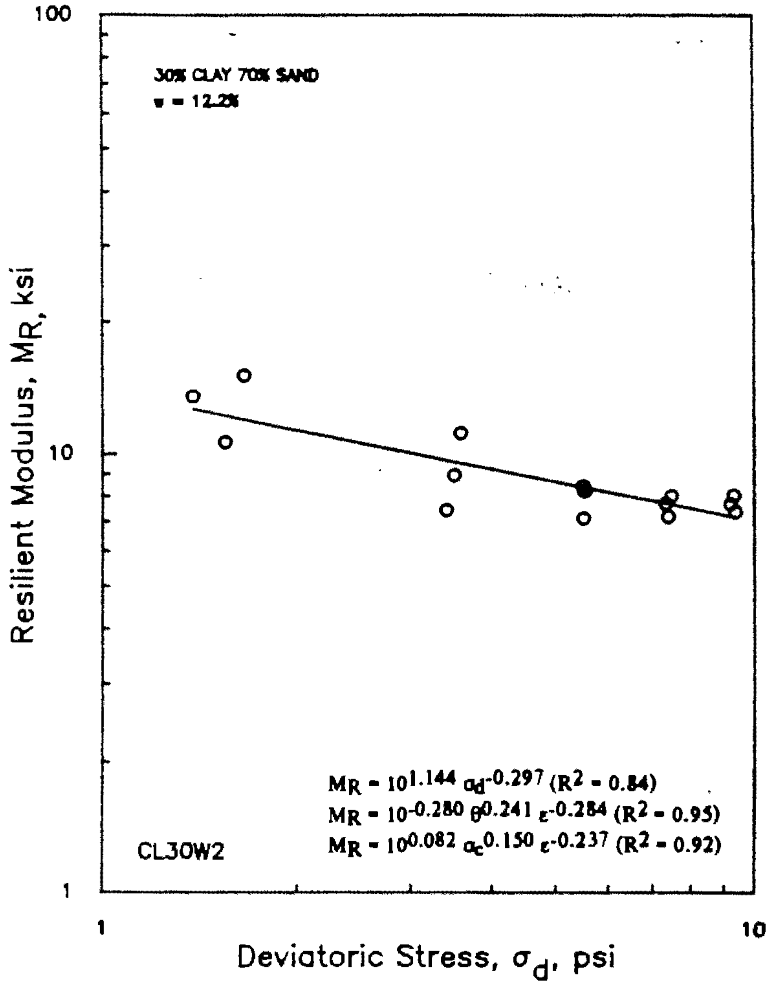

Figure E.35 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30W2.

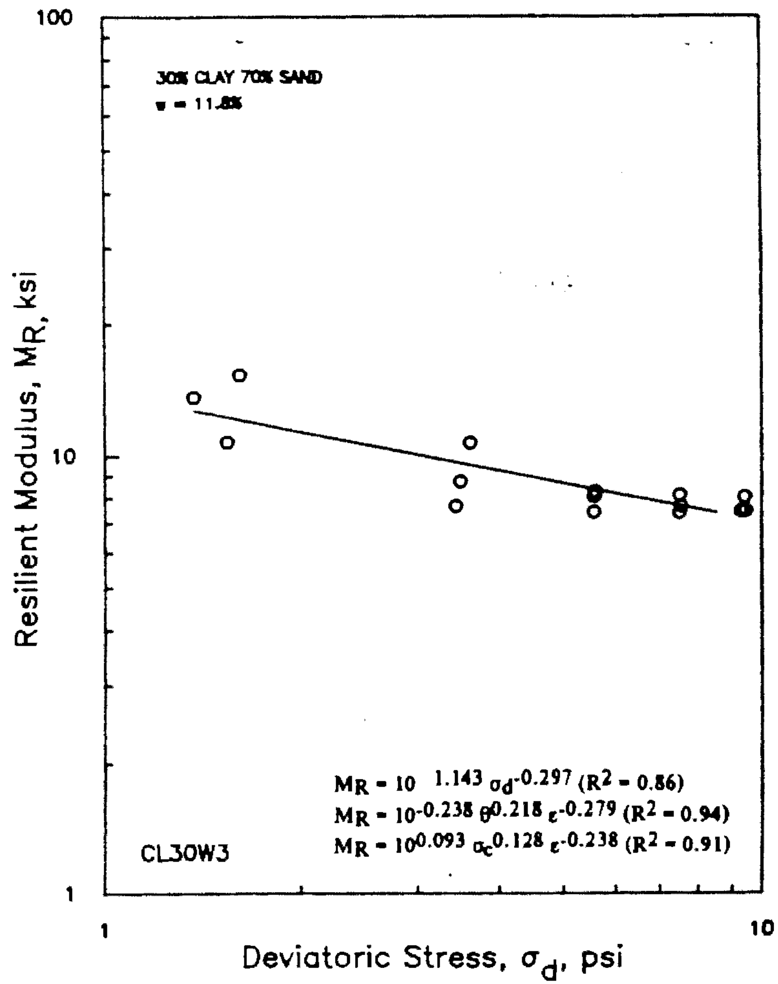

Figure E.36 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL30W3.

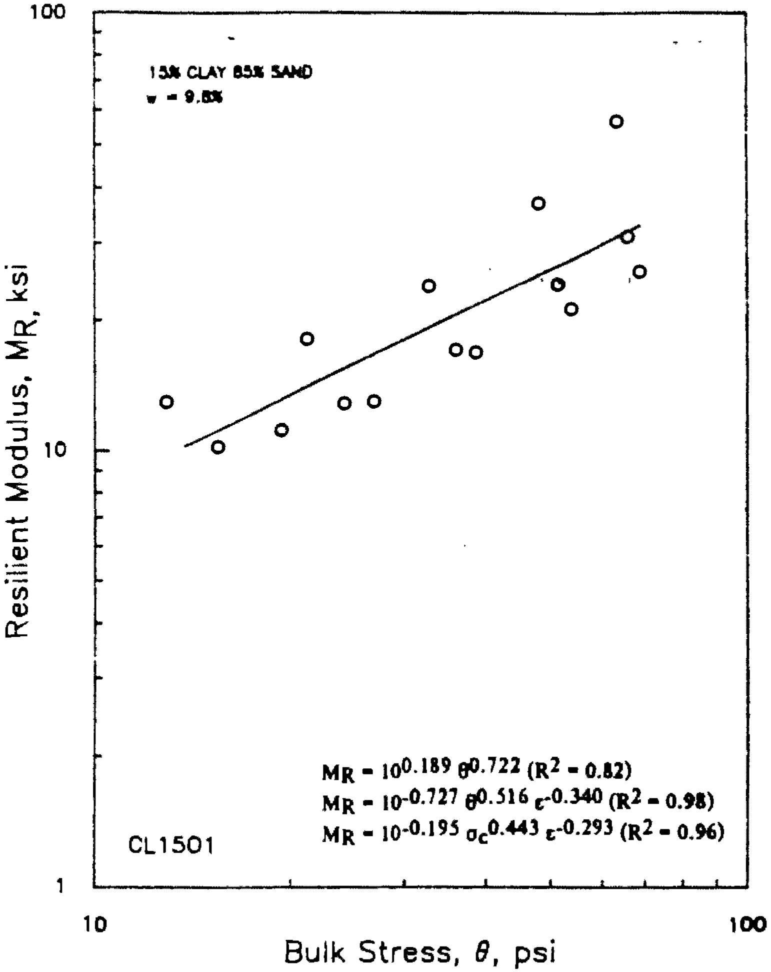

Figure E.37 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15O1.

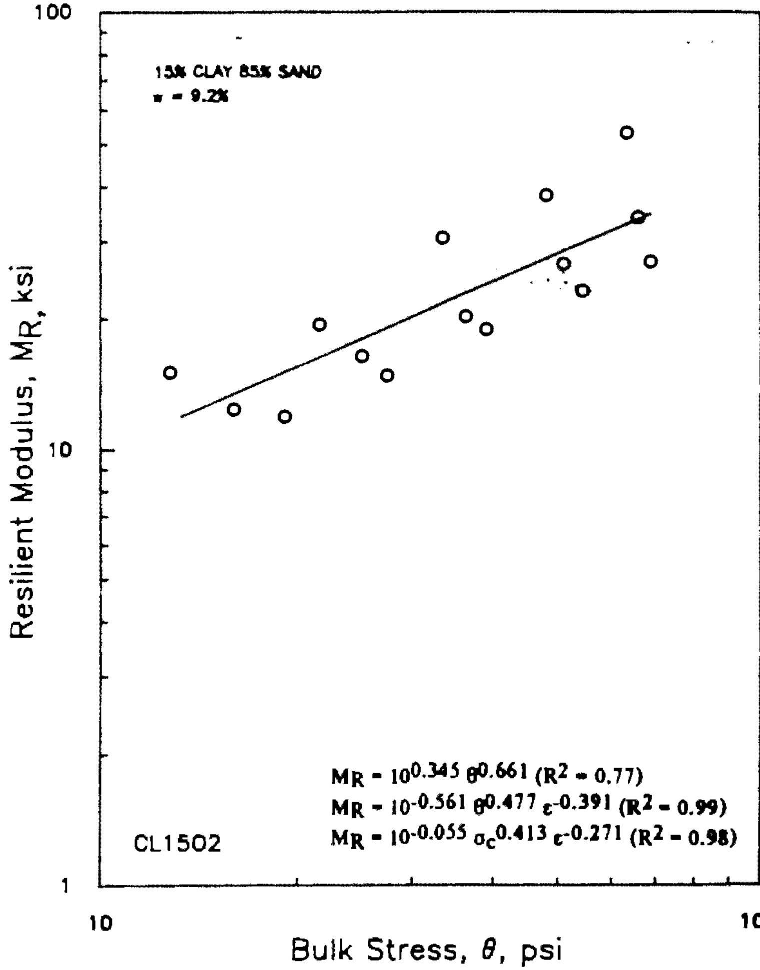

Figure E.38 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15O2.

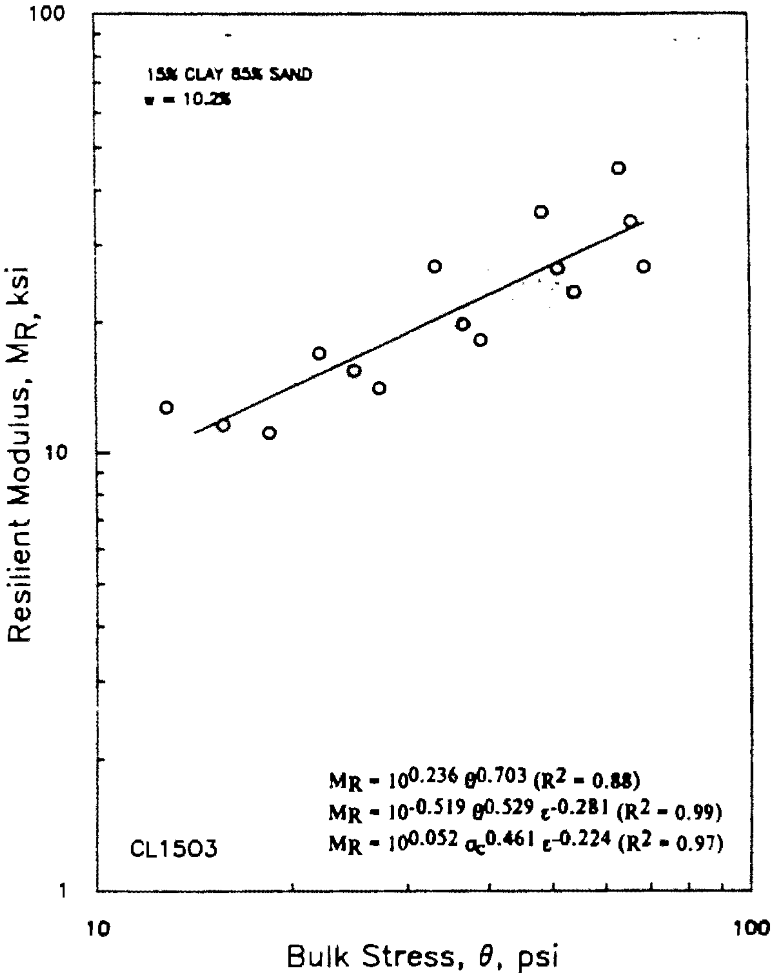

Figure E.39 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15O3.

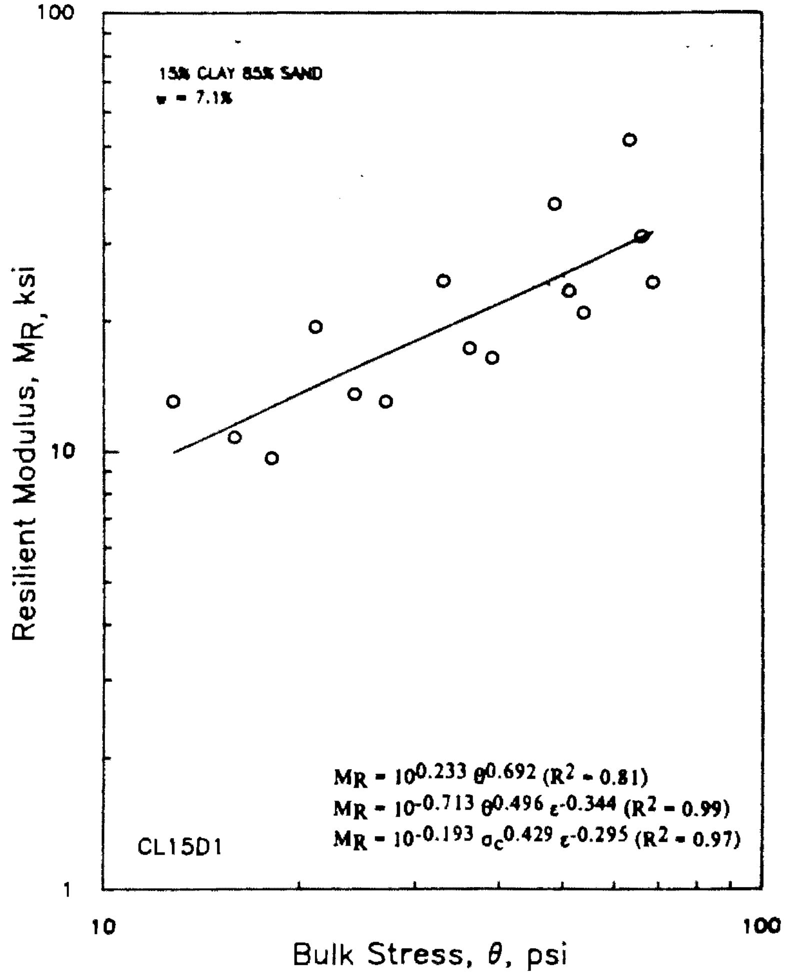

Figure E.40 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15D1.

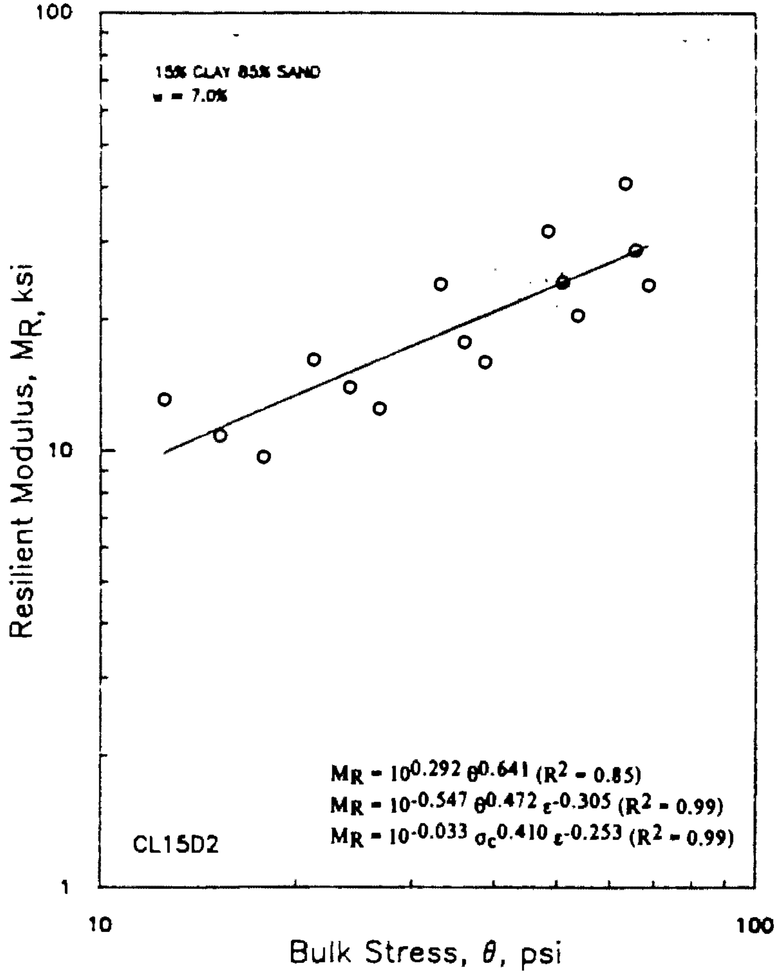

Figure E.41 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15D2.

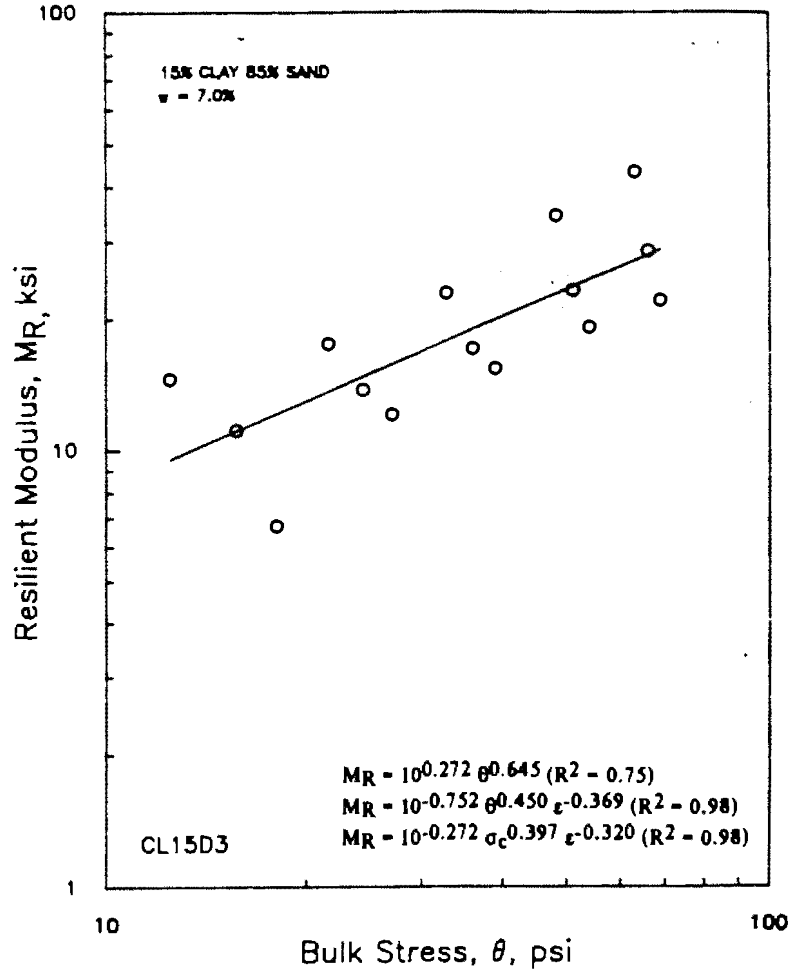

Figure E.42 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15D3.

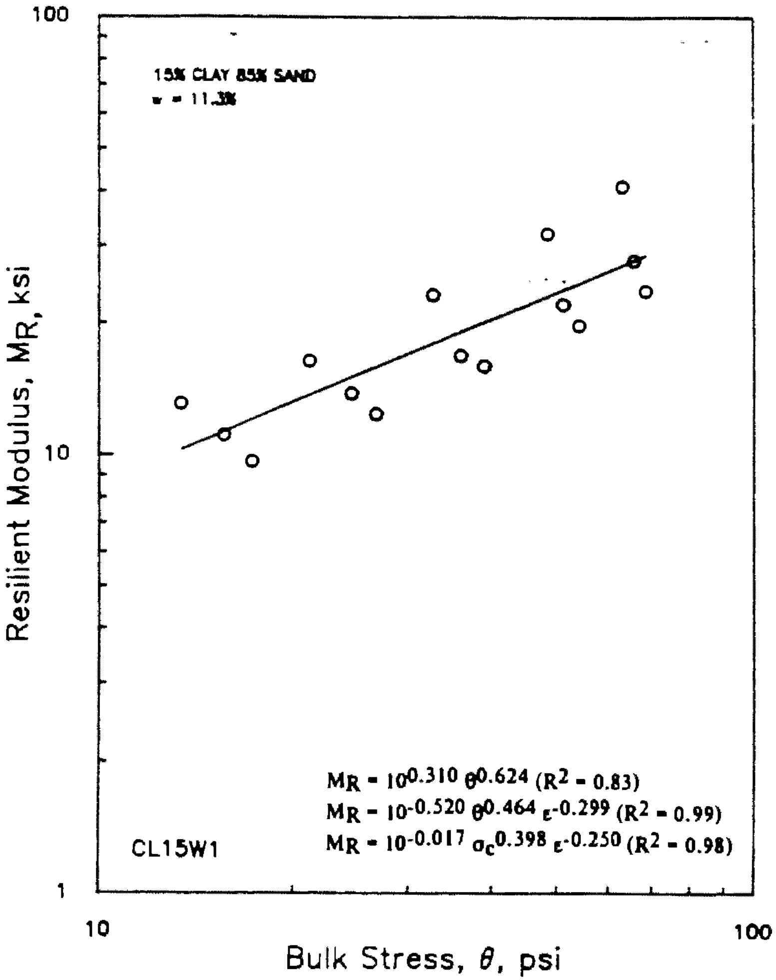

Figure E.43 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15W1.

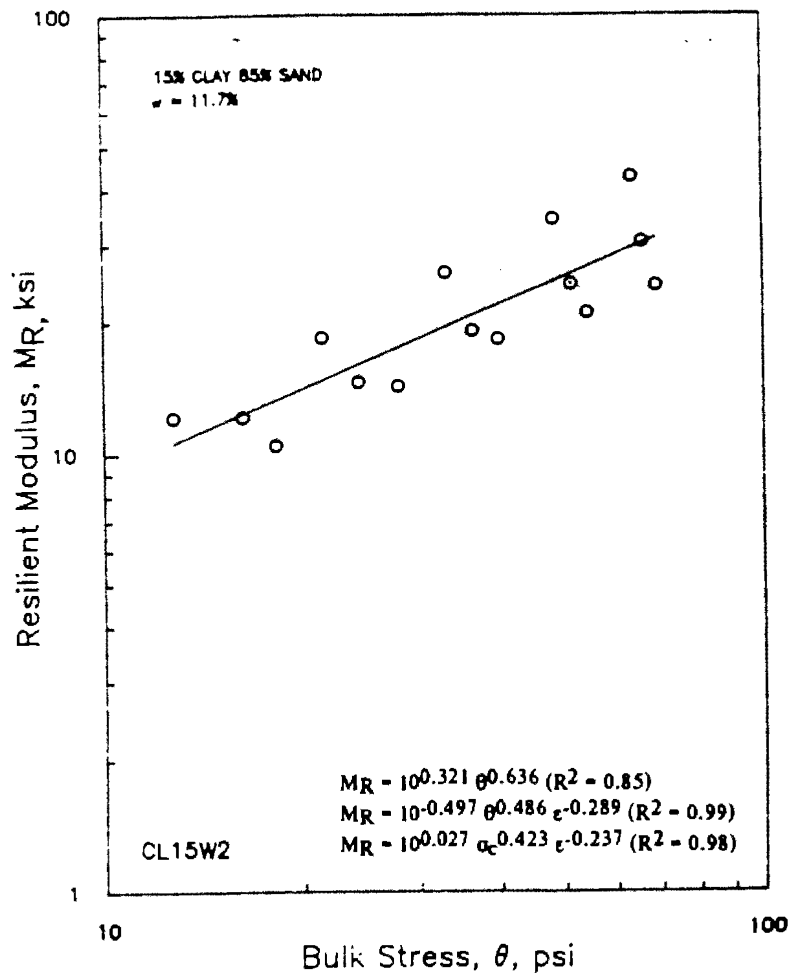

Figure E.44 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15W2.

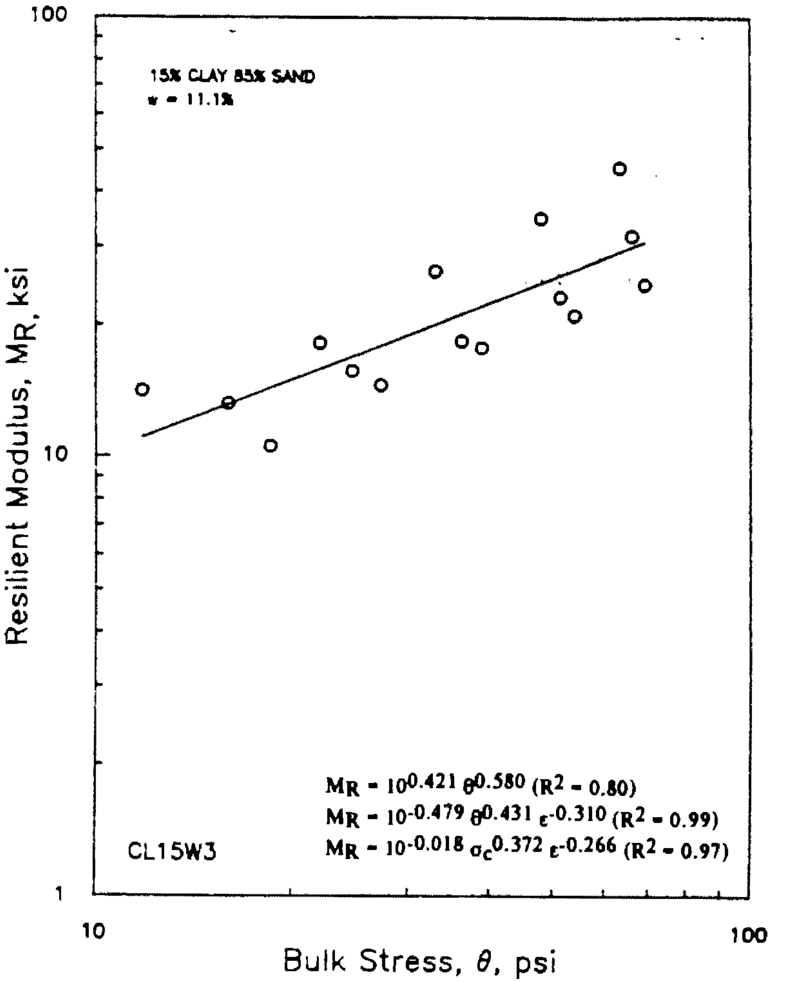

Figure E.45 - Variation in Resilient Modulus with Bulk Stress for Specimen CL15W3

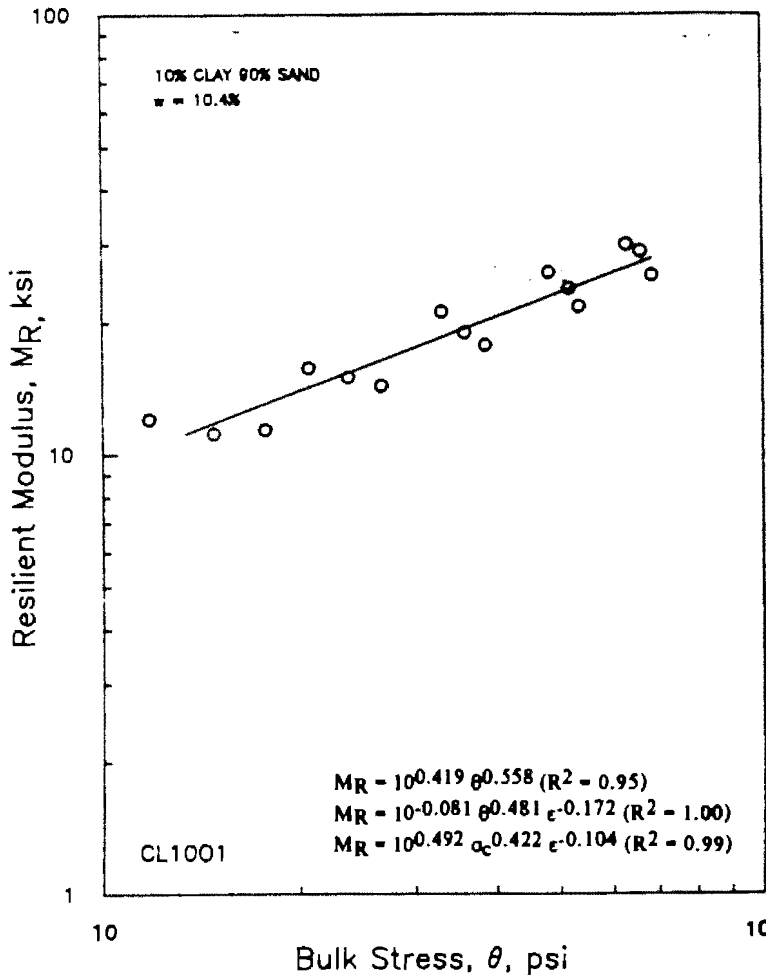

Figure E.46 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10O1.

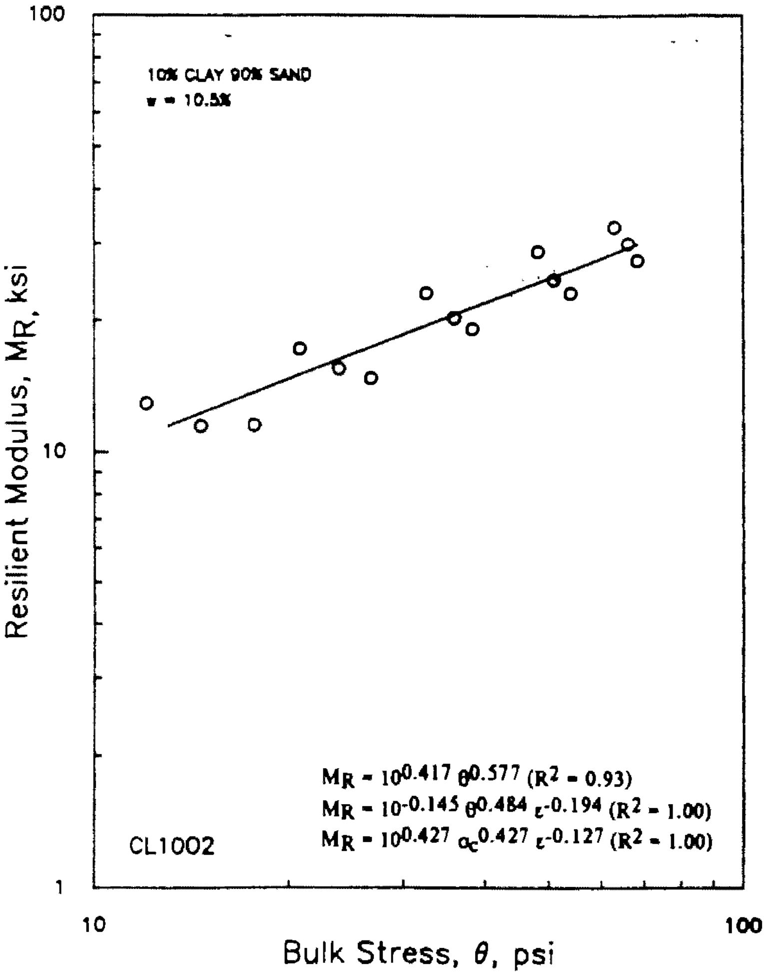

Figure E.47 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10O2.

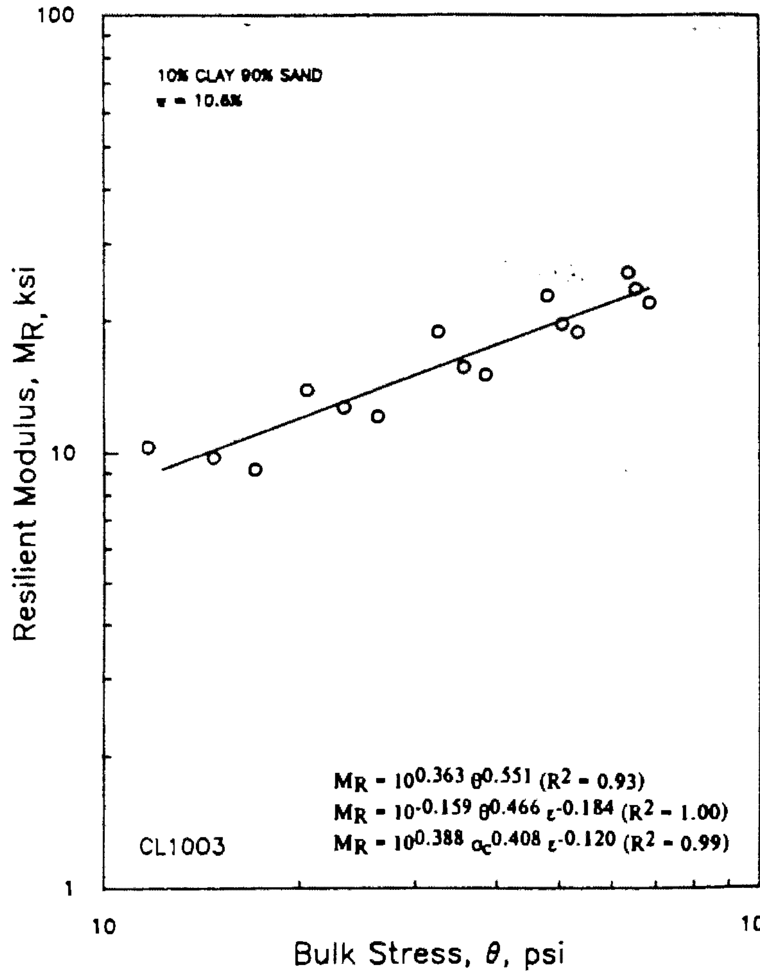

Figure E.48 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10O3.

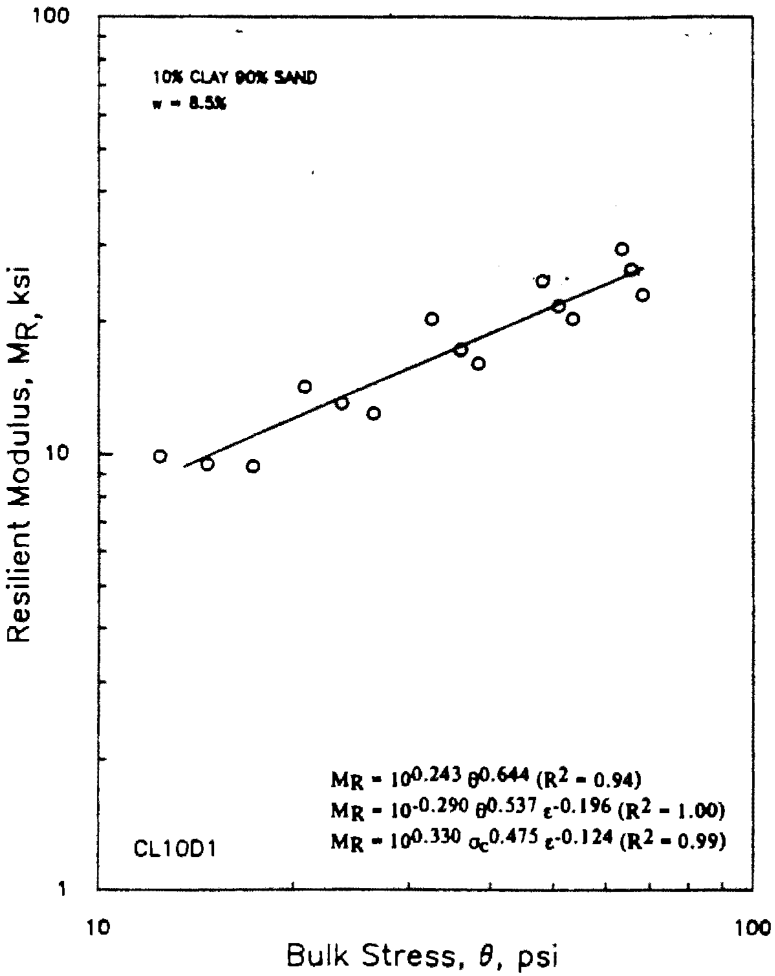

Figure E.49 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10D1.

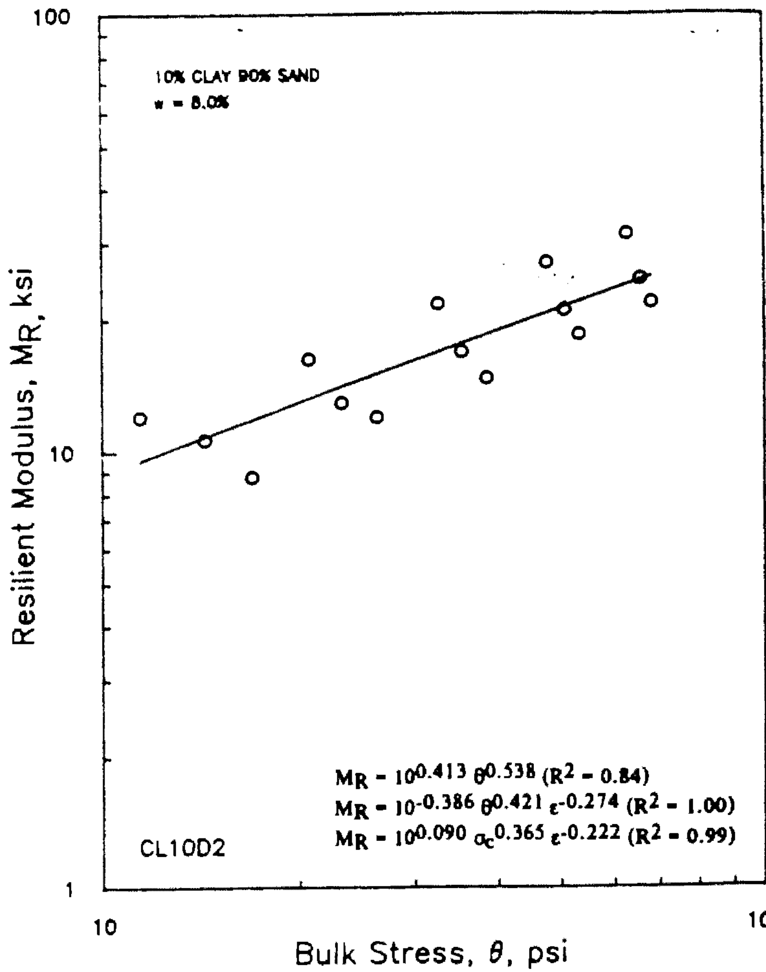

Figure E.50 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10D2.

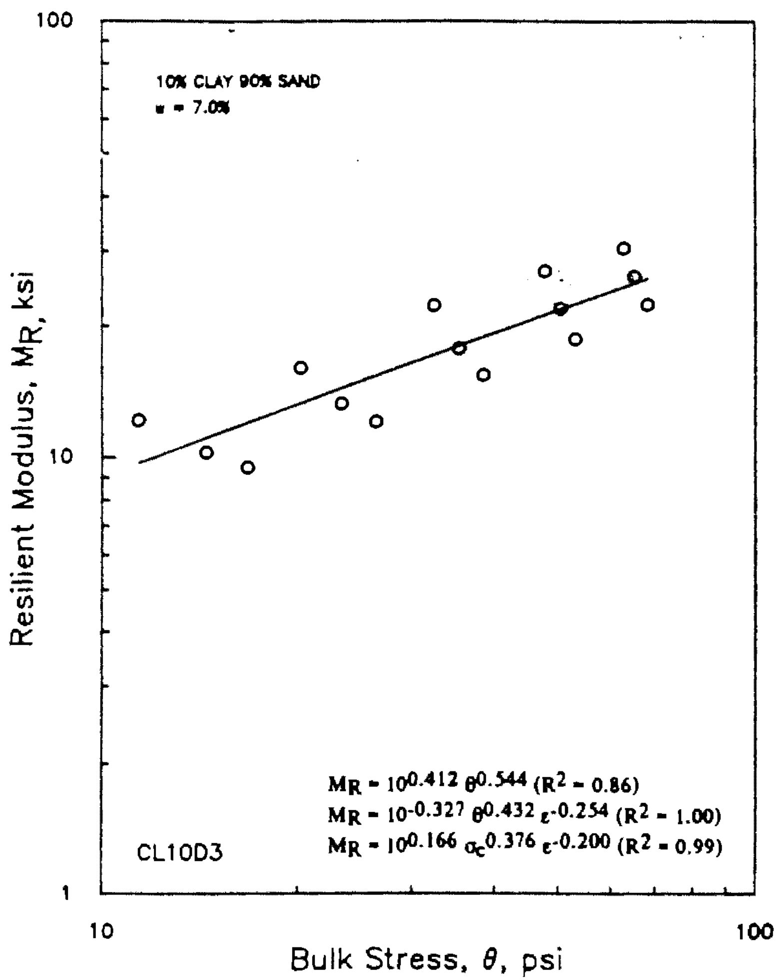

Figure E.51 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10D3.

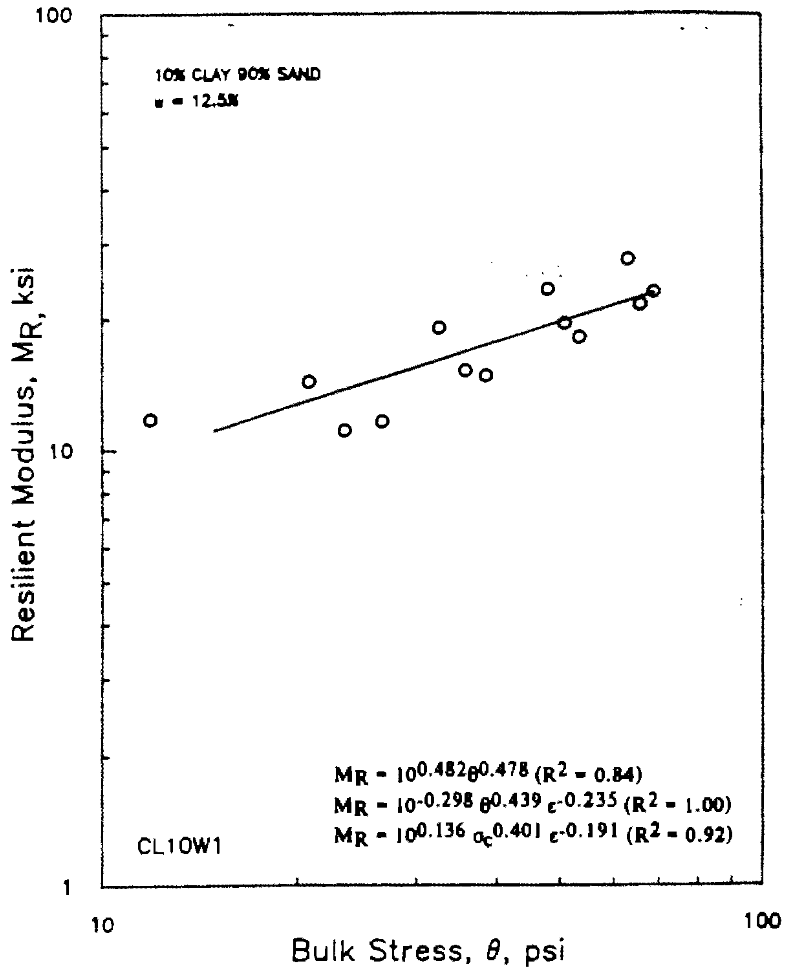

Figure E.52 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10W1.

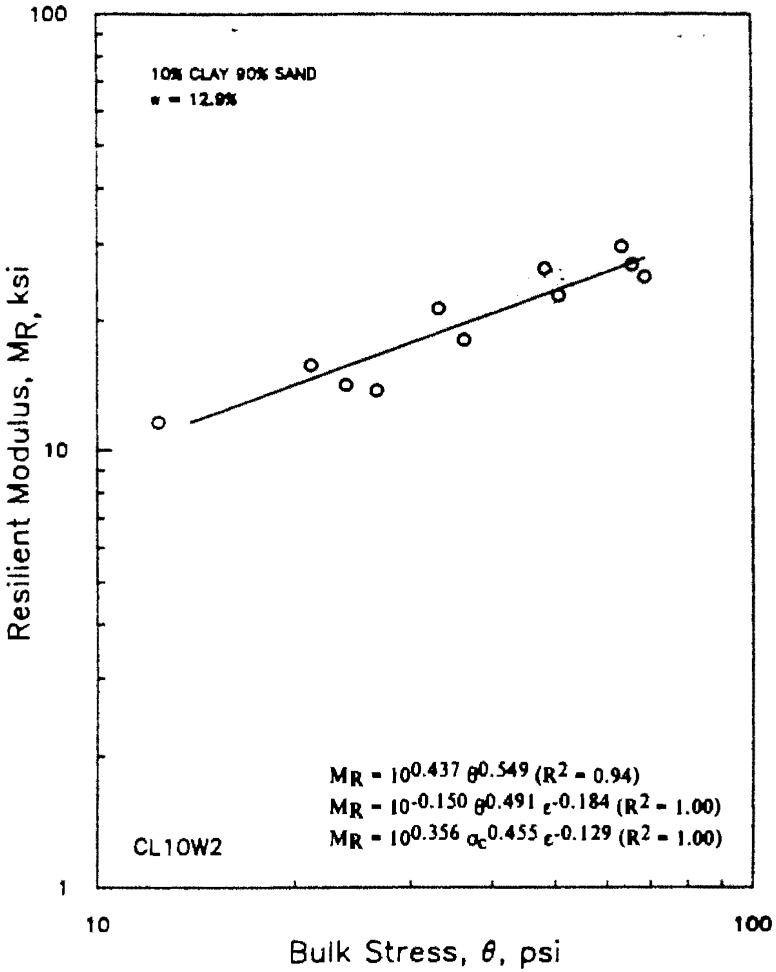

Figure E.53 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10W2.

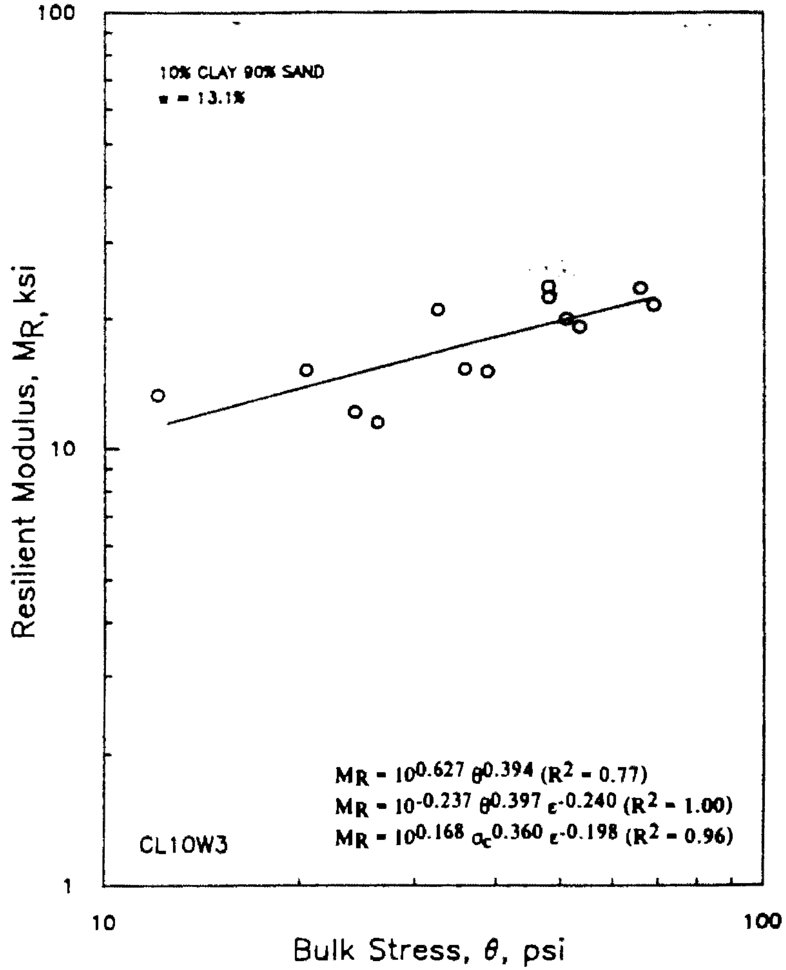

Figure E.54 - Variation in Resilient Modulus with Bulk Stress for Specimen CL10W3.

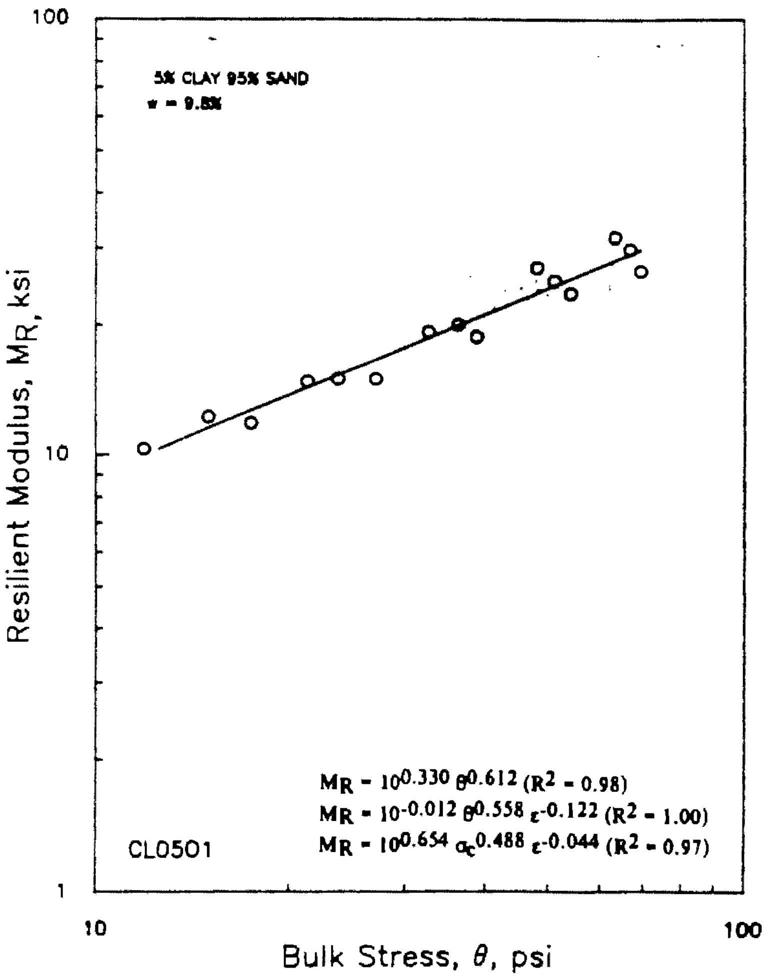

Figure E.55 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05O1.

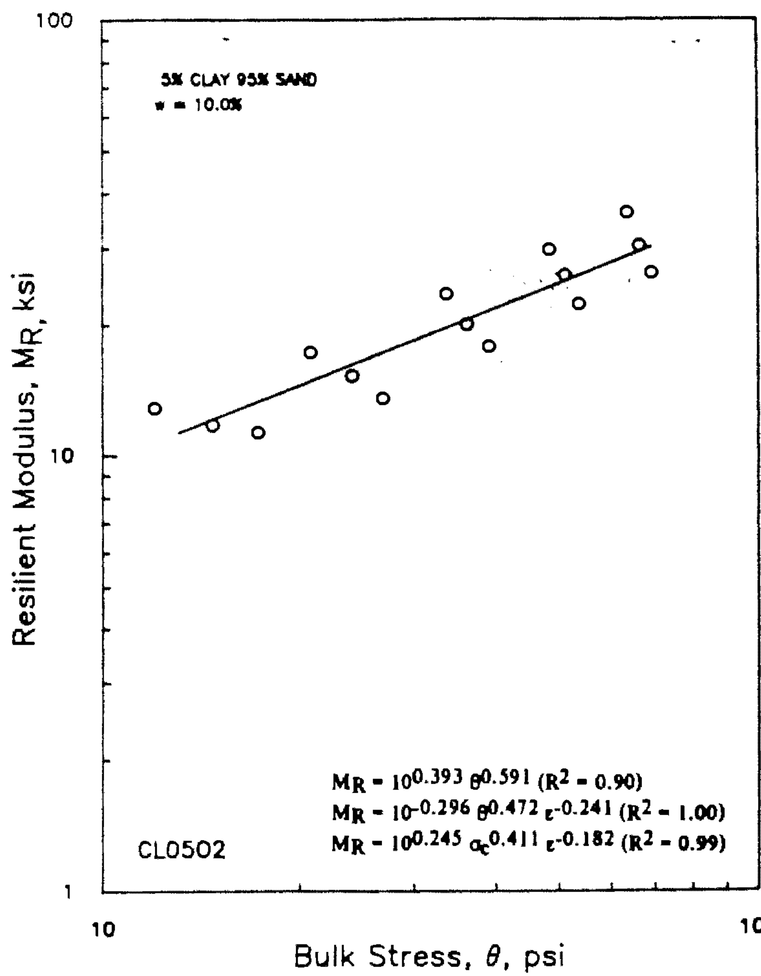

Figure E.56 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05O2.

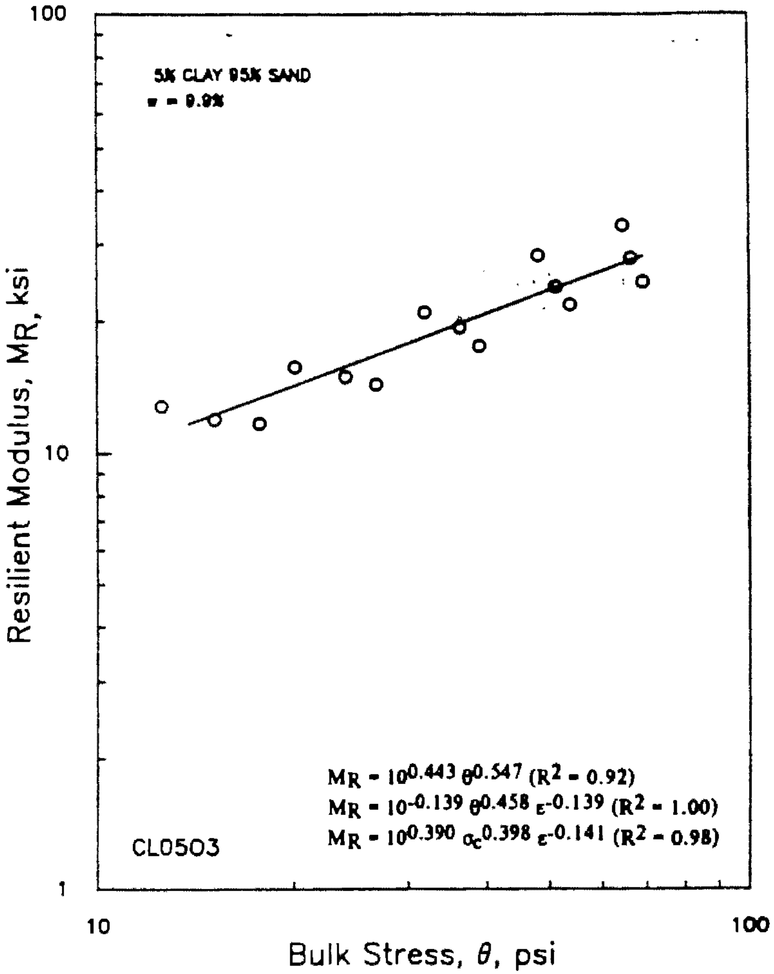

Figure E.57 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05O3.

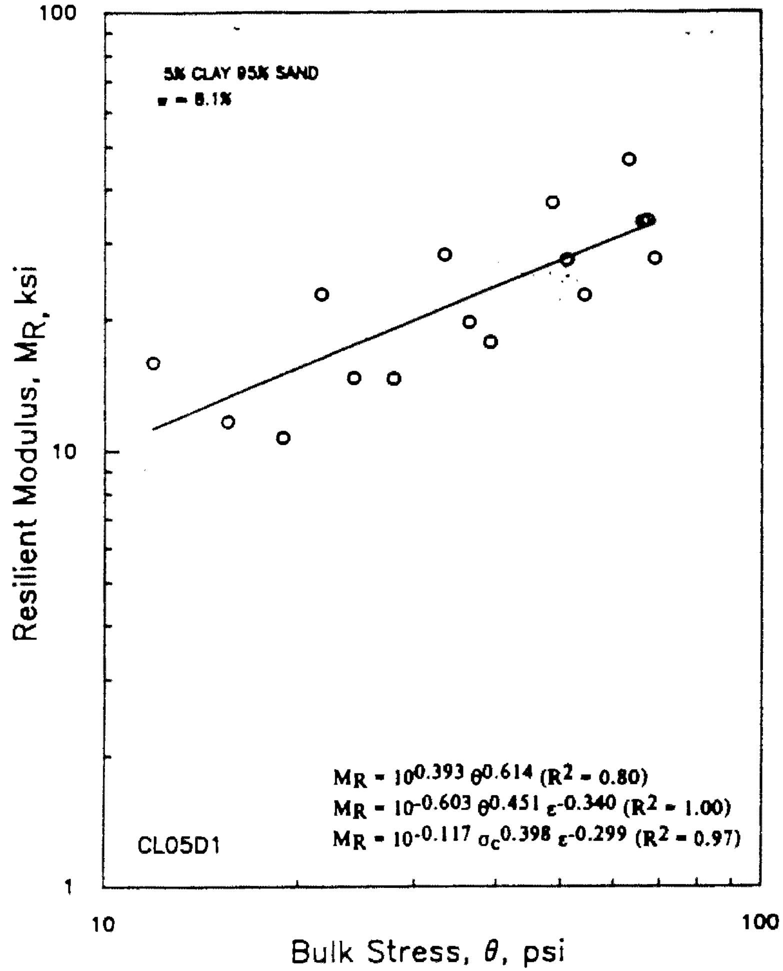

Figure E.58 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05D1.

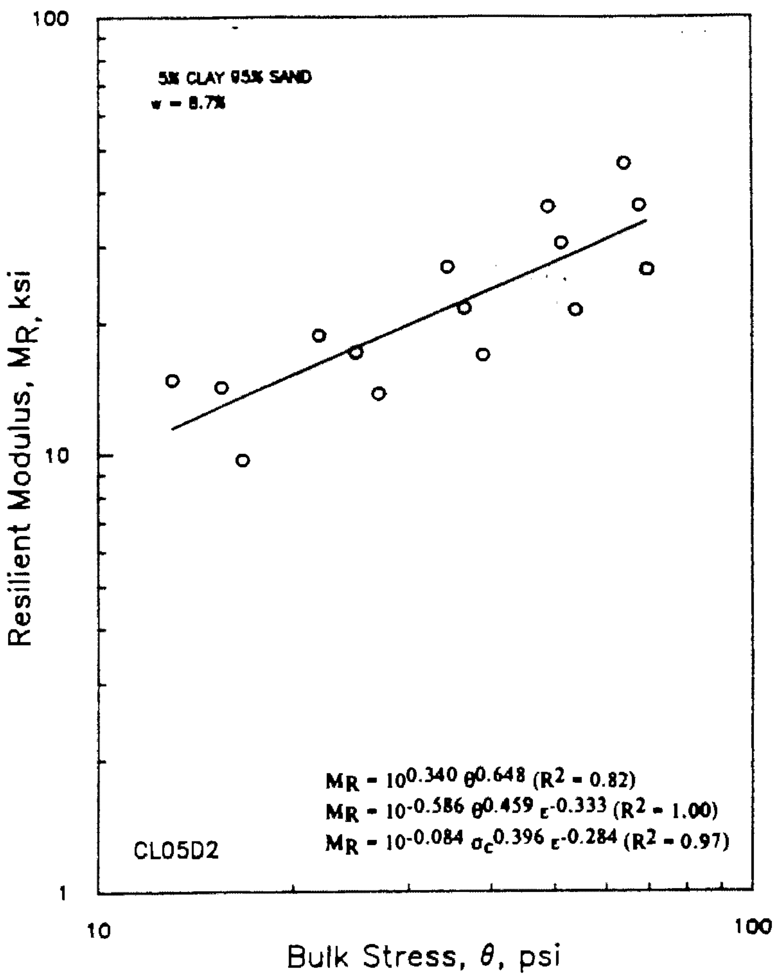

Figure E.59 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05D2.

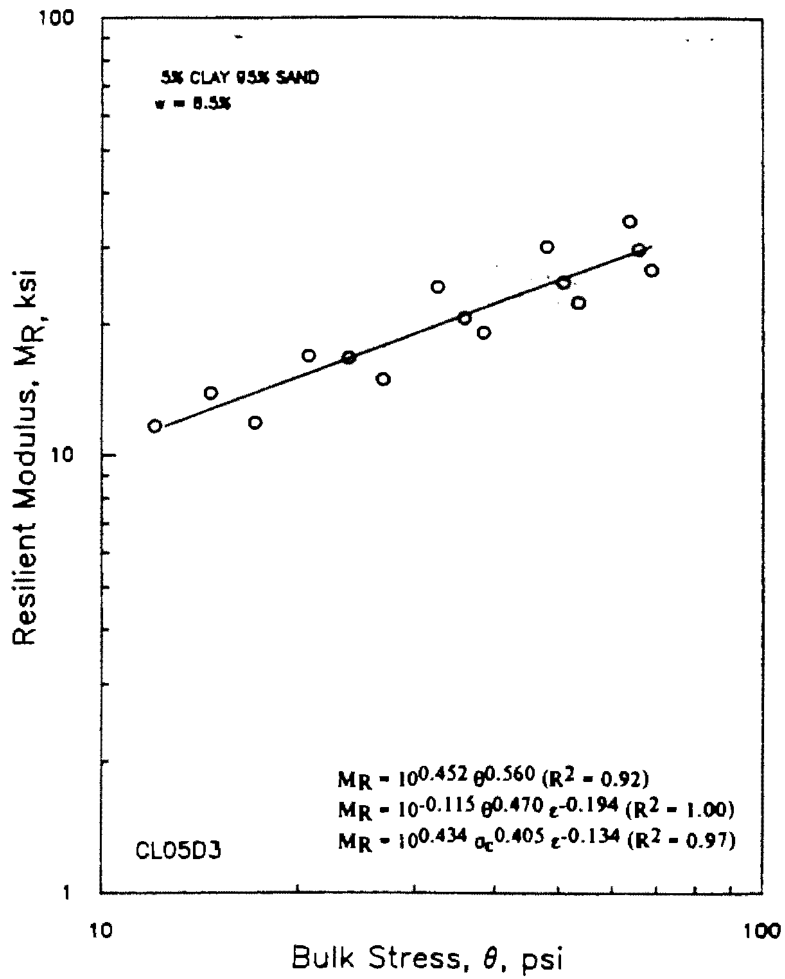

Figure E.60 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05D3.

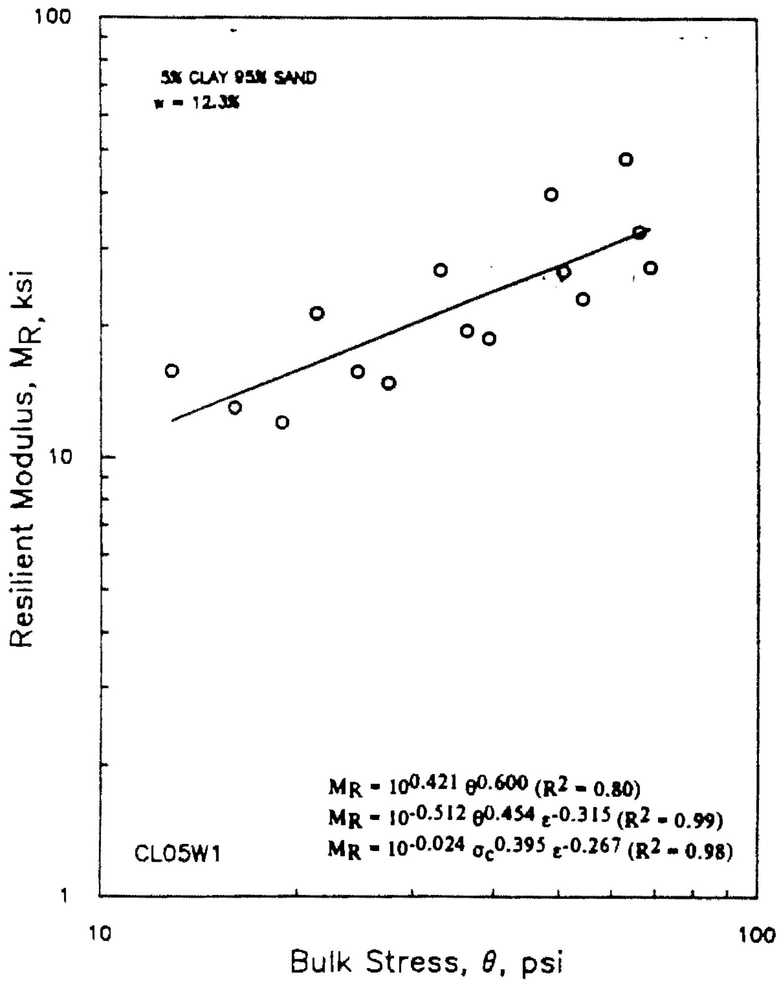

Figure E.61 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05W1.

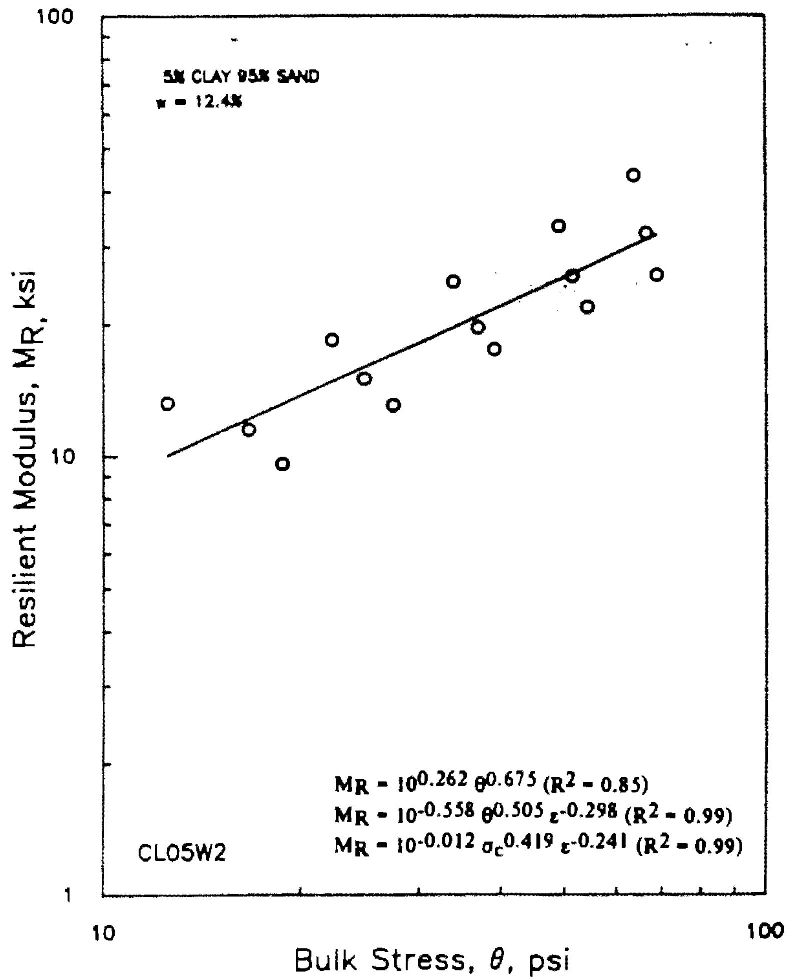

Figure E.62 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05W2.

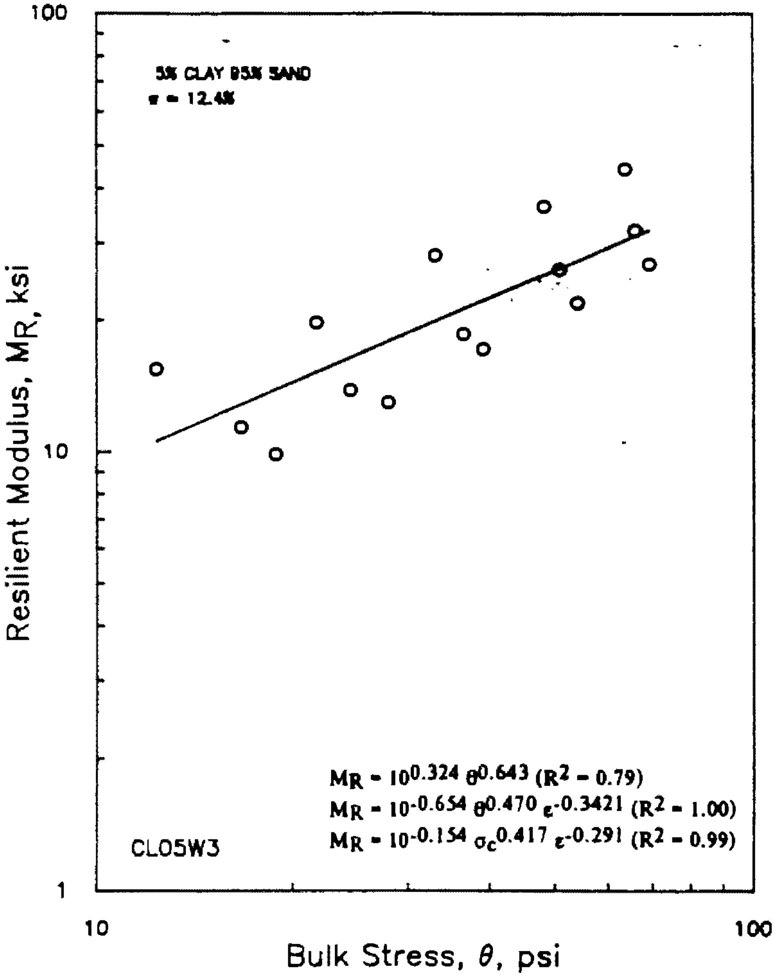

Figure E.63 - Variation in Resilient Modulus with Bulk Stress for Specimen CL05W3.

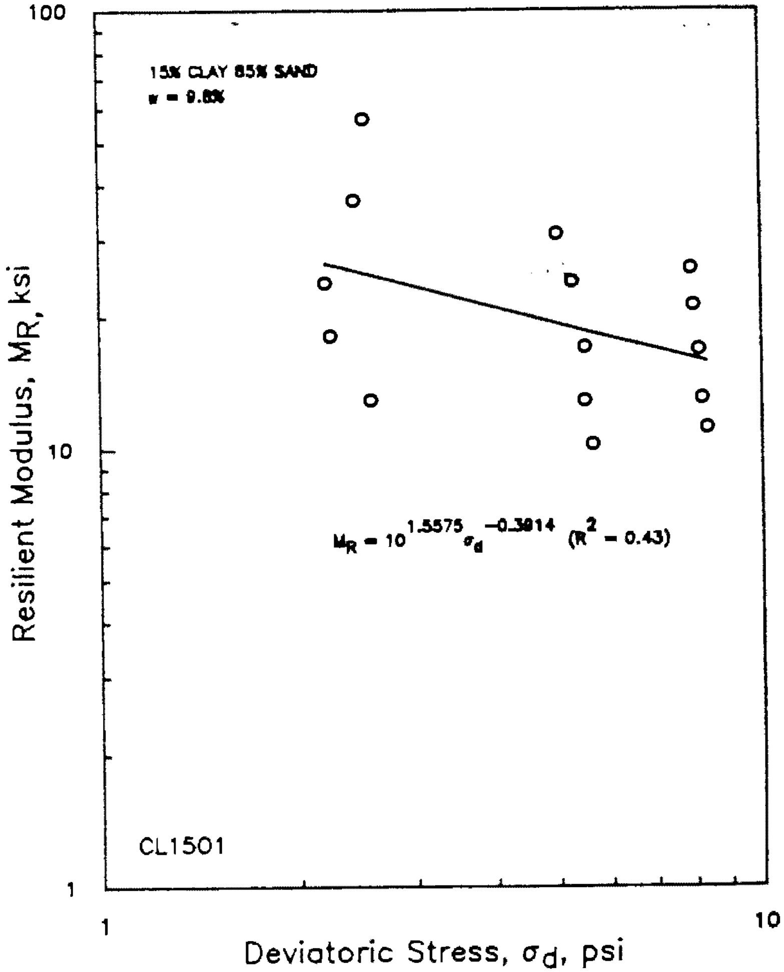

Figure E.64 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15O1.

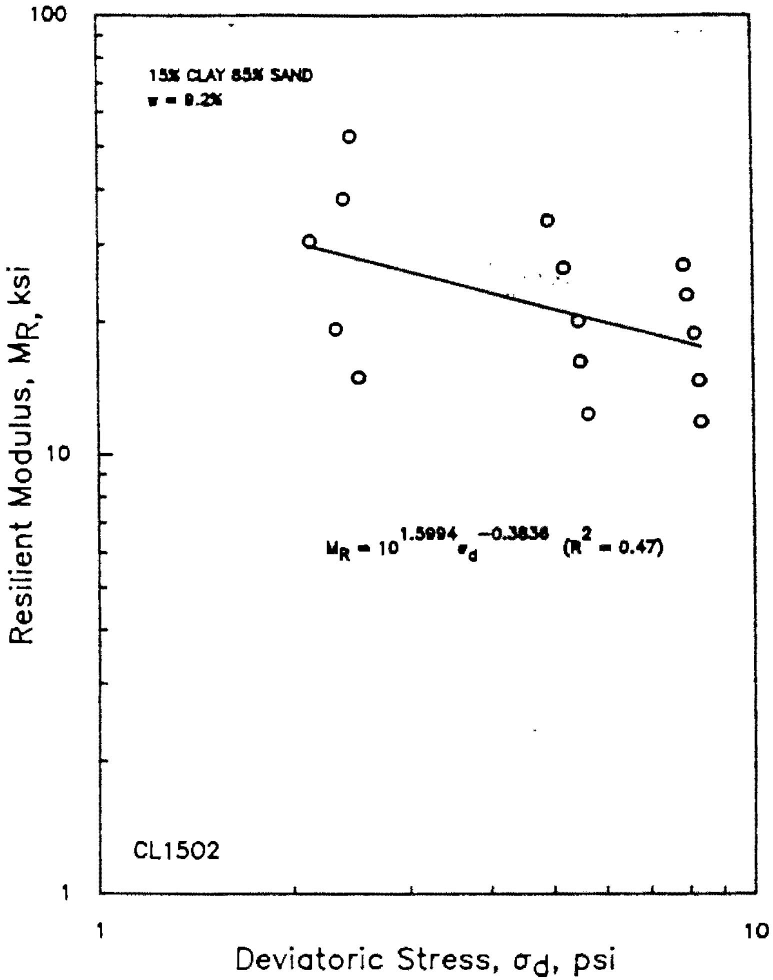

Figure E.65 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15O2.

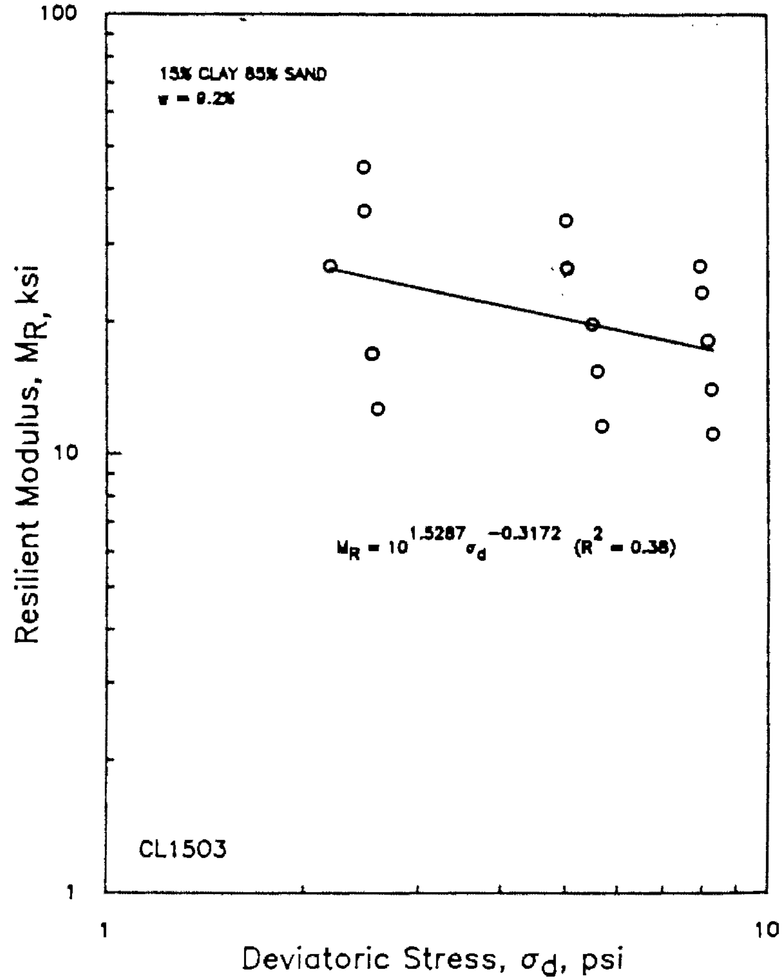

Figure E.66 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15O3.

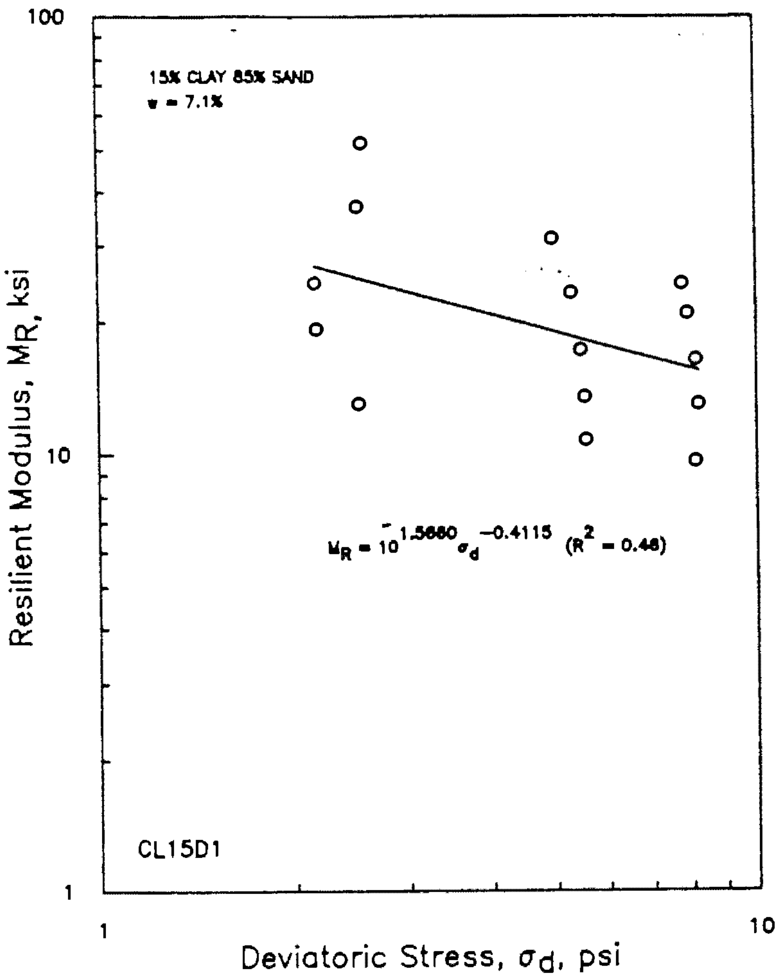

Figure E.67 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15D1.

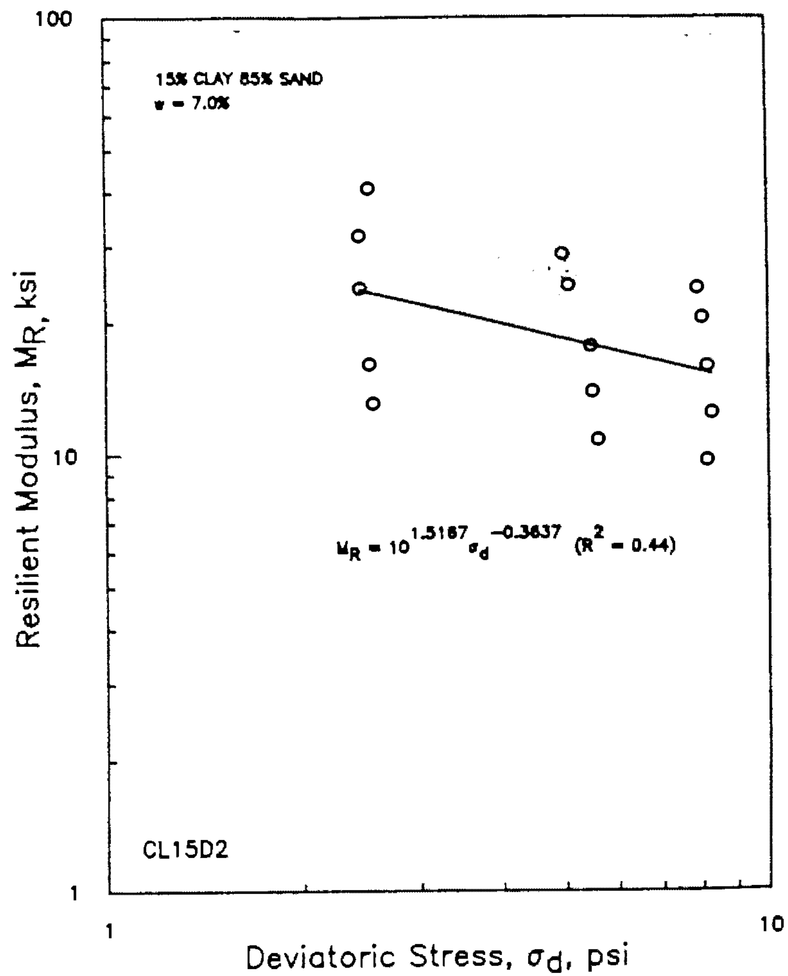

Figure E.68 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15D2.

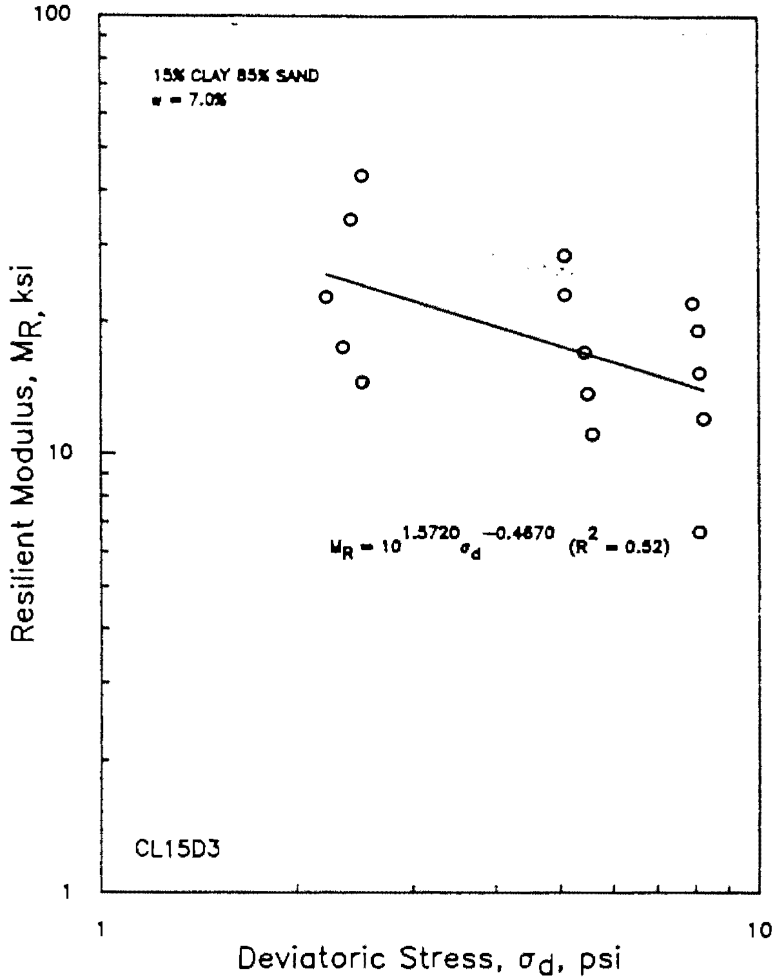

Figure E.69 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15D3.

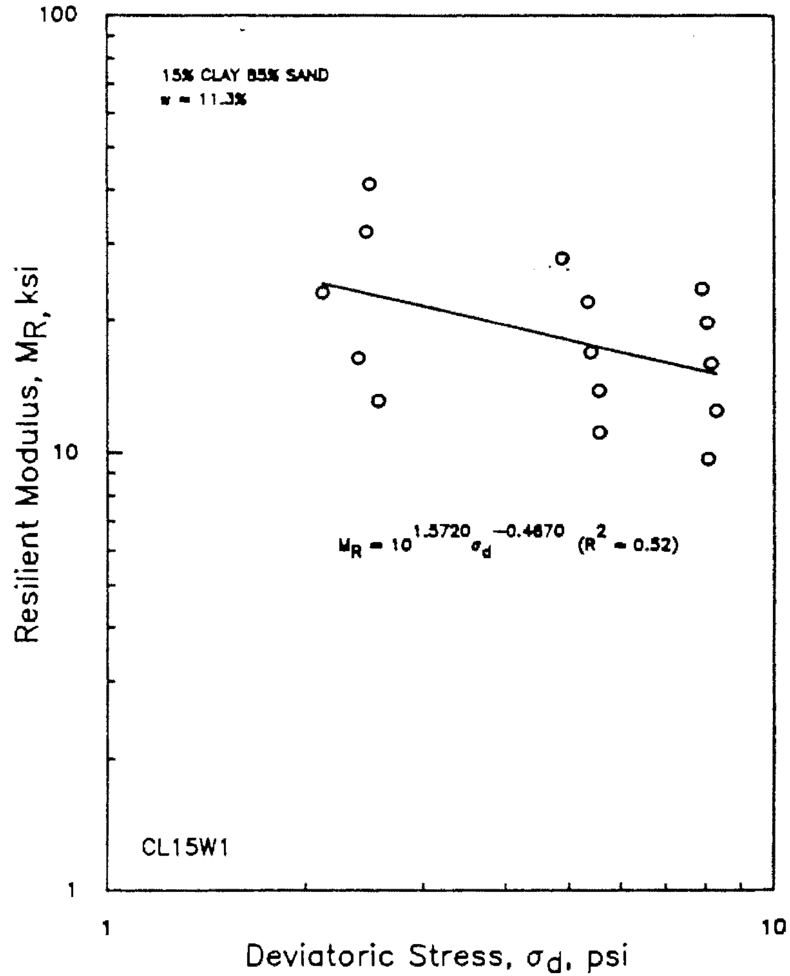

Figure E.70 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15W1.

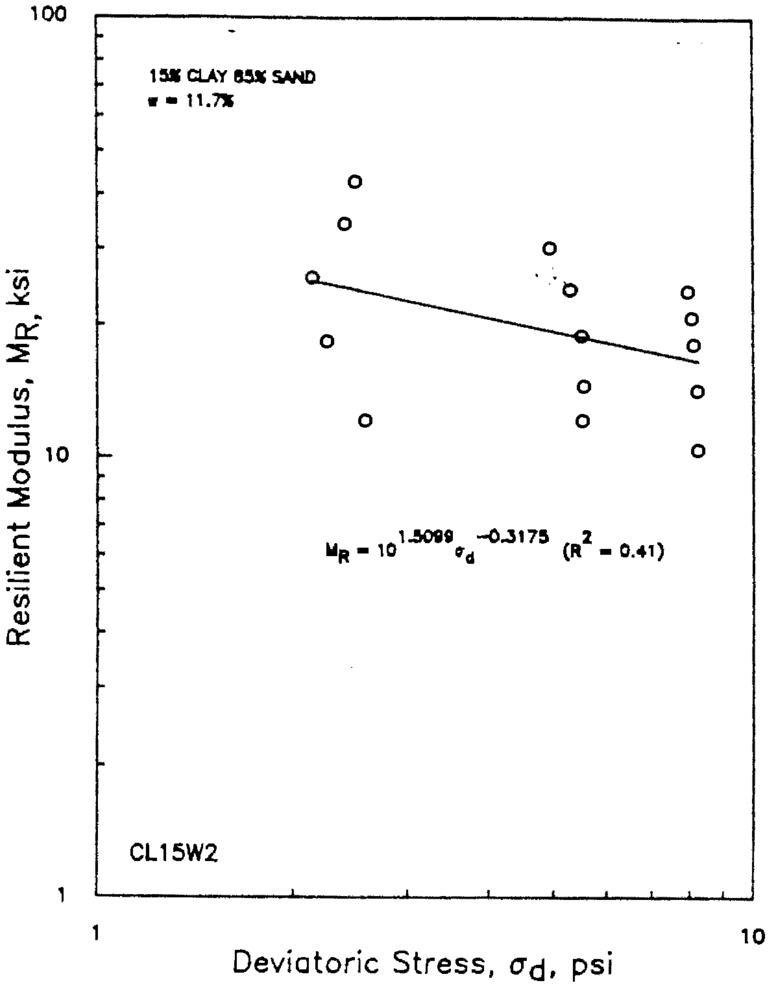

Figure E.71 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15W2.

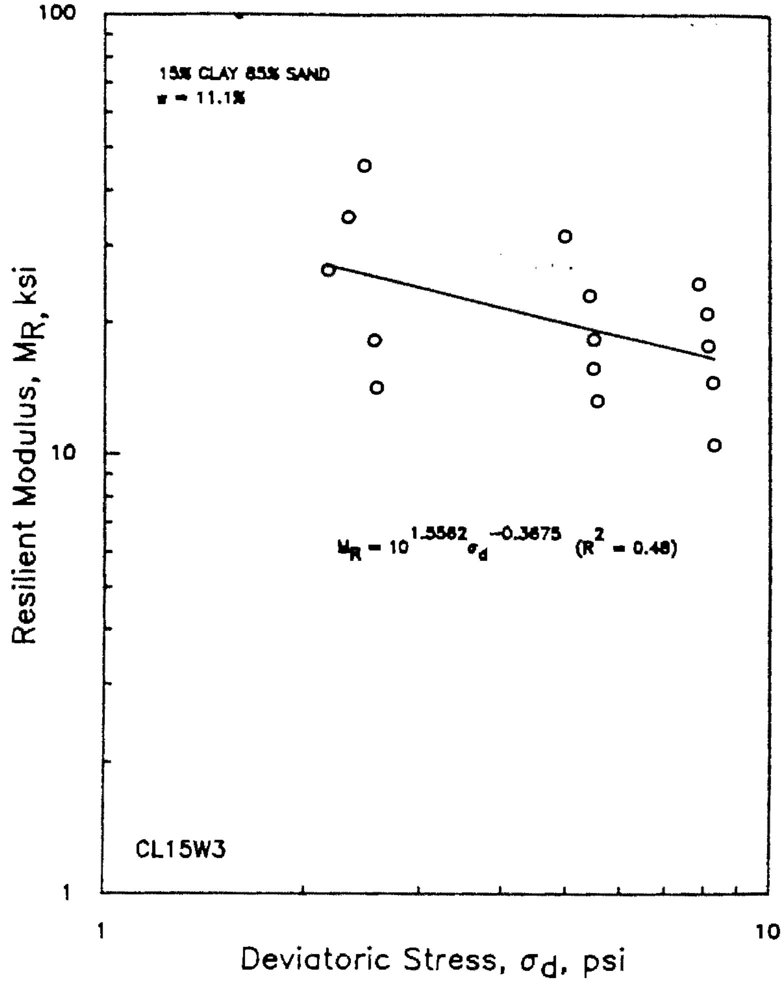

Figure E.72 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL15W3

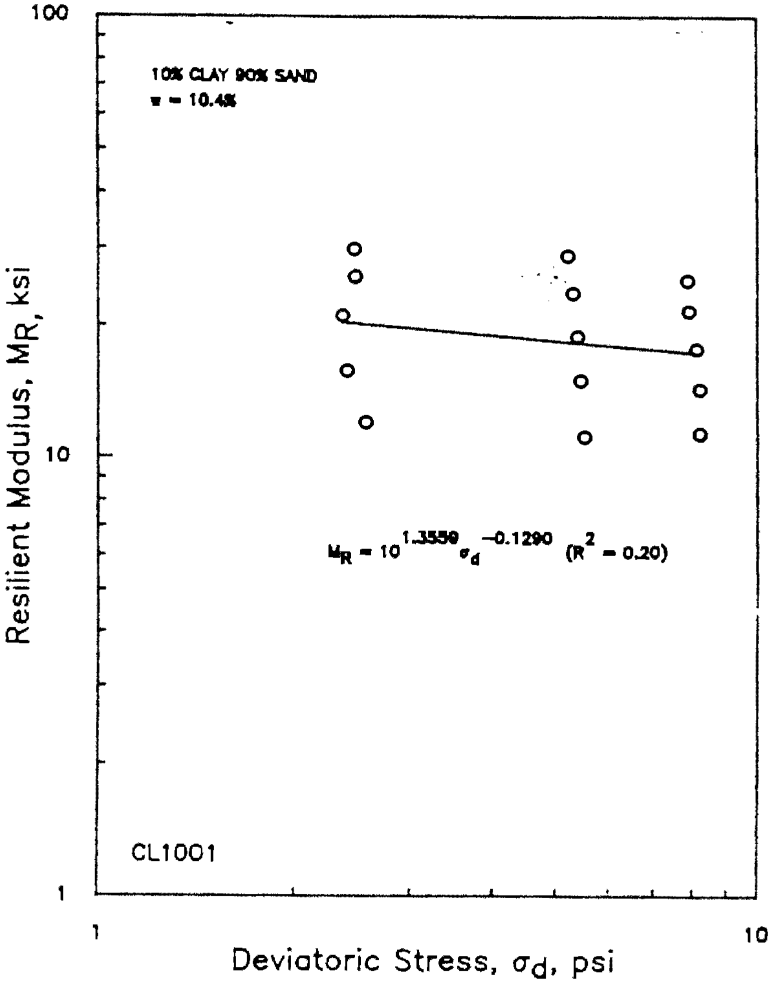

Figure E.73 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10O1.

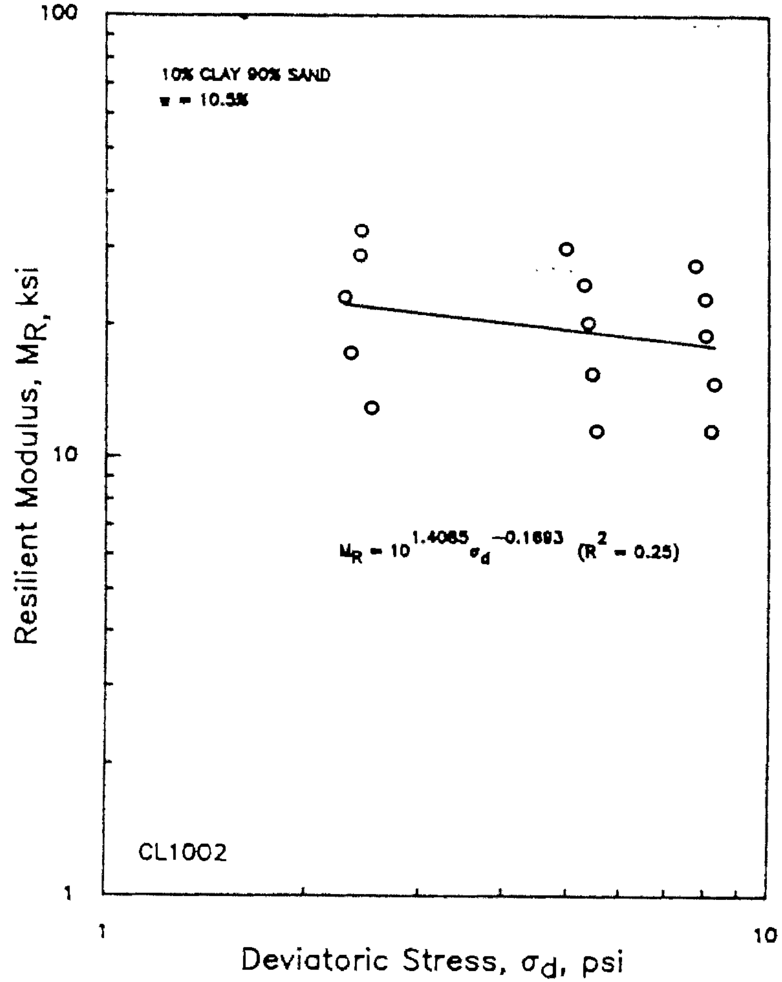

Figure E.74 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10O2.

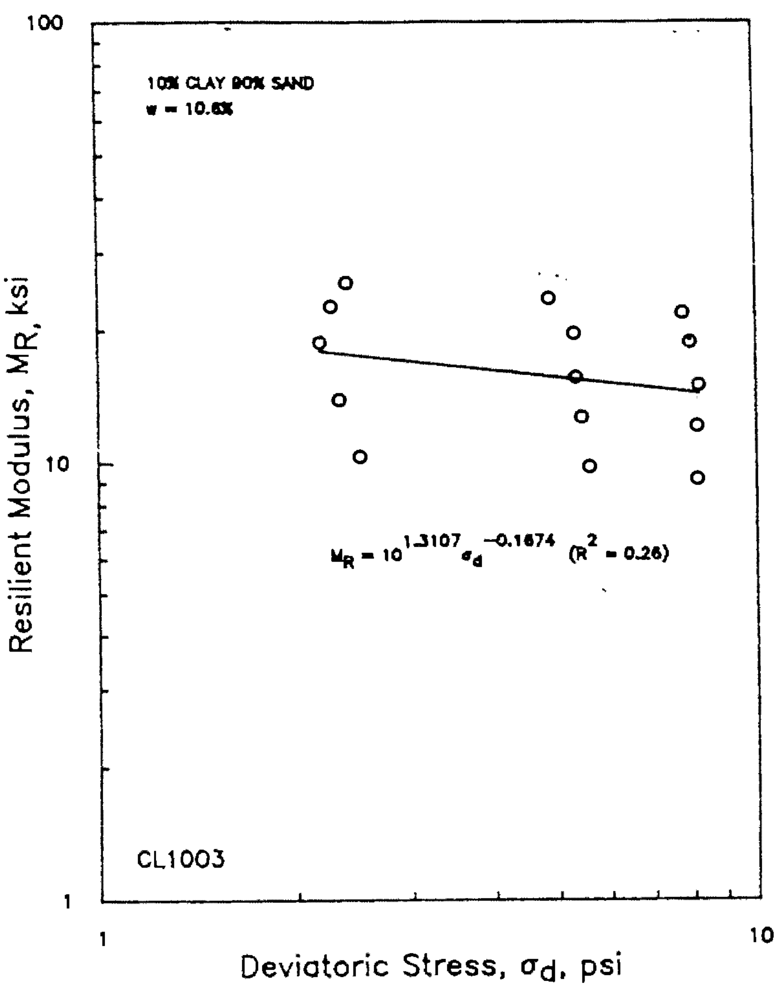

Figure E.75 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10O3.

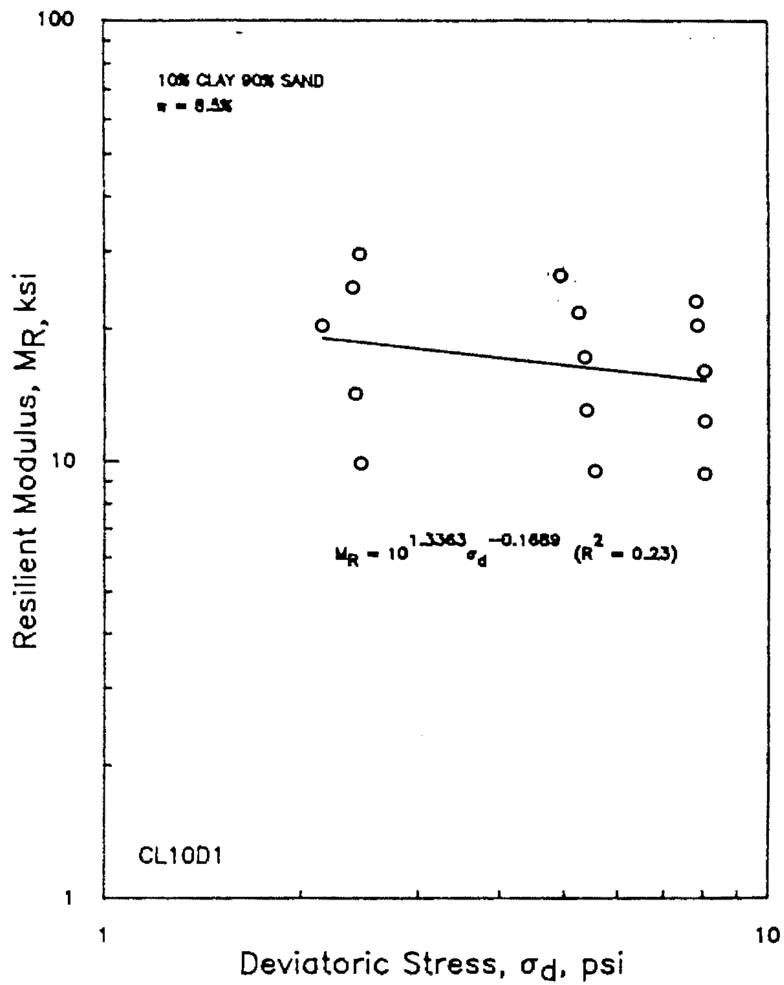

Figure E.76 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10D1.

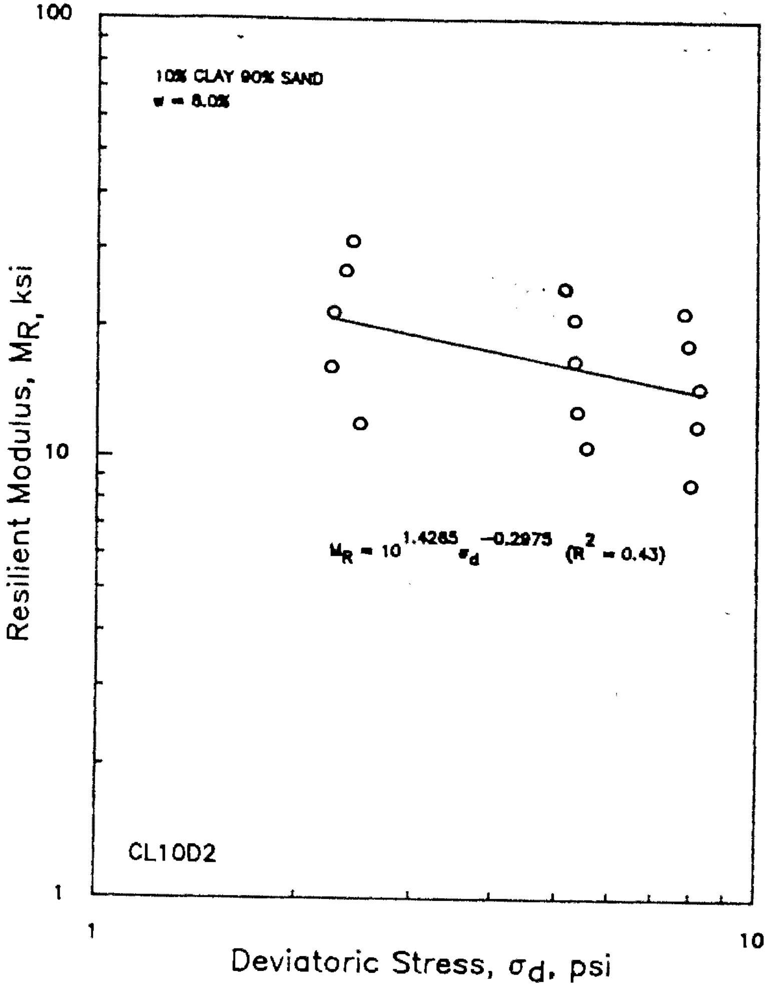

Figure E.77 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10D2.

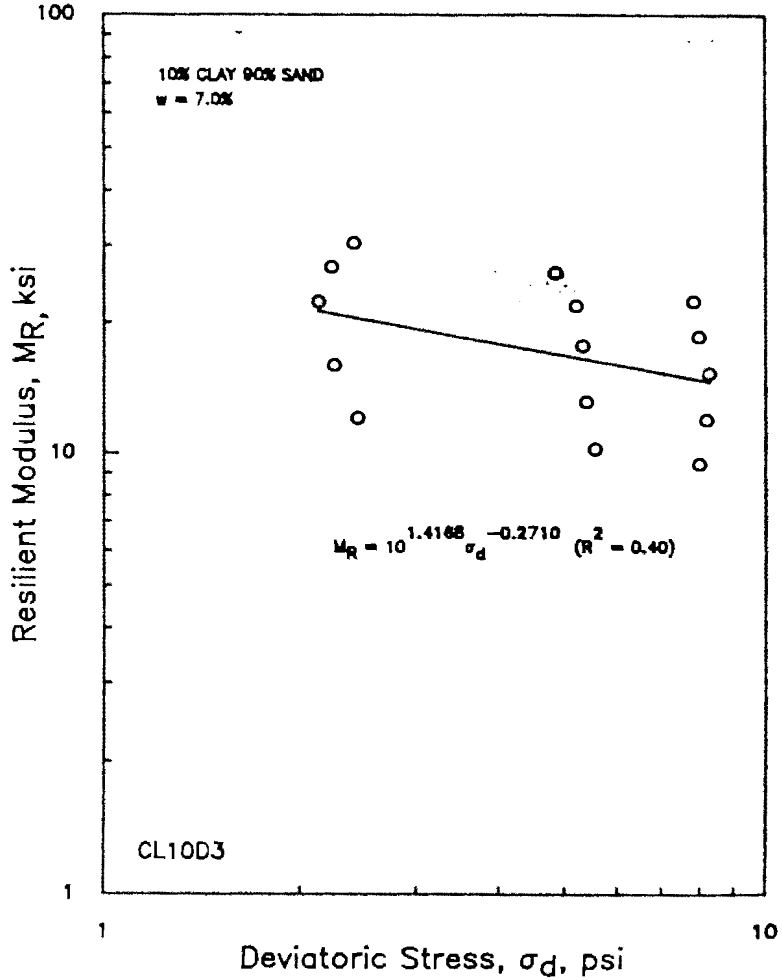

Figure E.78 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10D3.

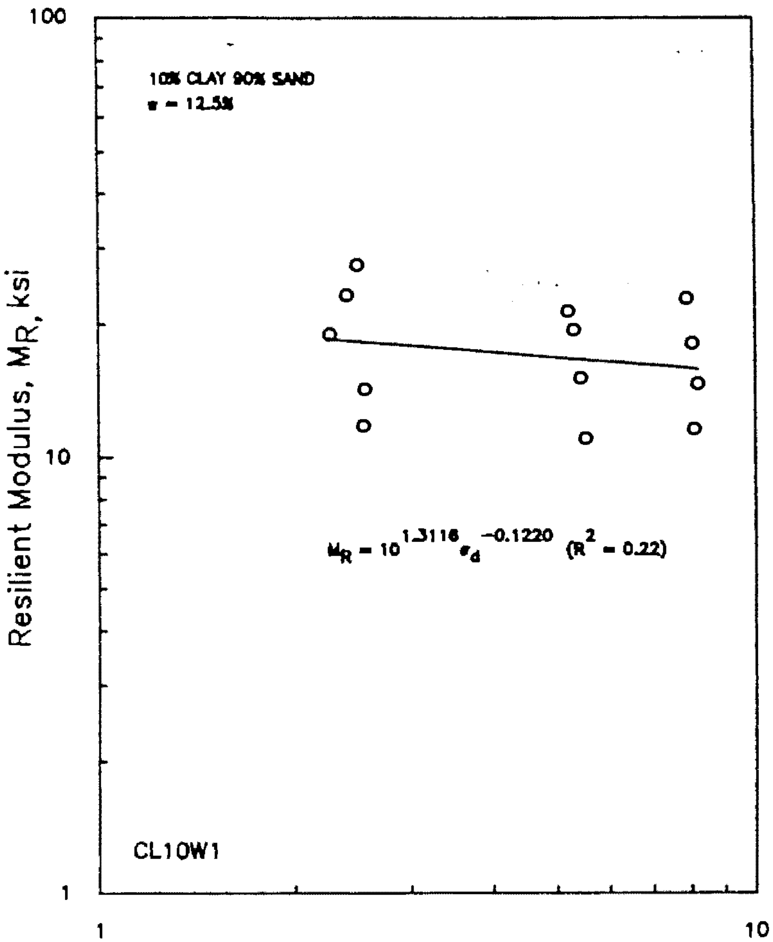

Figure E.79 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10W1.

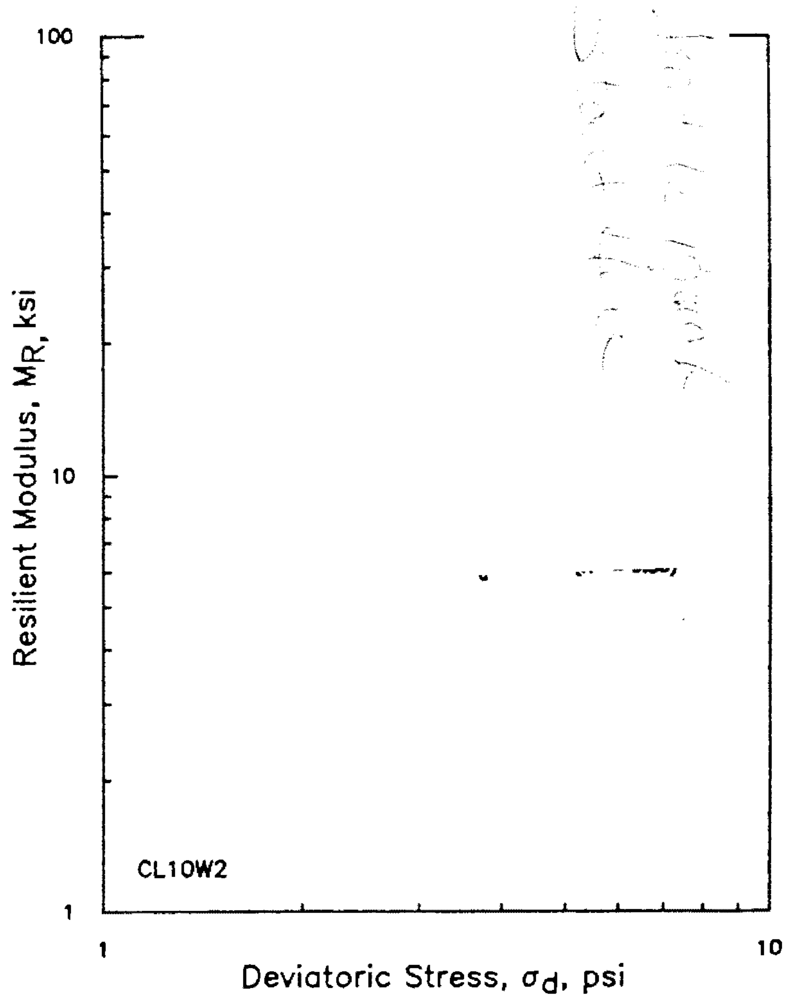

Figure E.80 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10W2.

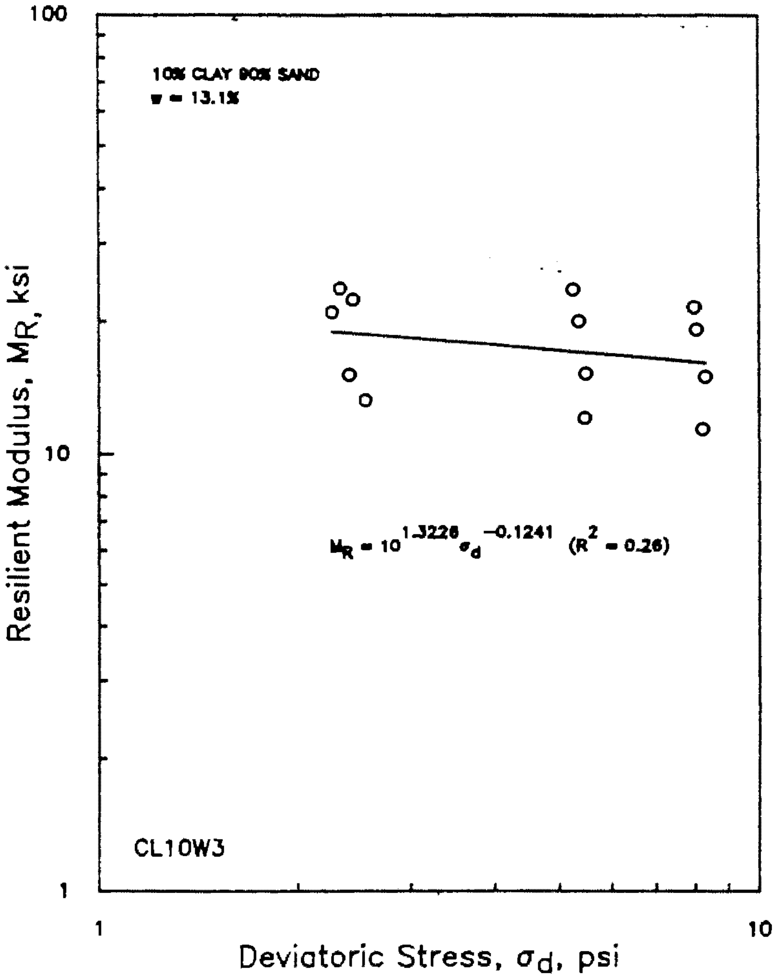

Figure E.81 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL10W3.

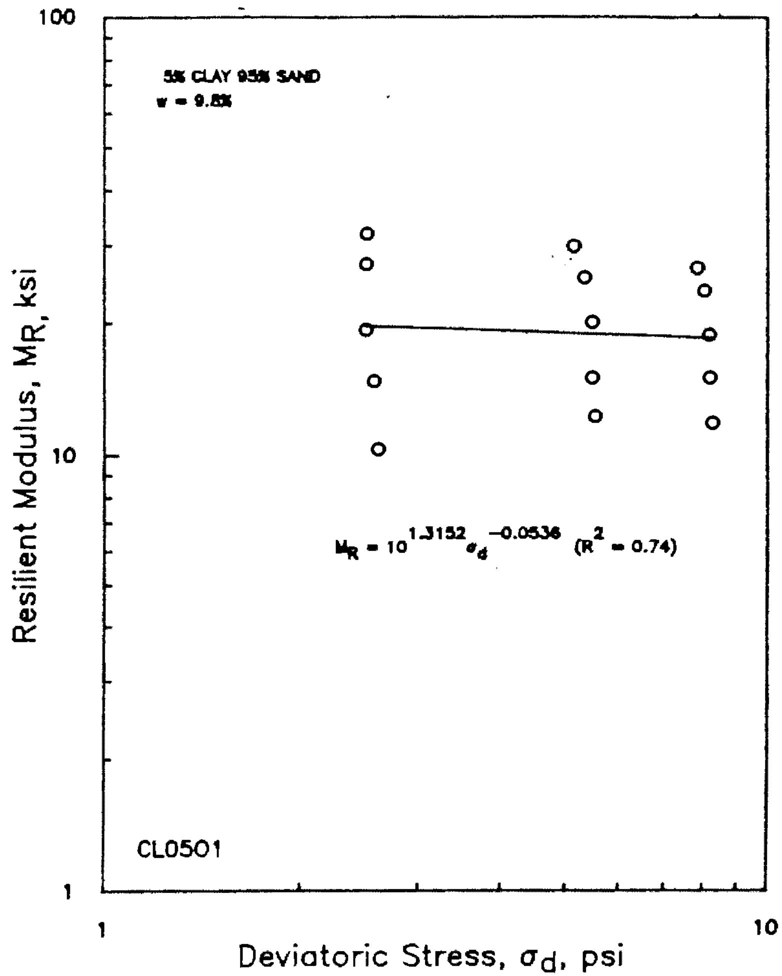

Figure E.82 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05O1.

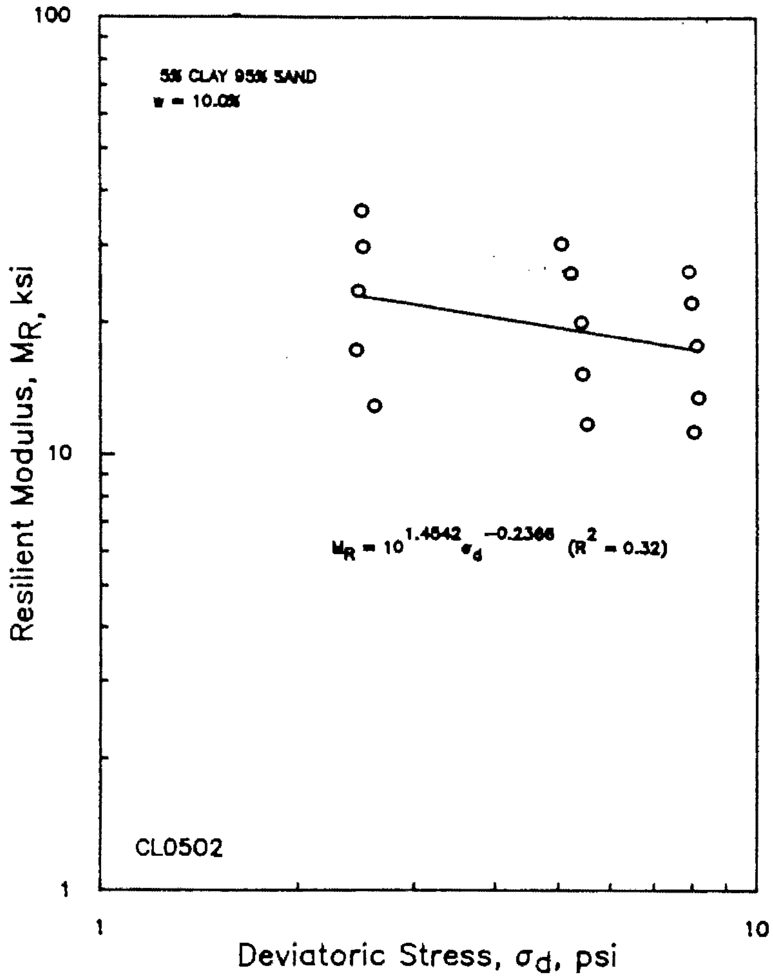

Figure E.83 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05O2.

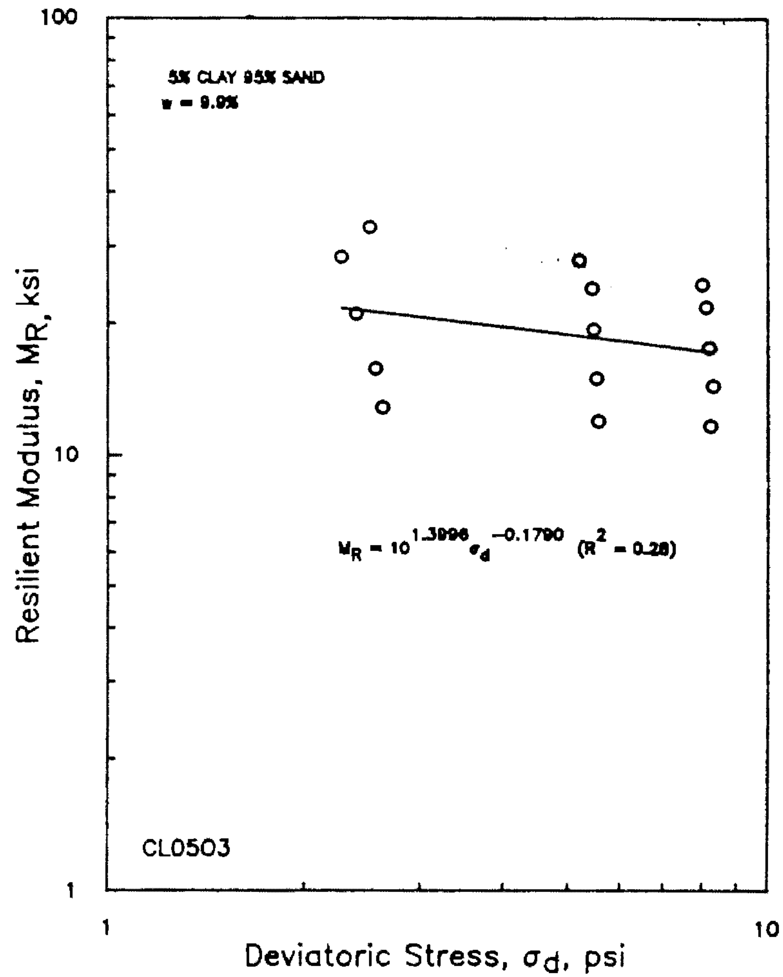

Figure E.84 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05O3.

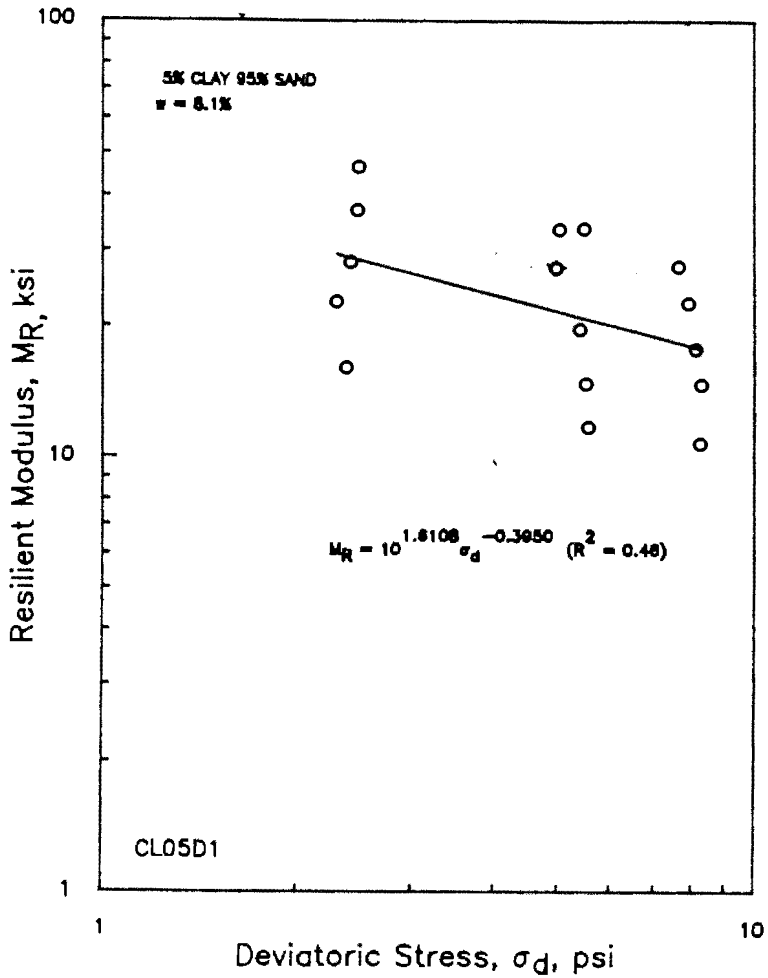

Figure E.85 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05D1.

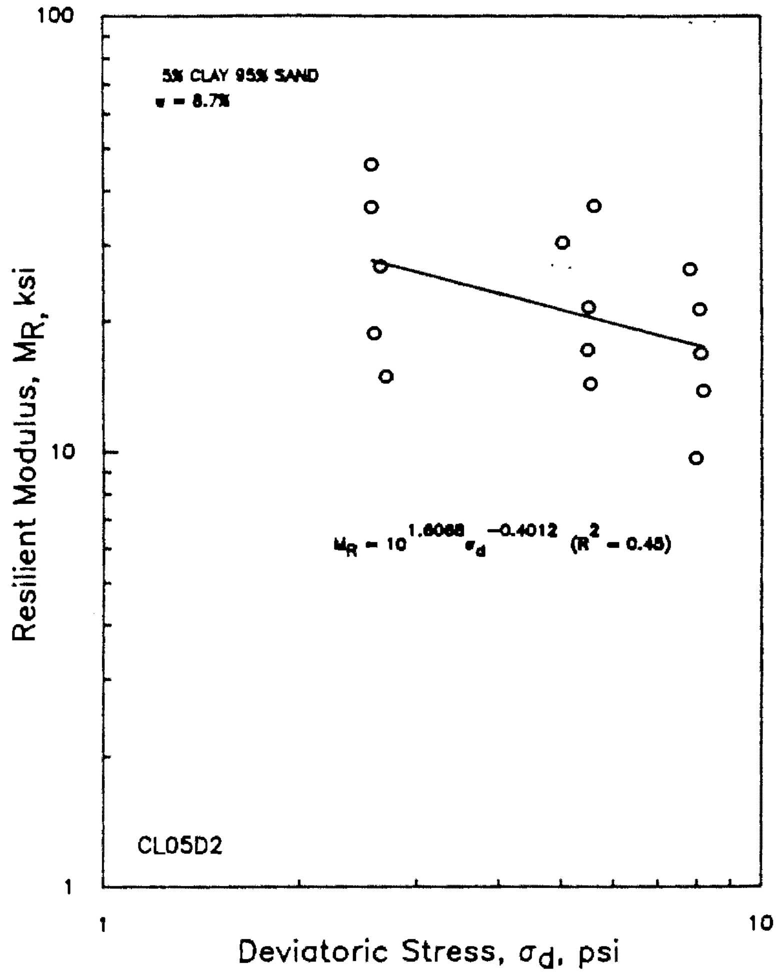

Figure E.86 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05D2.

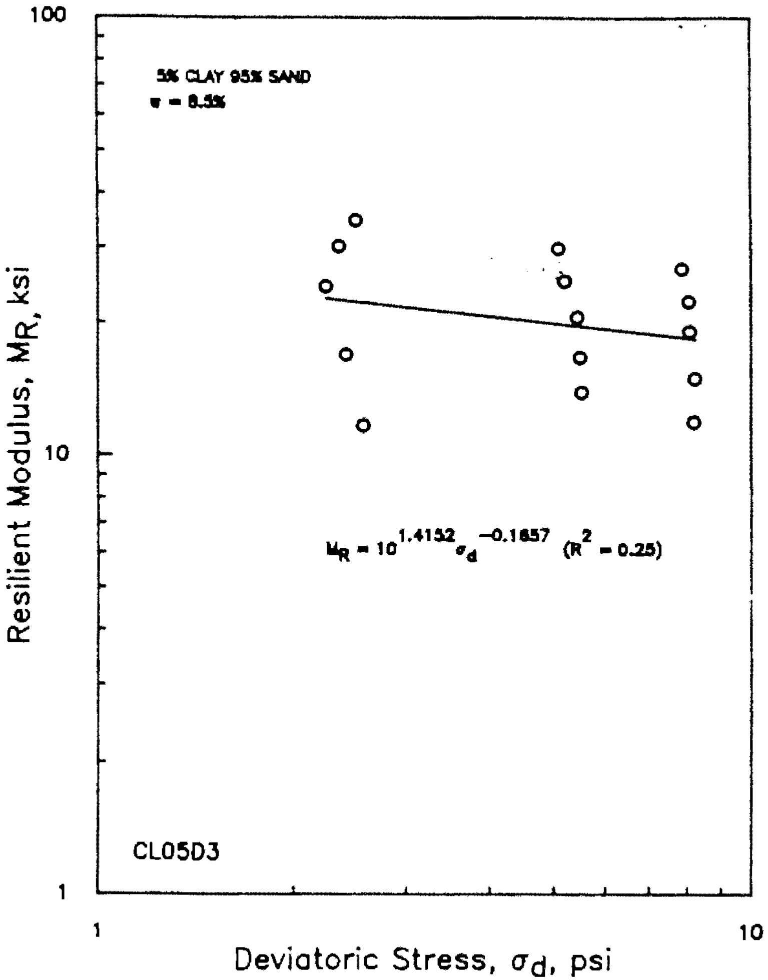

Figure E.87 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05D3.

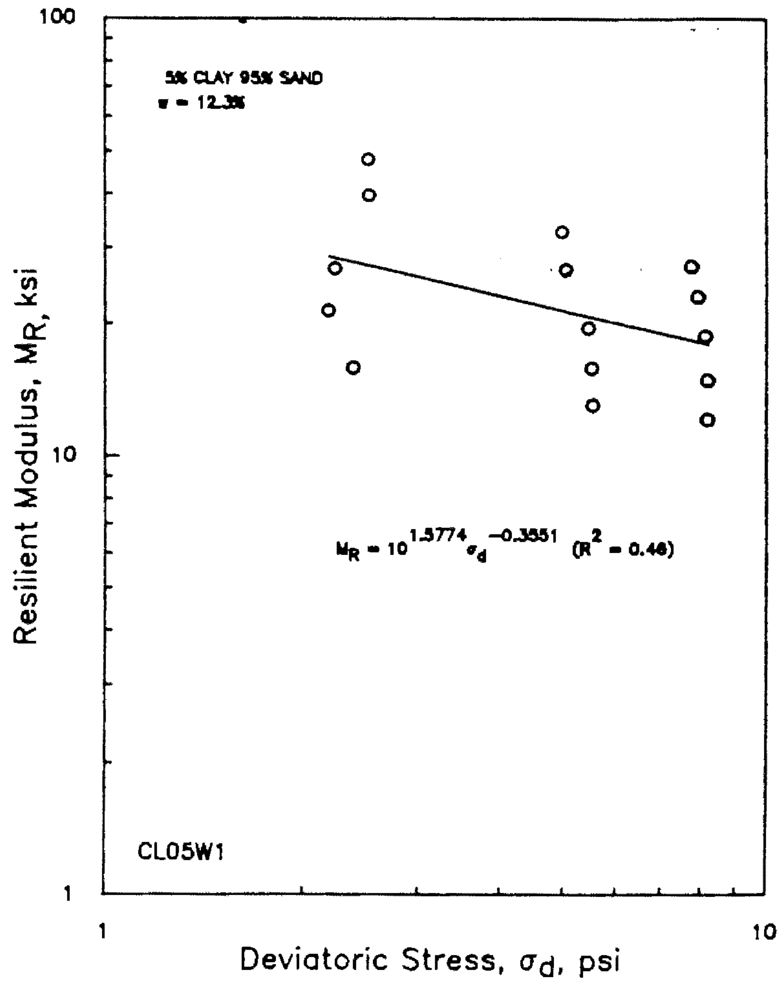

Figure E.88 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05W1.

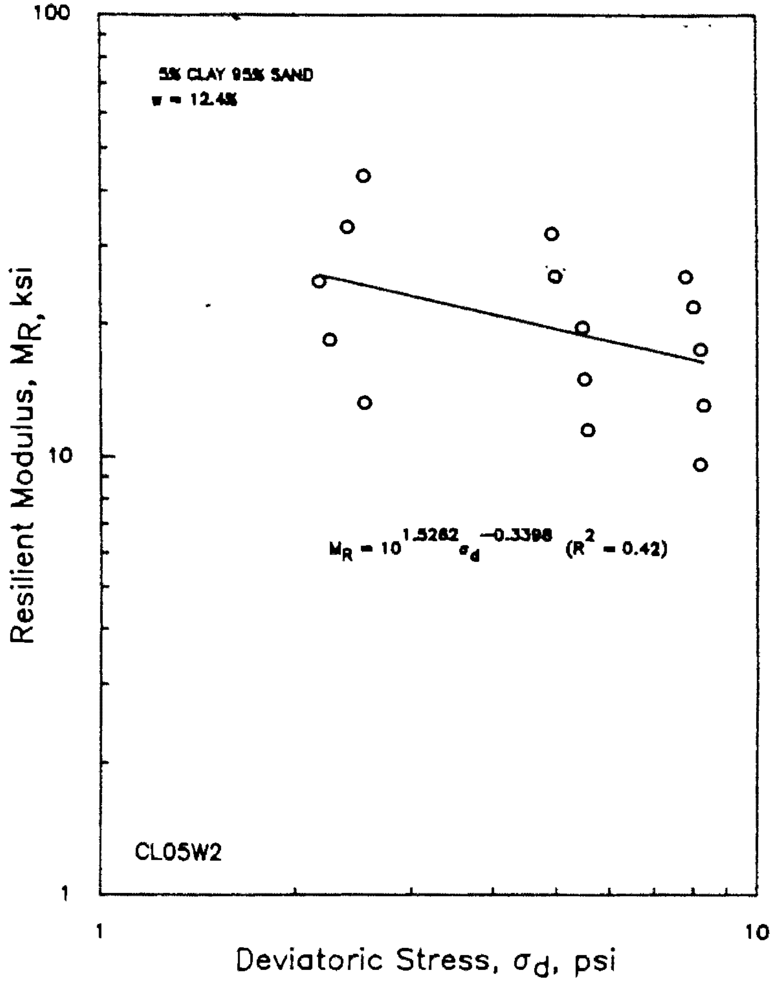

Figure E.89 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05W2.

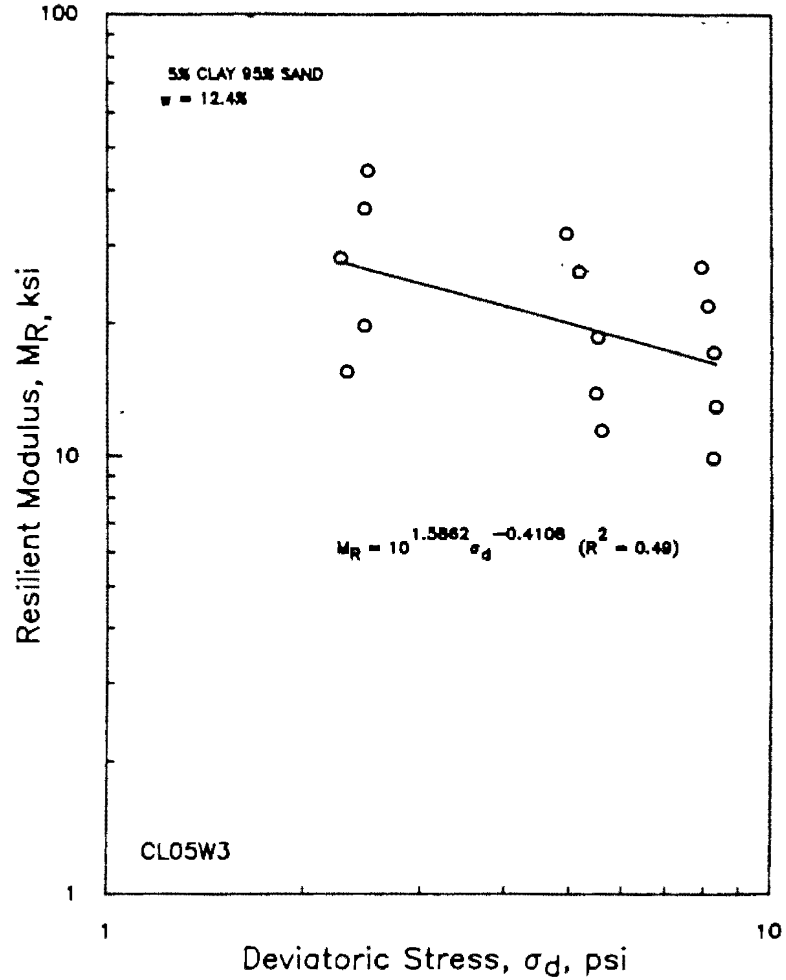

Figure E.90 - Variation in Resilient Modulus with Deviatoric Stress for Specimen CL05W3.

APPENDIX F

PLOTS FOR REGRESSION CONSTANTS

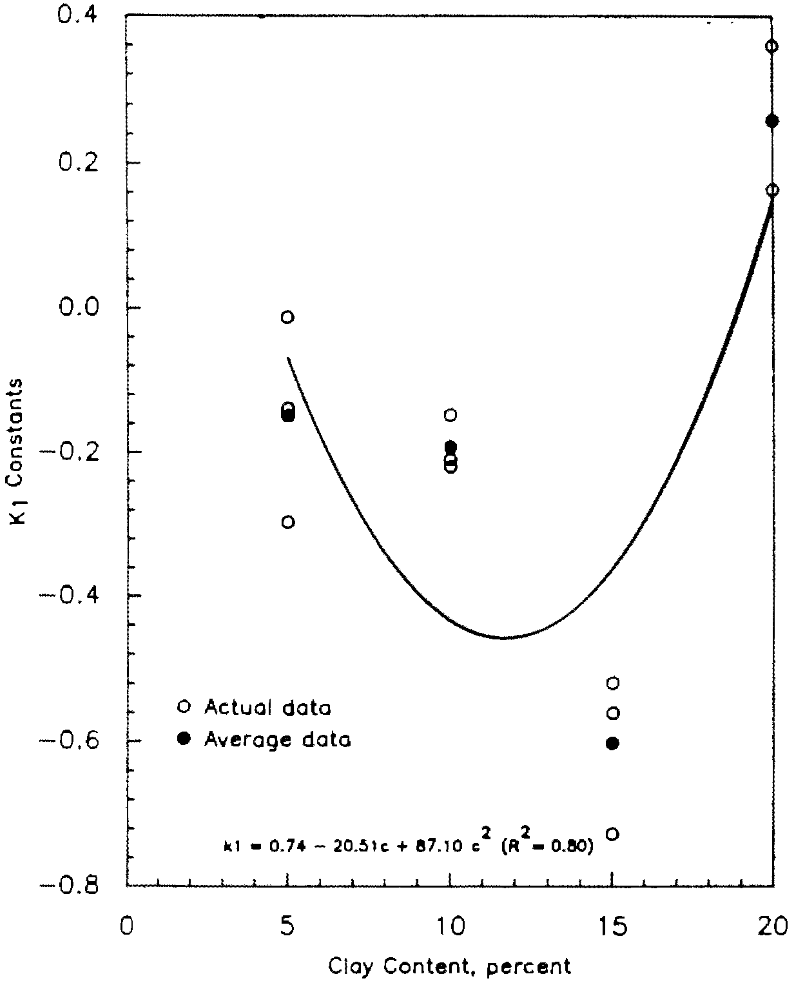

Figure F.1 - Variation in Constant k_1 from Model One with Clay Content at Optimum Water Content for Granular Soil.

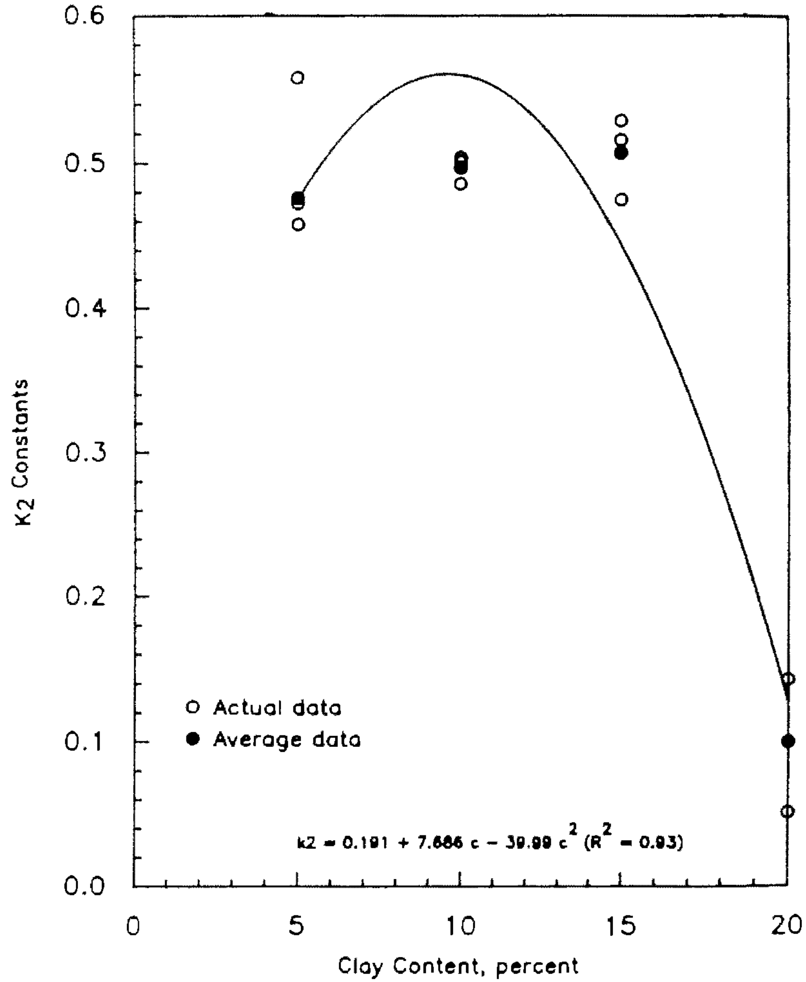

Figure F.2 - Variation in Constant k_2 from Model One with Clay Content at Optimum Water Content for Granular Soil.

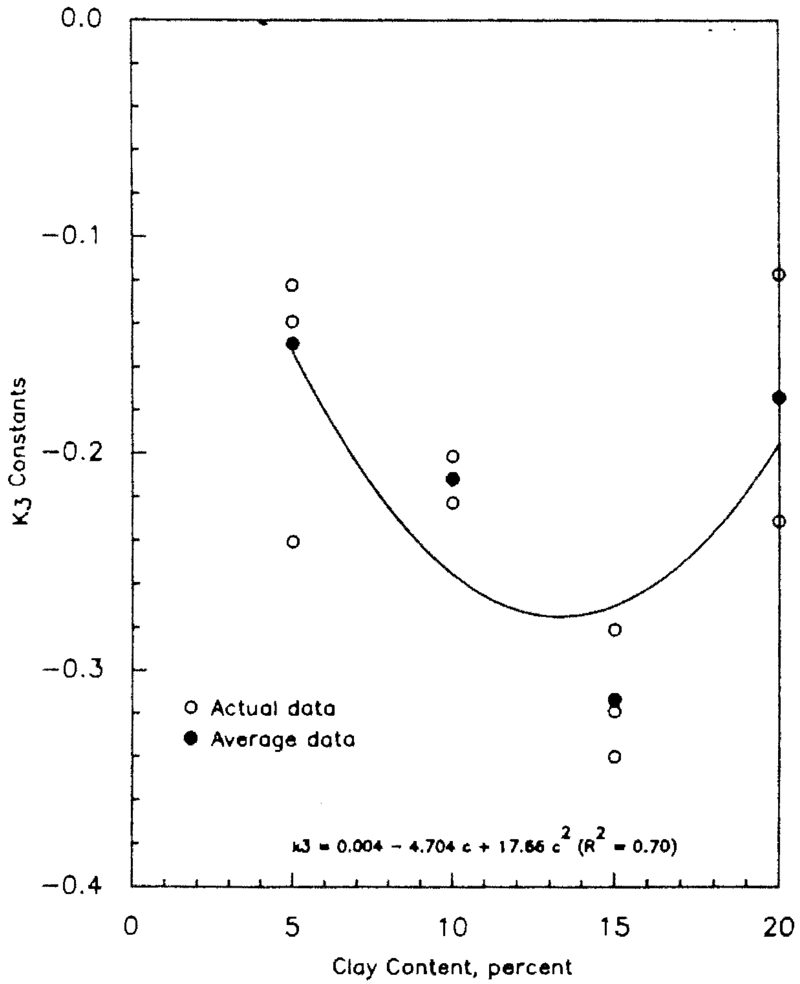

Figure F.3 - Variation in Constant k_3 from Model One with Clay Content at Optimum Water Content for Granular Soil.

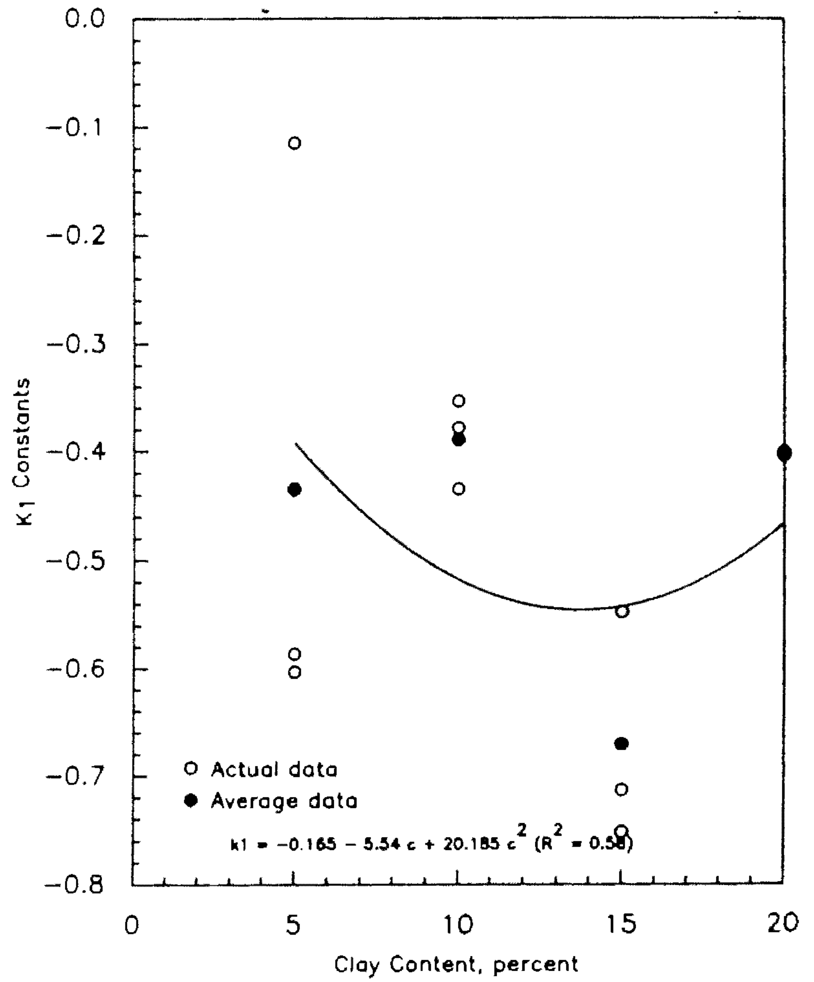

Figure F.4 - Variation in Constant k_1 from Model One with Clay Content at Dry of Optimum Water Content for Granular Soil.

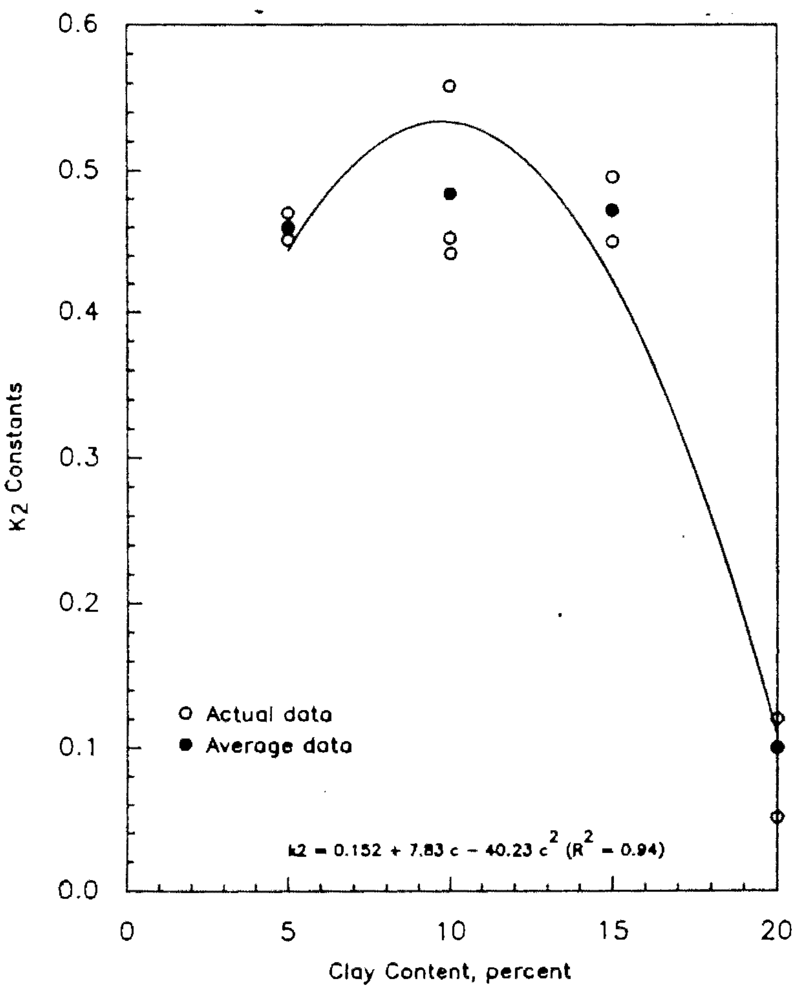

Figure F.5 - Variation in Constant k_2 from Model One with Clay Content at Dry of Optimum Water Content for Granular Soil.

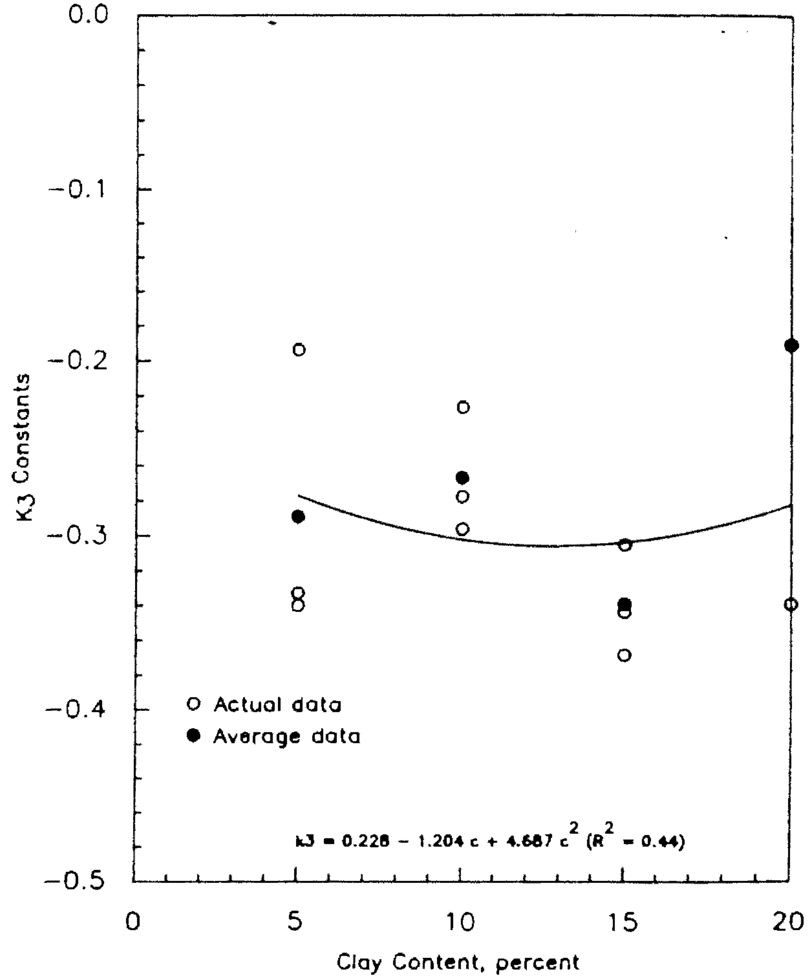

Figure F.6 - Variation in Constant k_3 from Model One with Clay Content at Dry of Optimum Water Content for Granular Soil.

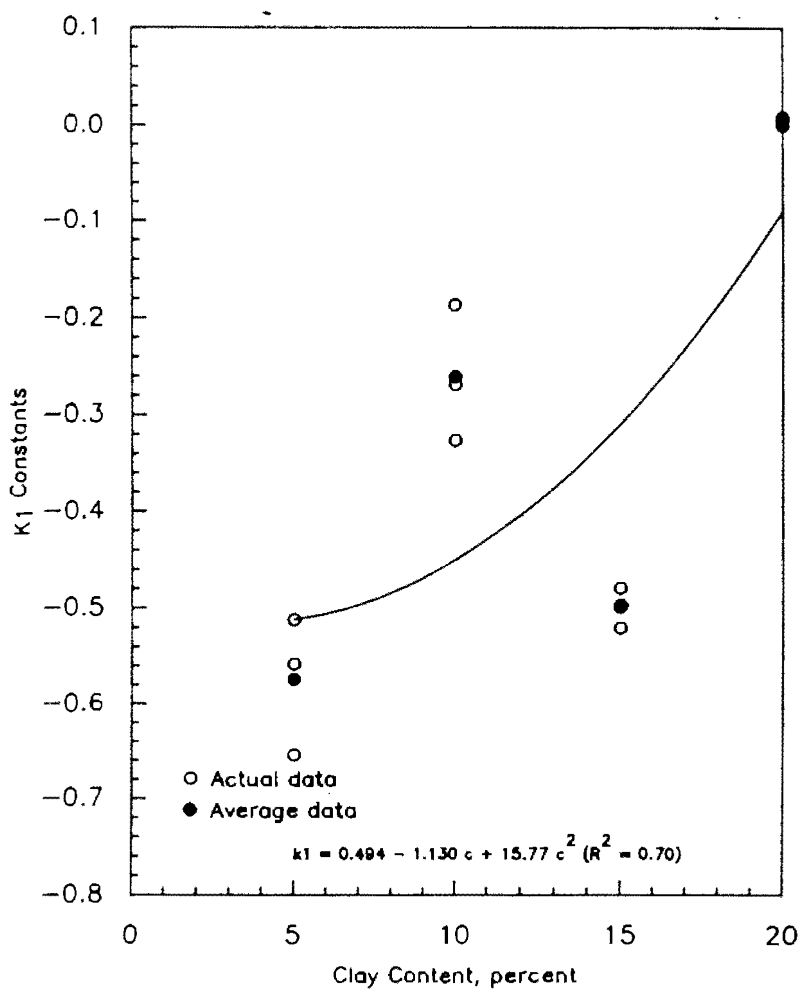

Figure F.7 - Variation in Constant k_1 from Model One with Clay Content at Wet of Optimum Water Content for Granular Soil.

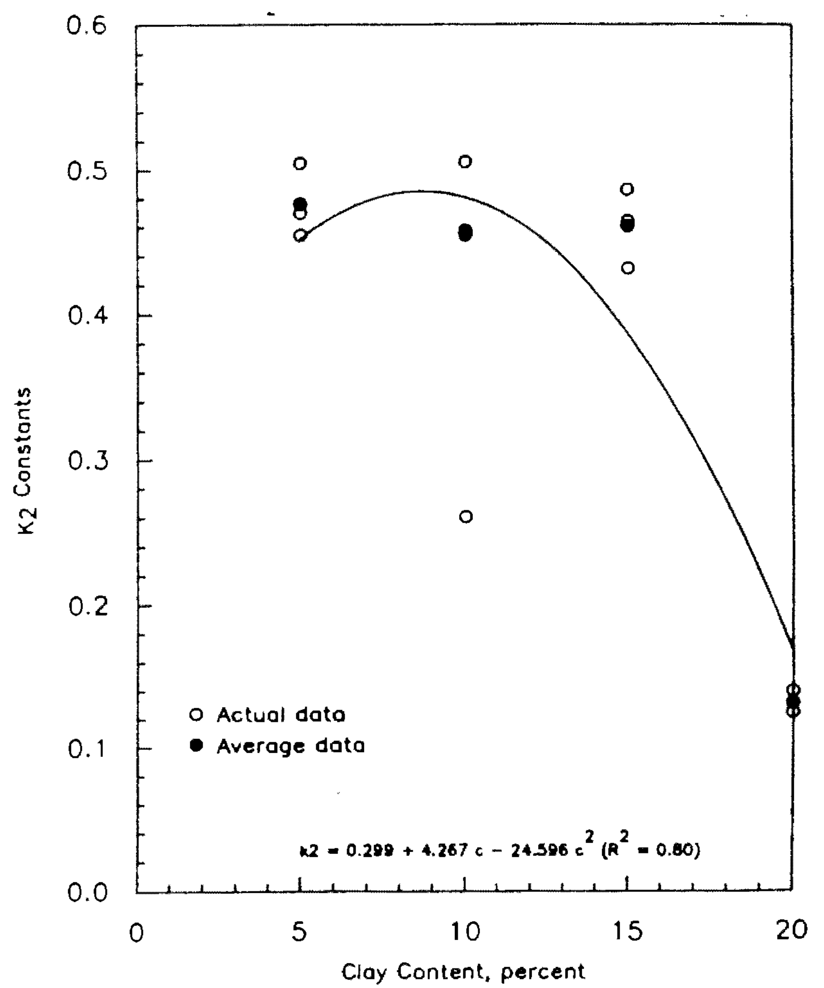

Figure F.8 - Variation in Constant k_2 from Model One with Clay Content at Wet of Optimum Water Content for Granular Soil.

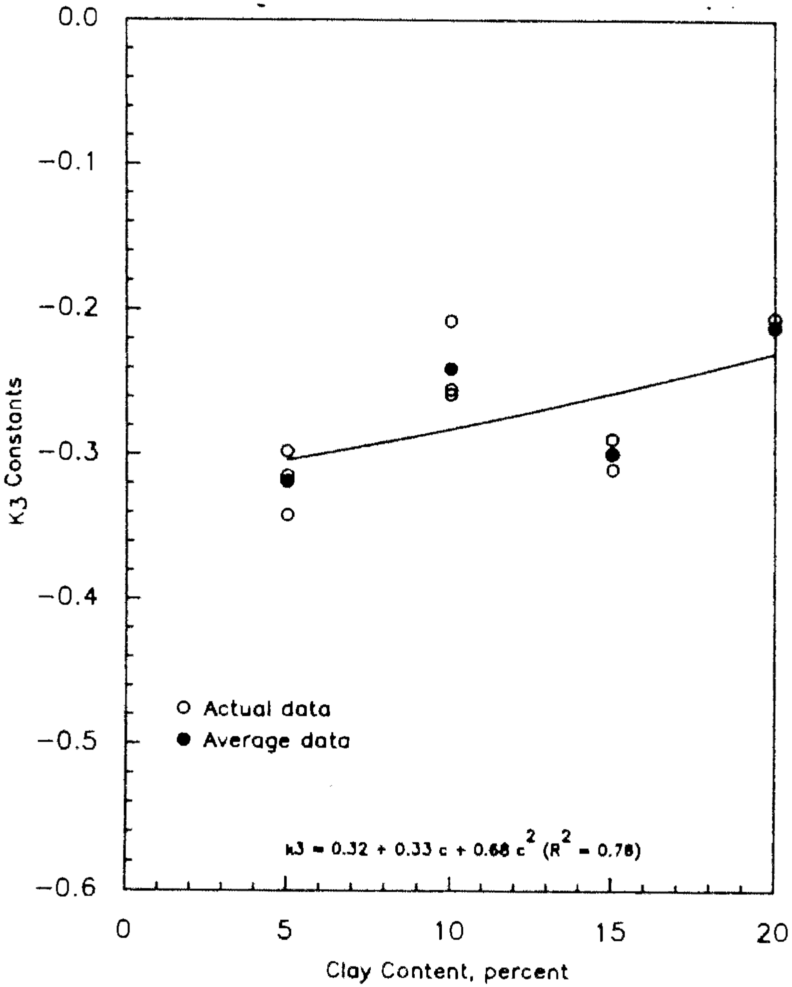

Figure F.9 - Variation in Constant k3 from Model One with Clay Content at Wet of Optimum Water Content for Granular Soil.

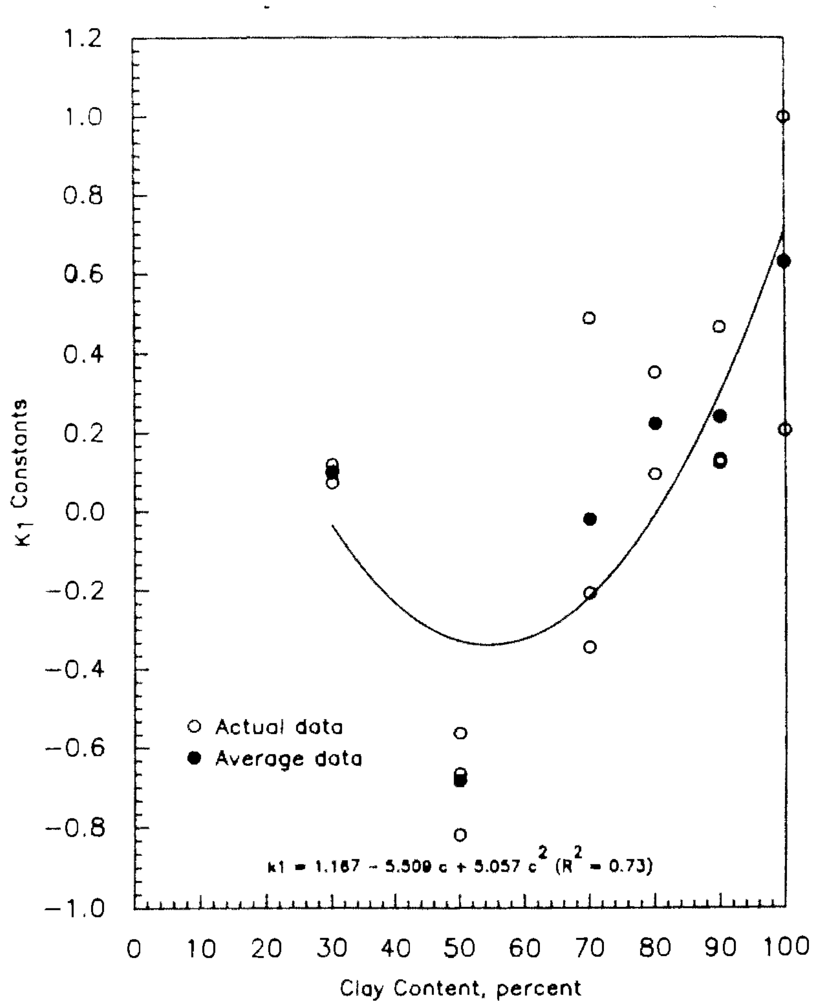

Figure F.10 - Variation in Constant k1 from Model One with Clay Content at Optimum Water Content for Cohesive Soil.

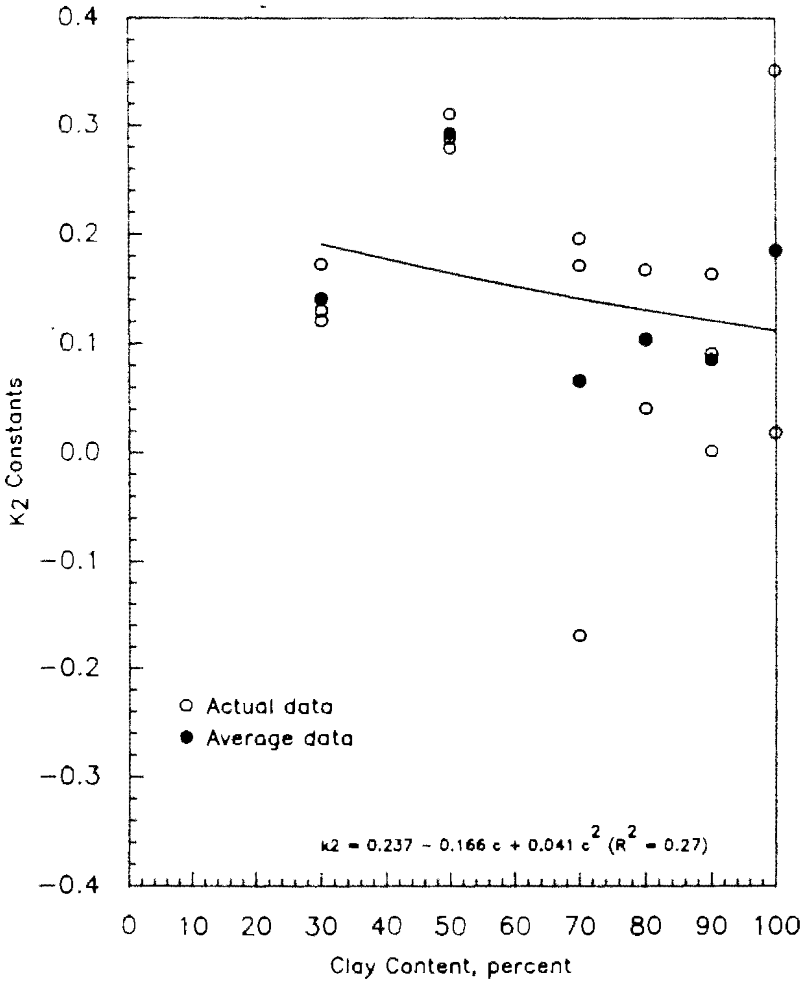

Figure F.11 - Variation in Constant k_2 from Model One with Clay Content at Optimum Water Content for Cohesive Soil.

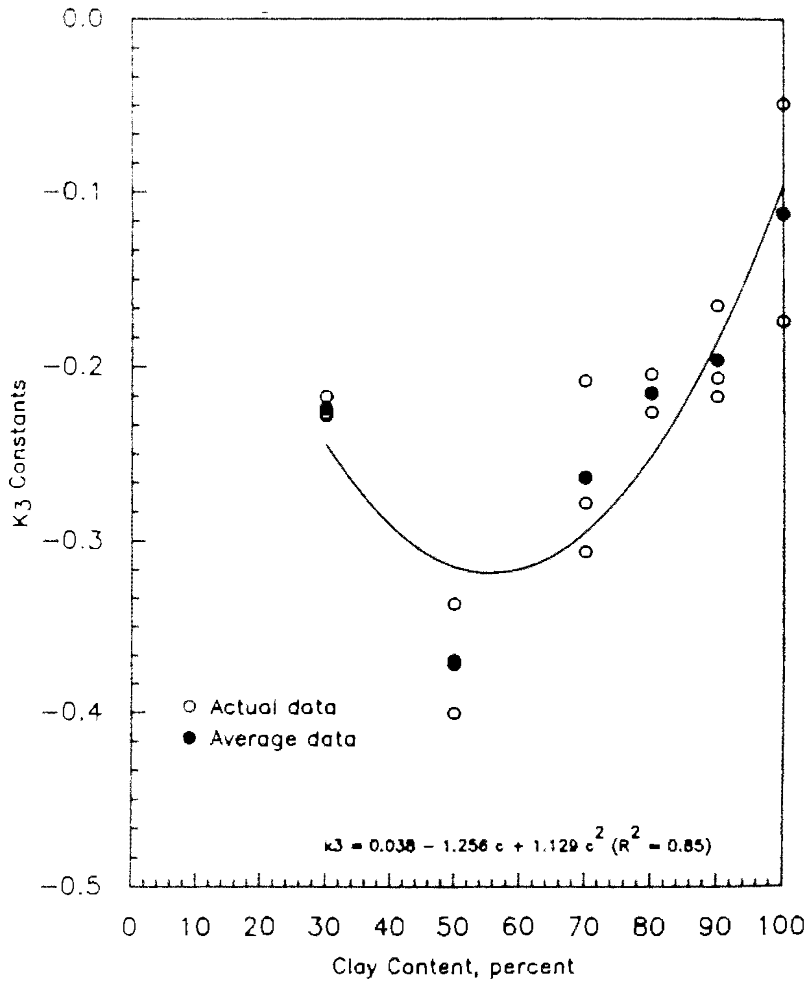

Figure F.12 - Variation in Constant k_3 from Model One with Clay Content at Optimum Water Content for Cohesive Soil.

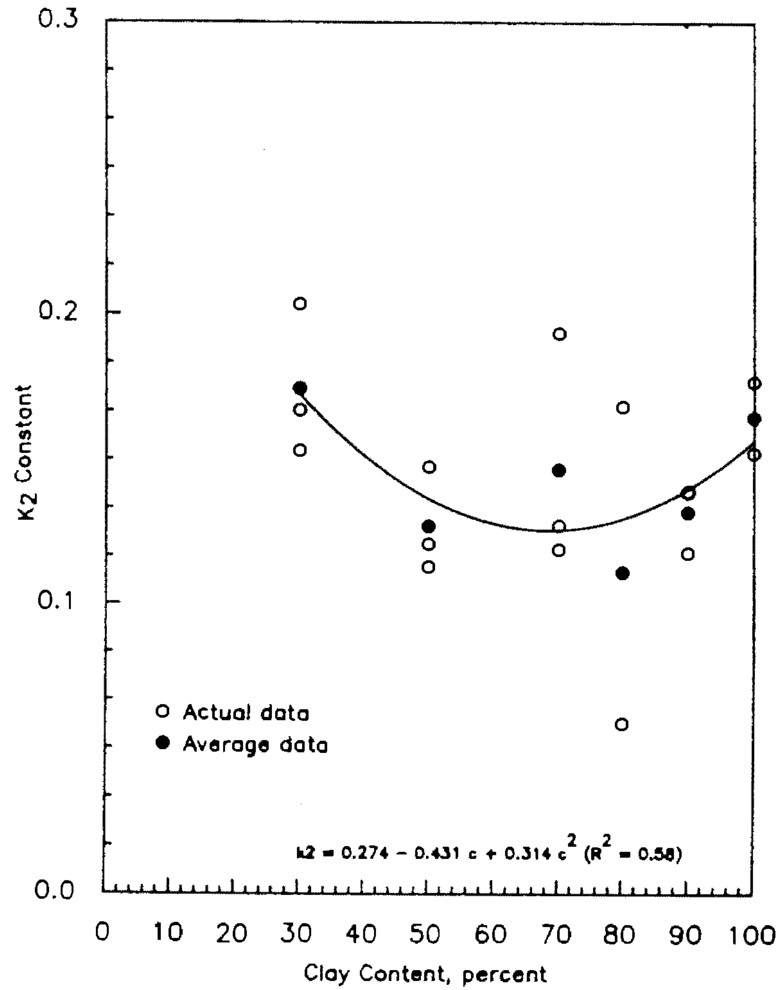

Figure F.13 - Variation in Constant k_1 from Model One with Clay Content at Dry of Optimum Water Content for Cohesive Soil.

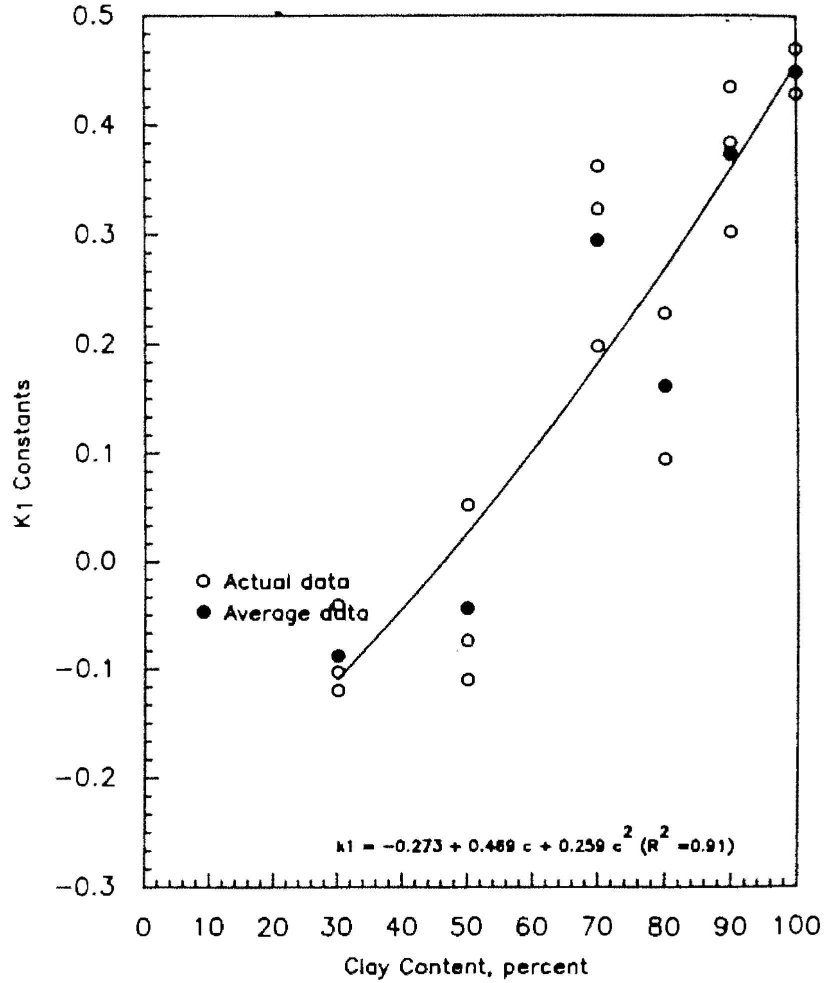

Figure F.14 - Variation in Constant k_2 from Model One with Clay Content at Dry of Optimum Water Content for Cohesive Soil.

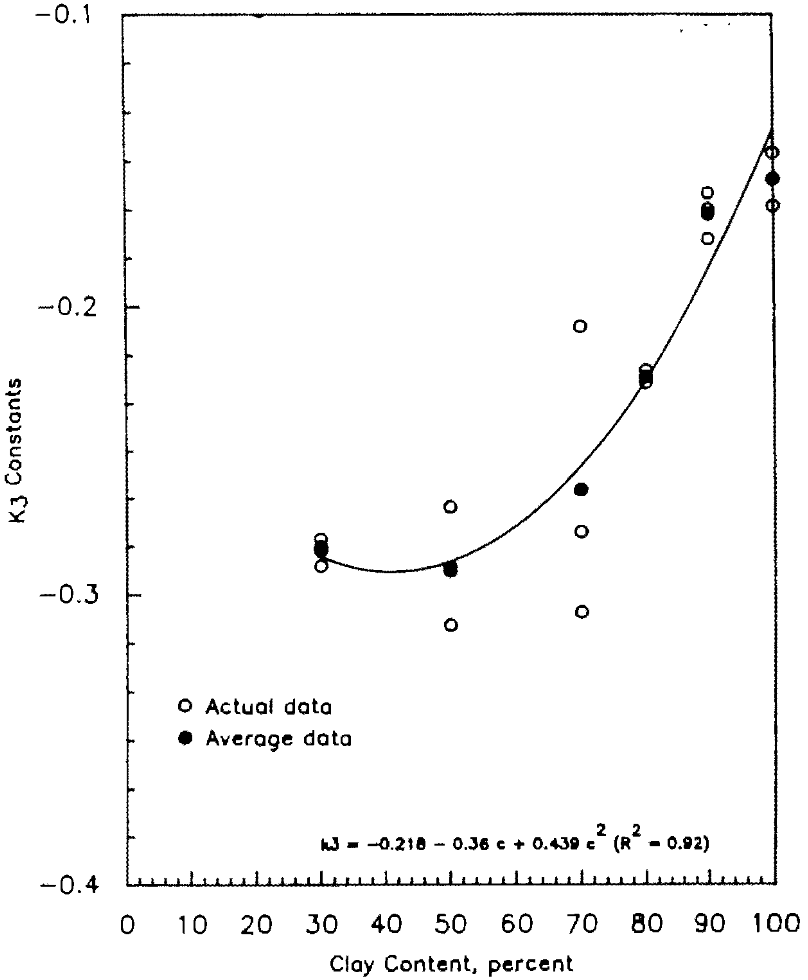

Figure F.15 - Variation in Constant k3 from Model One with Clay Content at Dry of Optimum Water Content for Cohesive Soil.

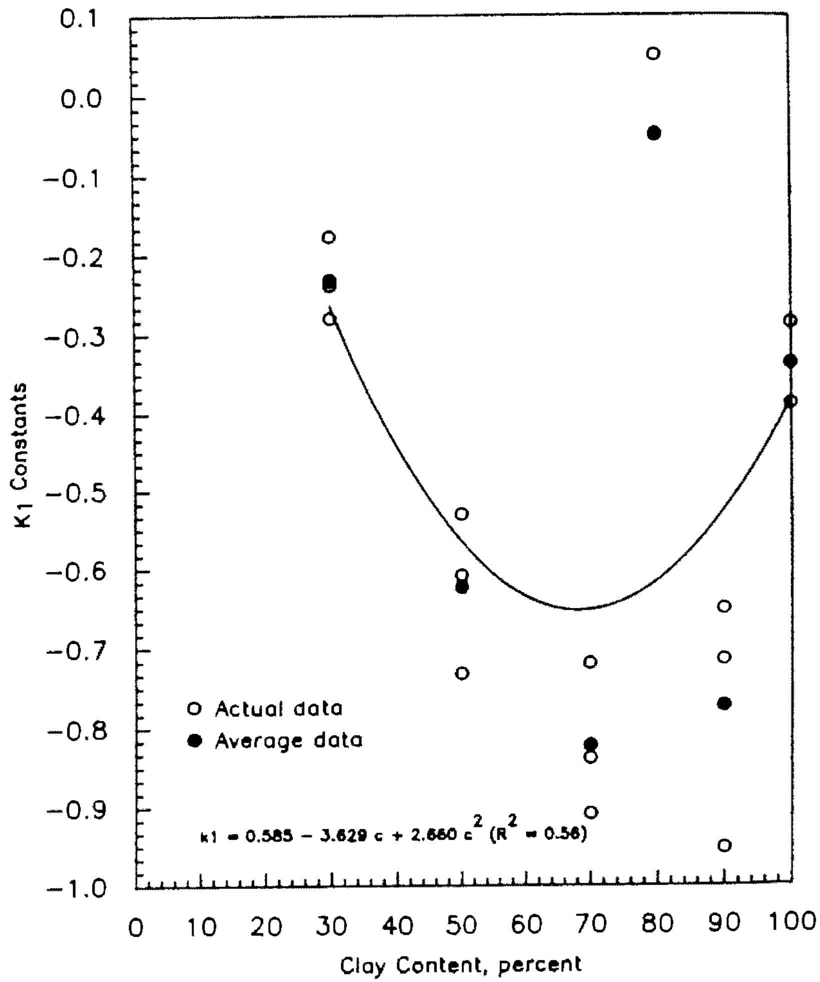

Figure F.16 - Variation in Constant k1 from Model One with Clay Content at Wet of Optimum Water Content for Cohesive Soil.

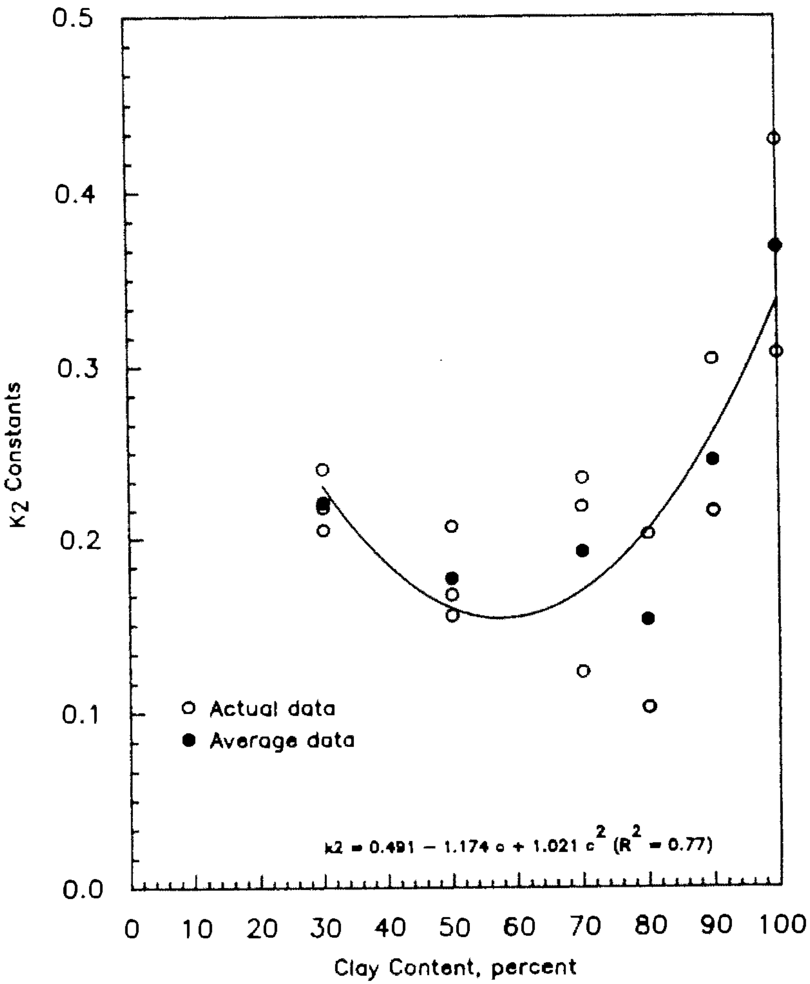

Figure F.17 - Variation in Constant k_2 from Model One with Clay Content at Wet of Optimum Water Content for Cohesive Soil.

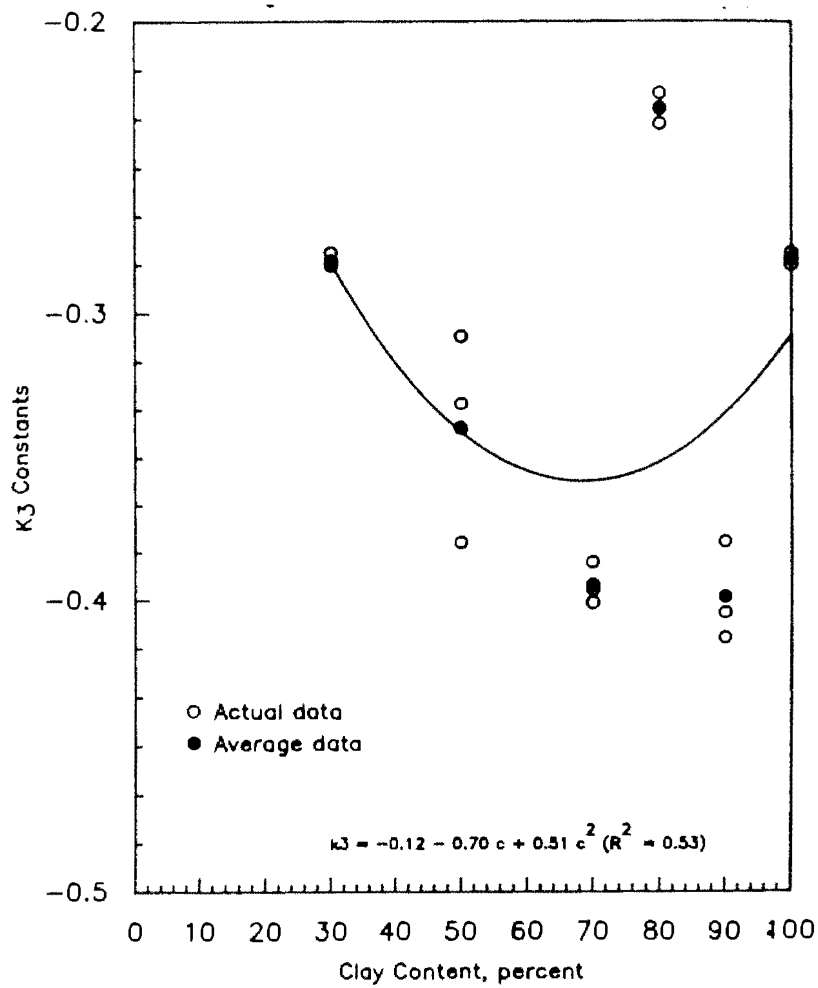

Figure F.18 - Variation in Constant k_3 from Model One with Clay Content at Wet of Optimum Water Content for Cohesive Soil.

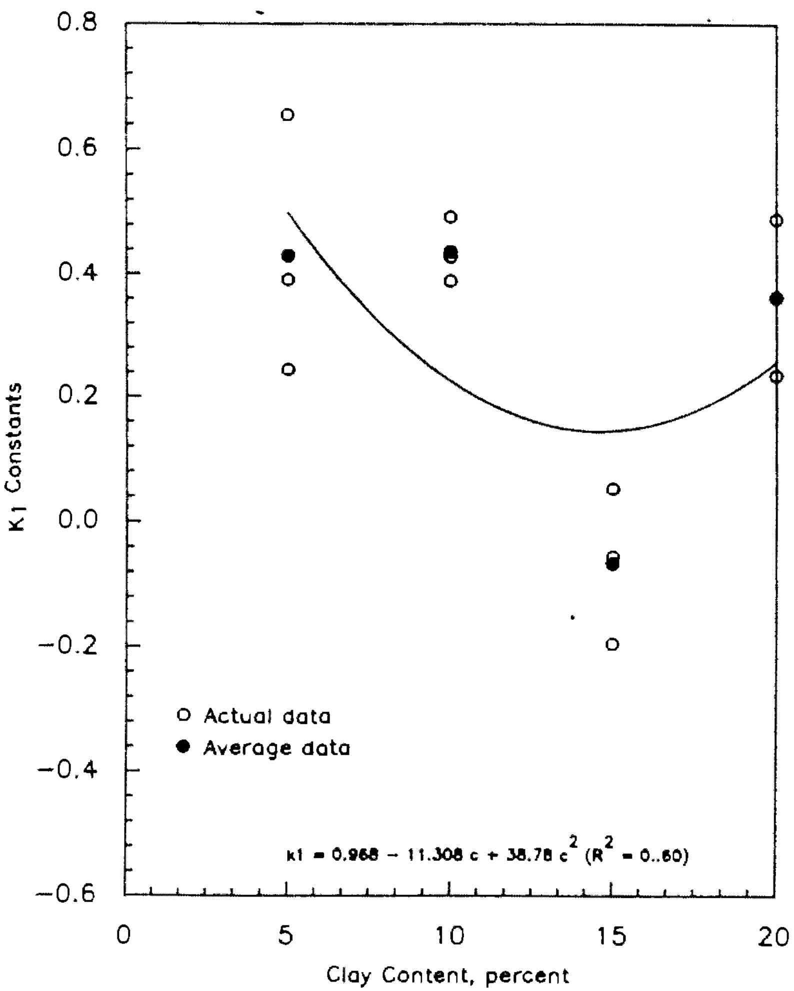

Figure F.19 - Variation in Constant k_1 from Model Two with Clay Content at Optimum Water Content for Granular Soil.

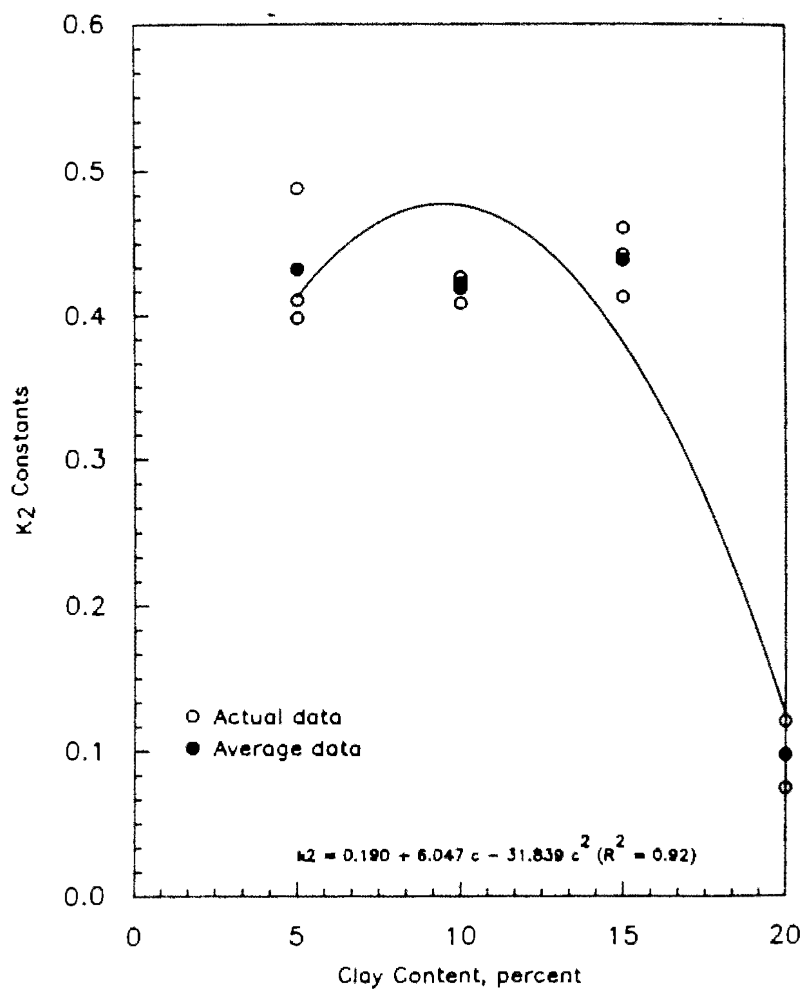

Figure F.20 - Variation in Constant k_2 from Model Two with Clay Content at Optimum Water Content for Granular Soil.

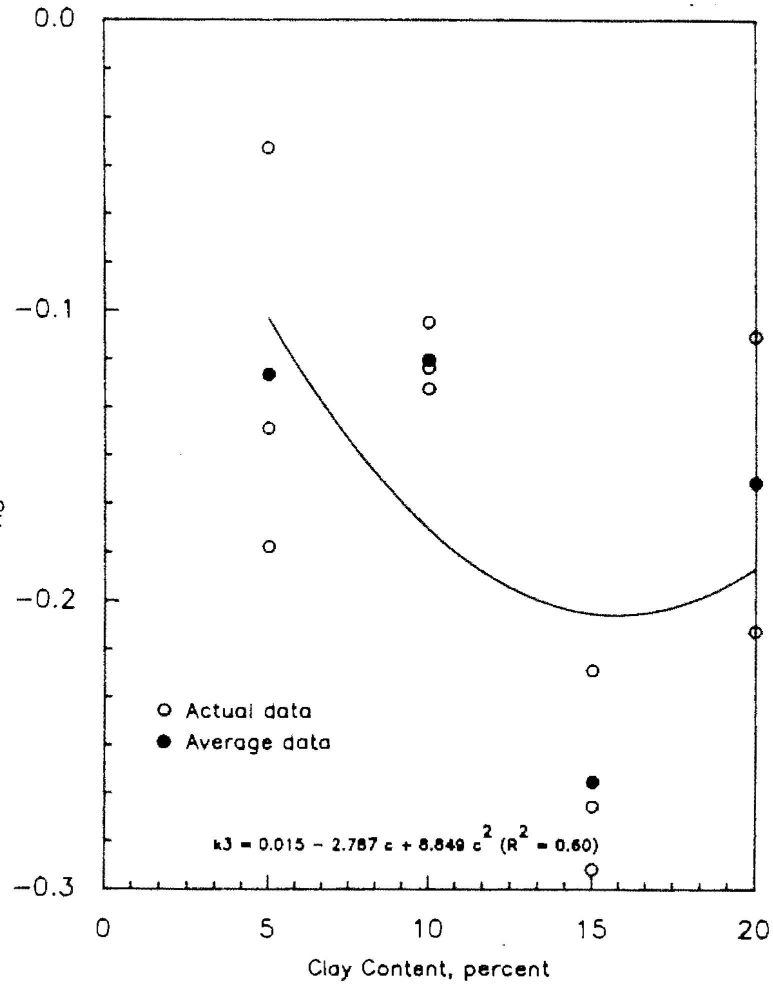

Figure F.21 - Variation in Constant k_3 from Model Two with Clay Content at Optimum Water Content for Granular Soil.

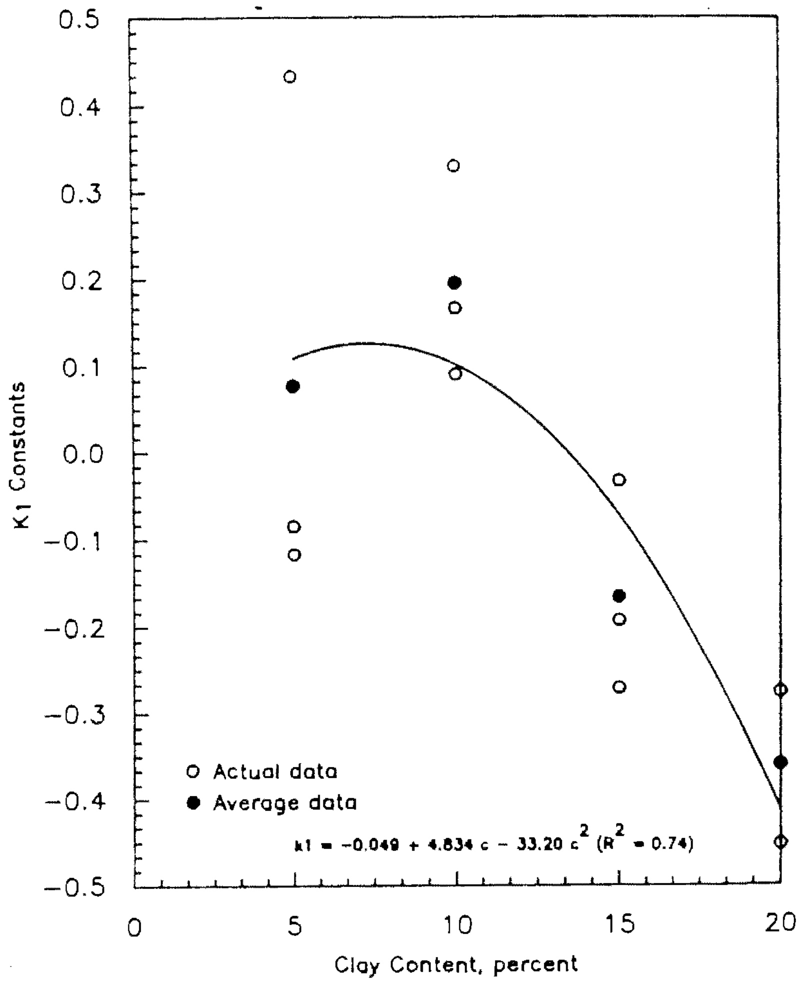

Figure F.22 - Variation in Constant k_1 from Model Two with Clay Content at Dry of Optimum Water Content for Granular Soil.

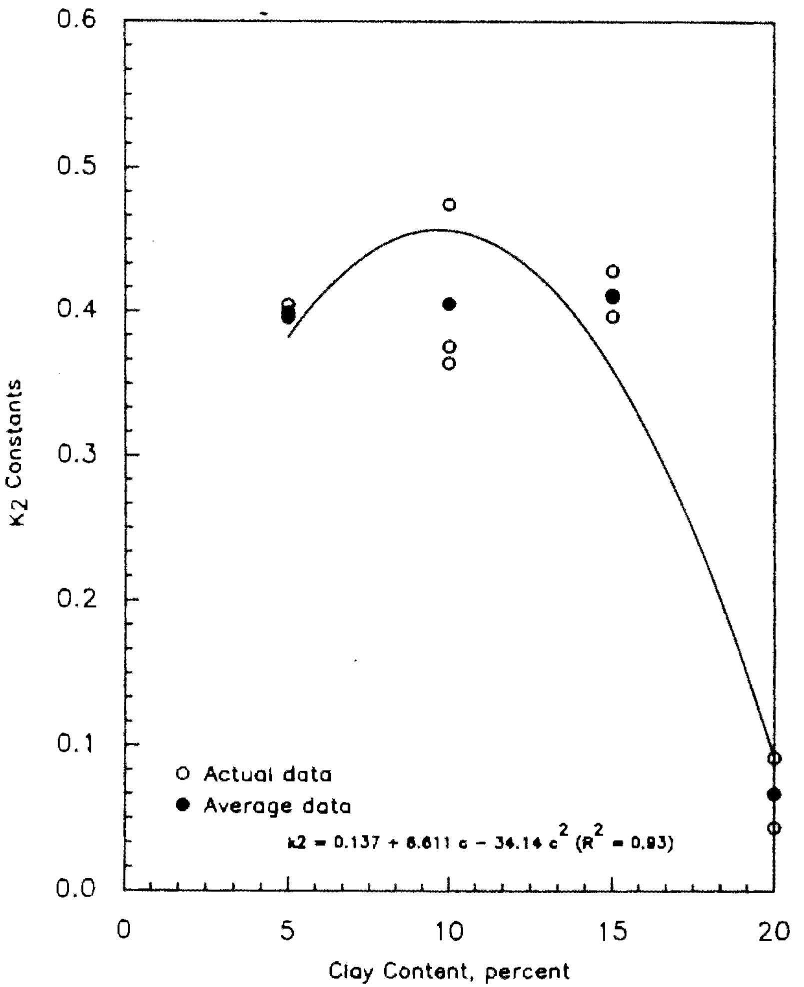

Figure F.23 - Variation in Constant k_2 from Model Two with Clay Content at Dry of Optimum Water Content for Granular Soil.

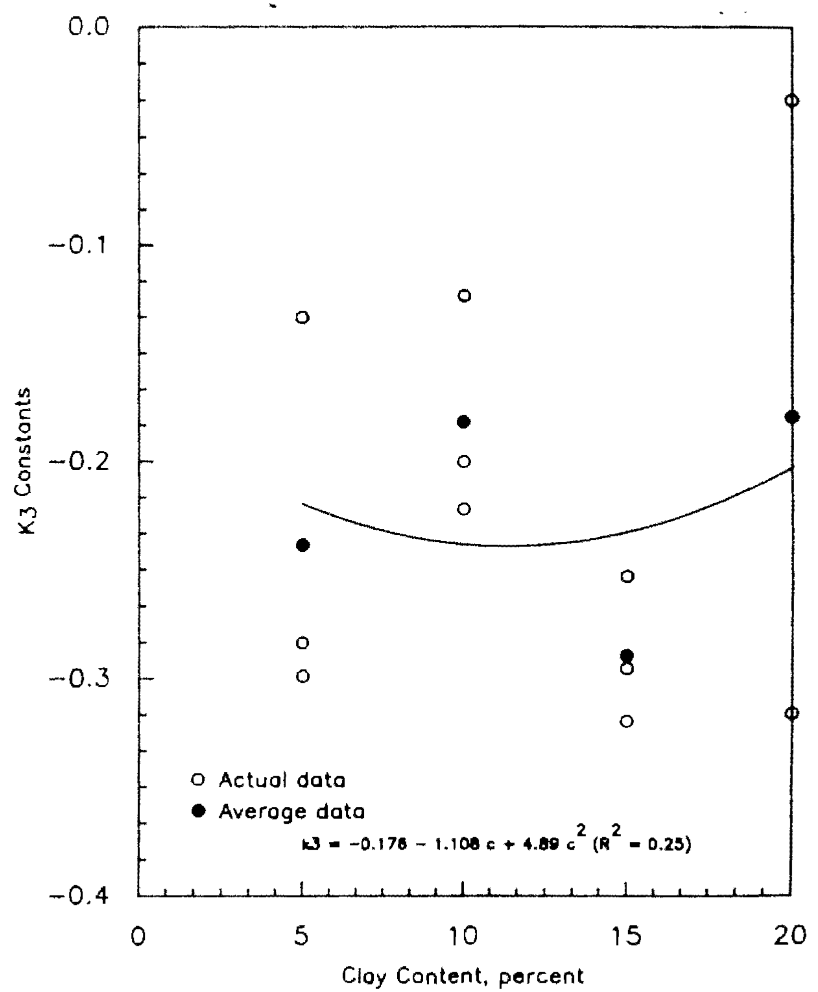

Figure F.24 - Variation in Constant k_3 from Model Two with Clay Content at Dry of Optimum Water Content for Granular Soil.

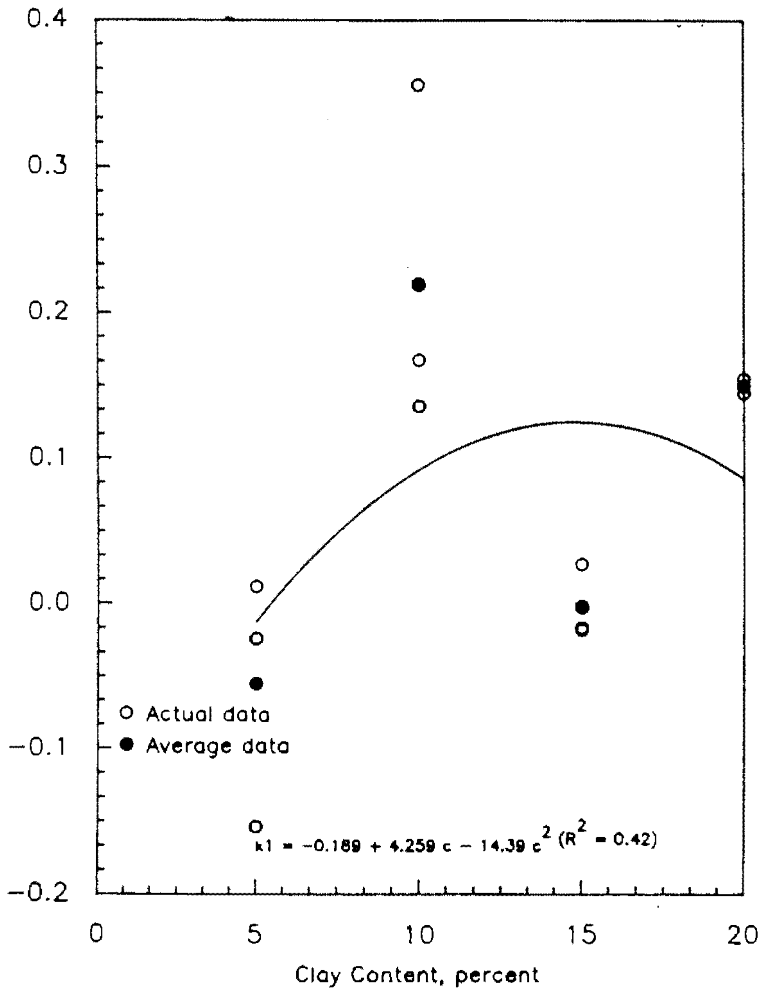

Figure F.25 - Variation in Constant k_1 from Model Two with Clay Content at Wet of Optimum Water Content for Granular Soil.

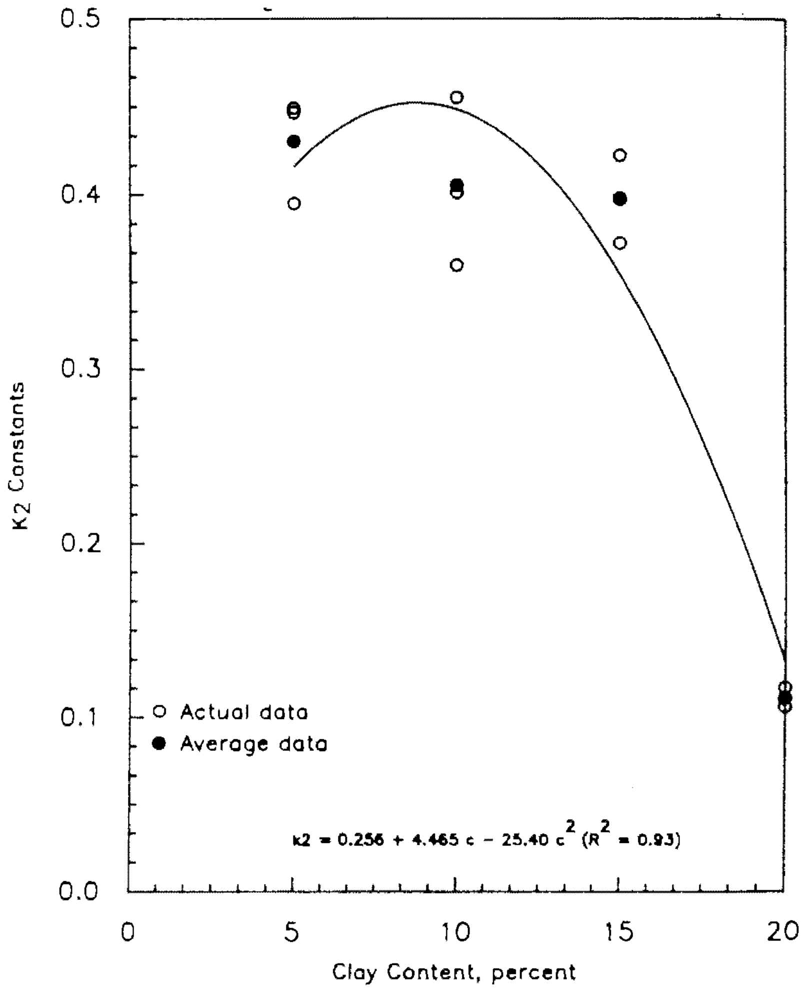

Figure F.26 - Variation in Constant k_2 from Model Two with Clay Content at Wet of Optimum Water Content for Granular Soil.

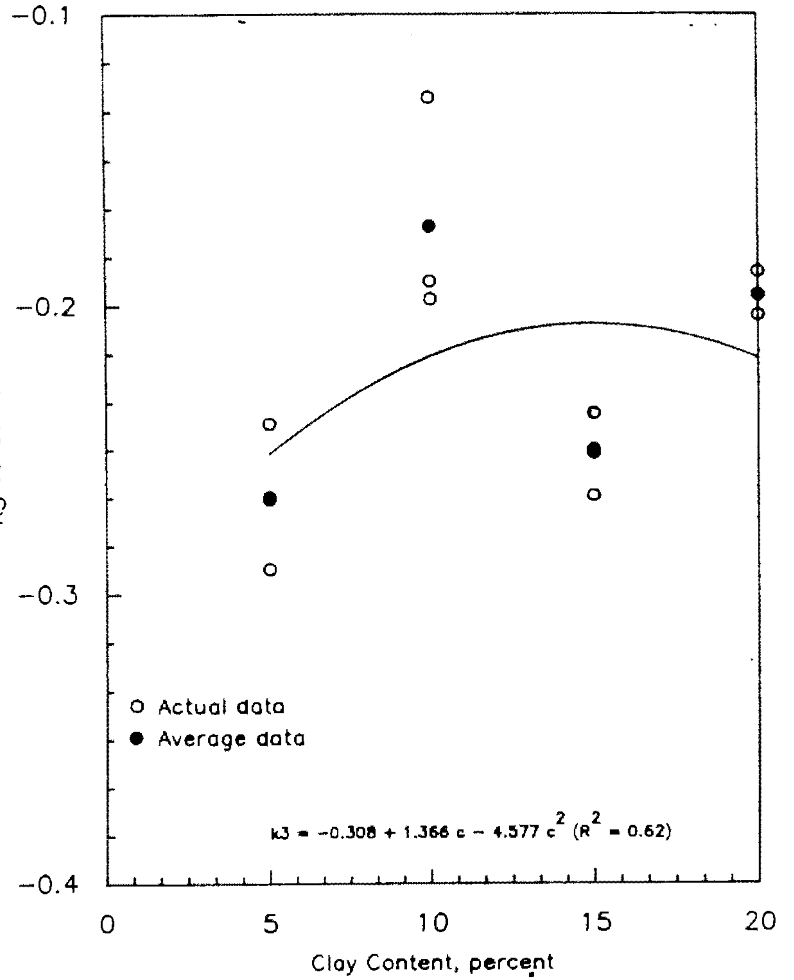

Figure F.27 - Variation in Constant k_3 from Model Two with Clay Content at Wet of Optimum Water Content for Granular Soil.

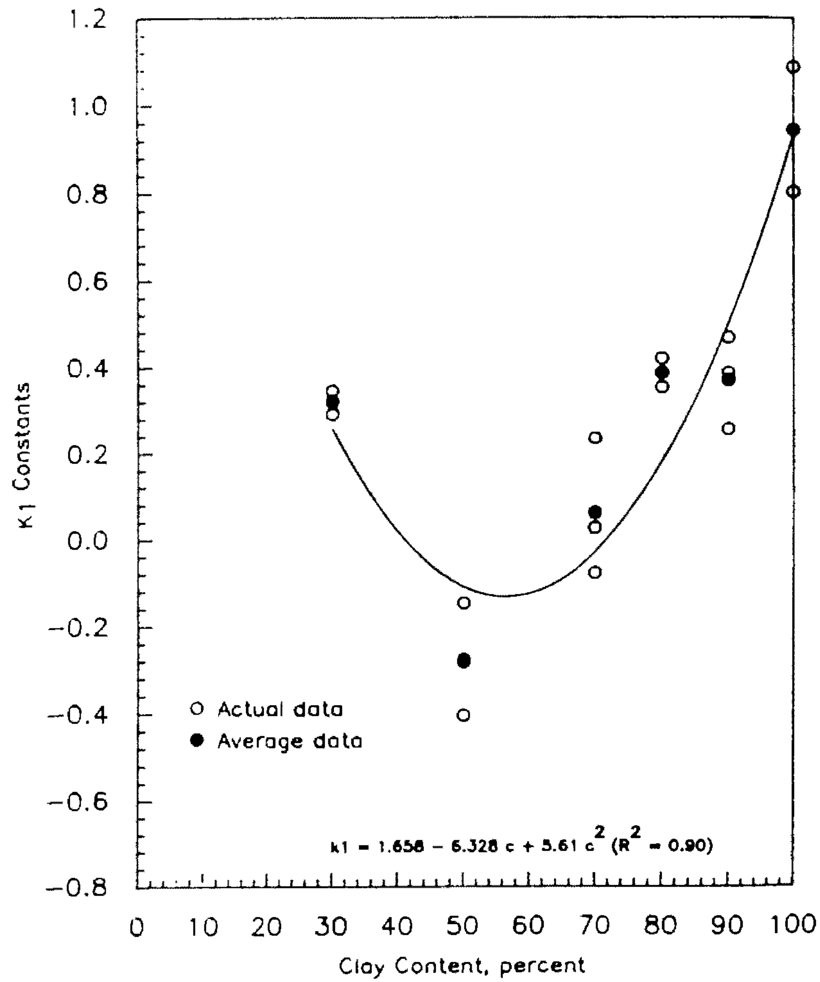

Figure F.28 - Variation in Constant k_1 from Model Two with Clay Content at Optimum Water Content for Cohesive Soil.

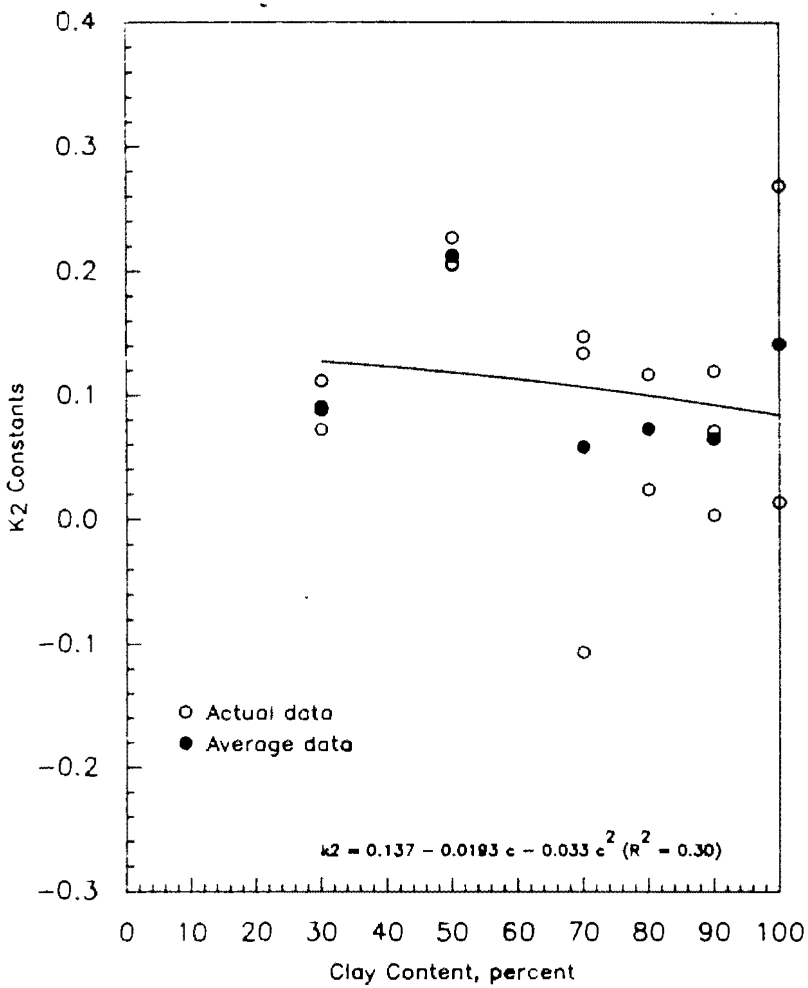

Figure F.29 - Variation in Constant k_2 from Model Two with Clay Content at Optimum Water Content for Cohesive Soil.

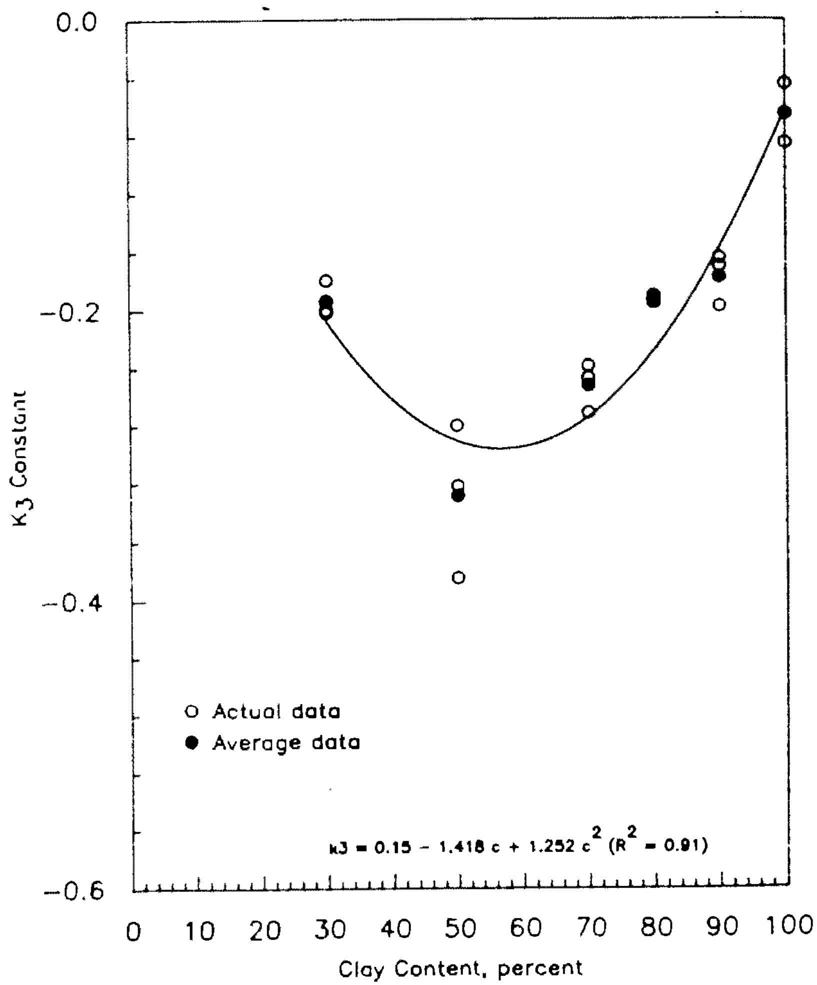

Figure F.30 - Variation in Constant k_3 from Model Two with Clay Content at Optimum Water Content for Cohesive Soil.

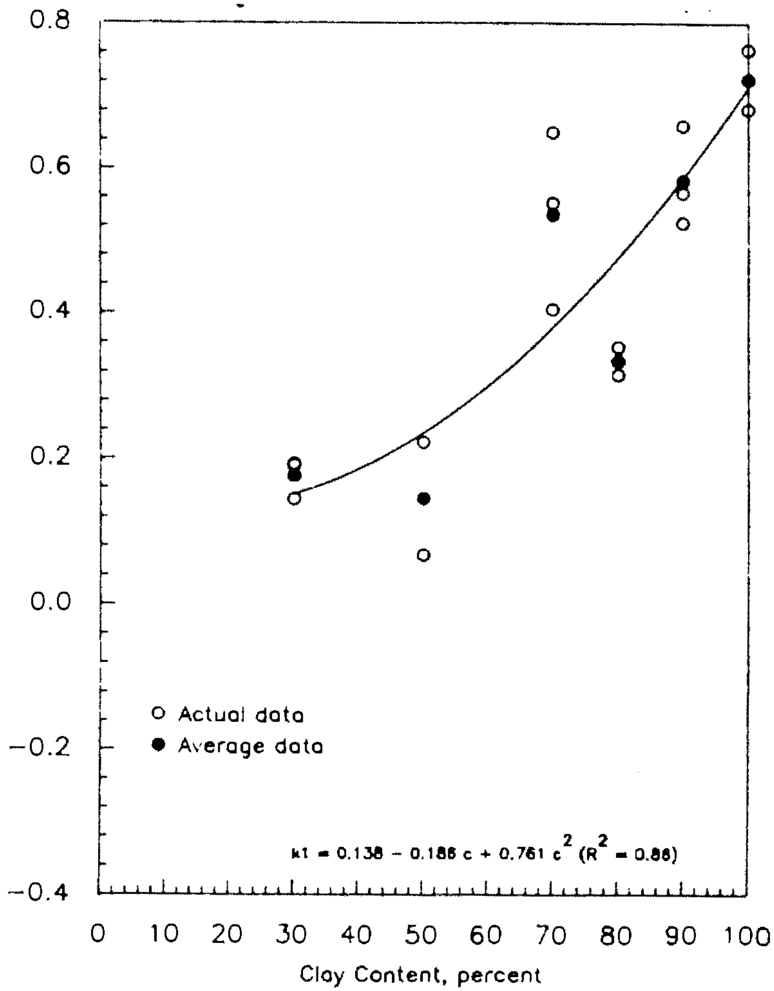

Figure F.31 - Variation in Constant k_1 from Model Two with Clay Content at Dry of Optimum Water Content for Cohesive Soil.

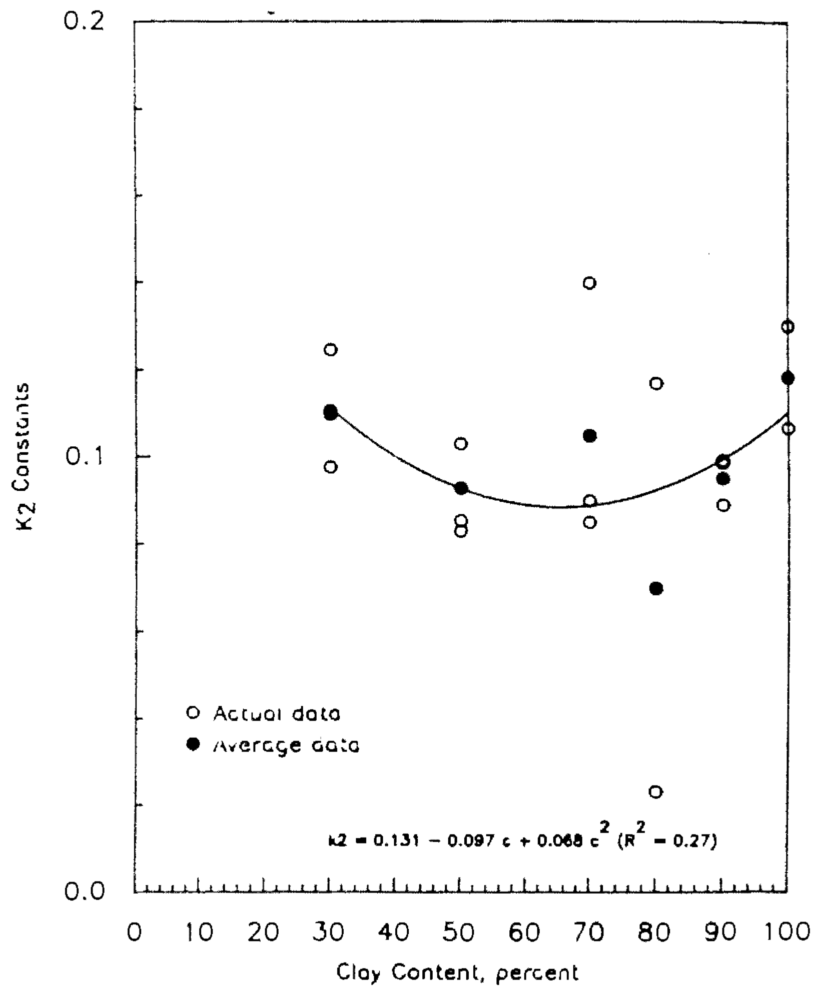

Figure F.32 - Variation in Constant k_2 from Model Two with Clay Content at Dry of Optimum Water Content for Cohesive Soil.

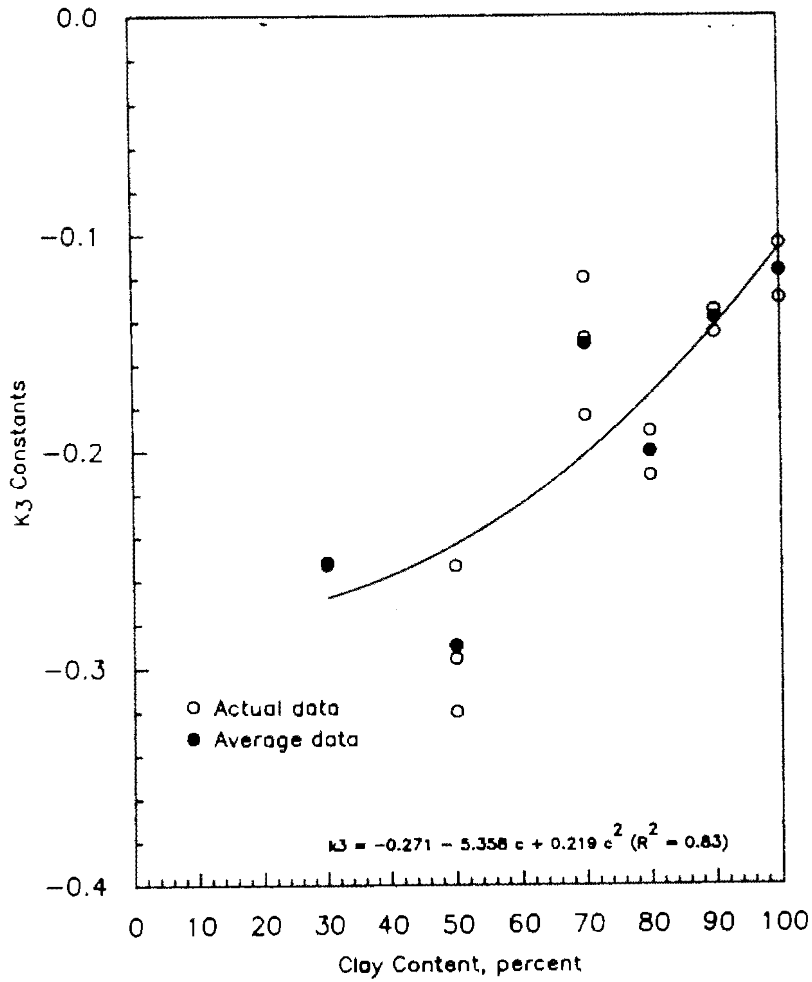

Figure F.33 - Variation in Constant k_3 from Model Two with Clay Content at Dry of Optimum Water Content for Cohesive Soil.

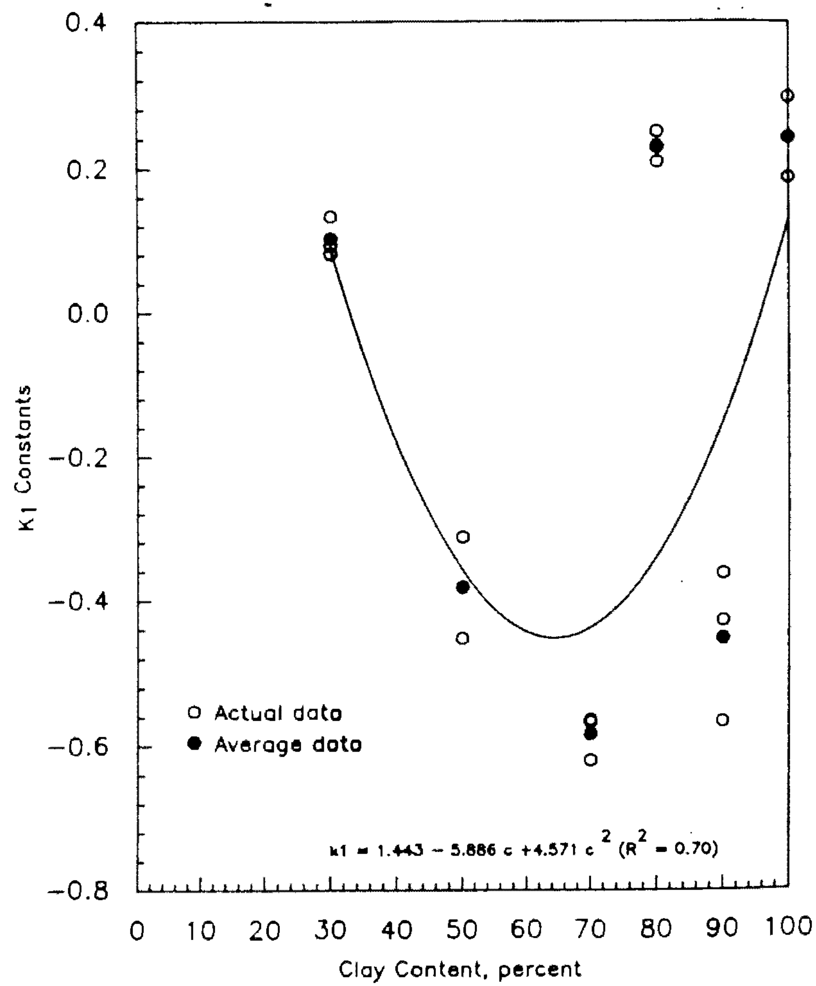

Figure F.34 - Variation in Constant k_1 from Model Two with Clay Content at Wet of Optimum Water Content for Cohesive Soil.

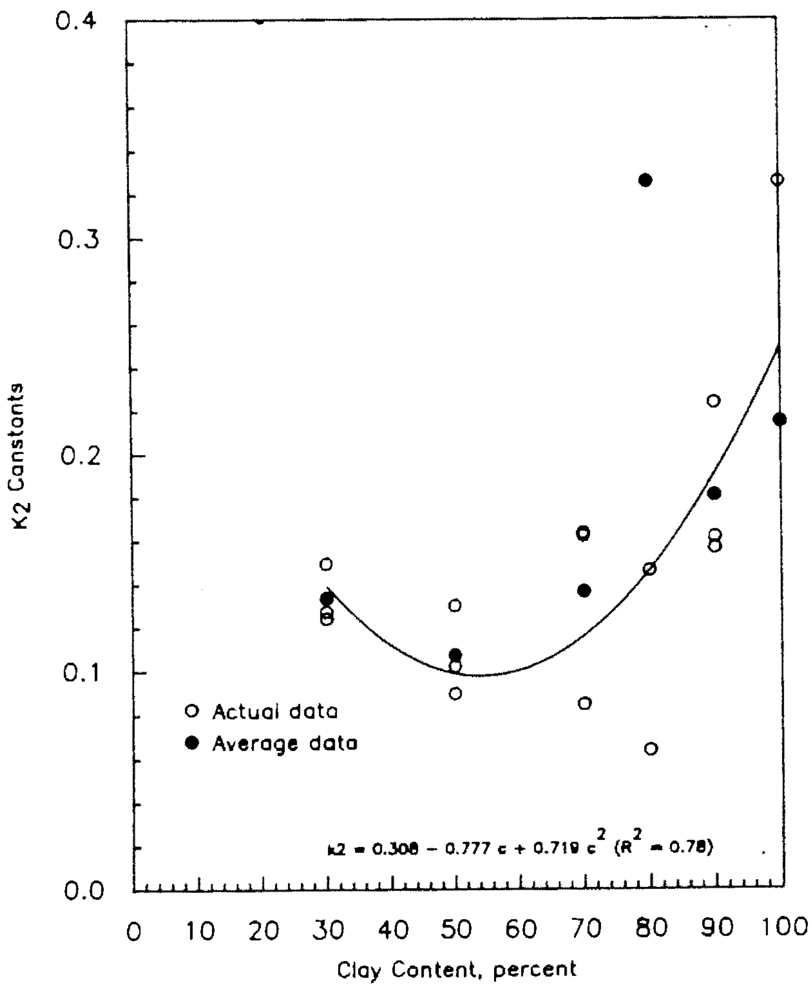

Figure F.35 - Variation in Constant k2 from Model Two with Clay Content at Wet of Optimum Water Content for Cohesive Soil.

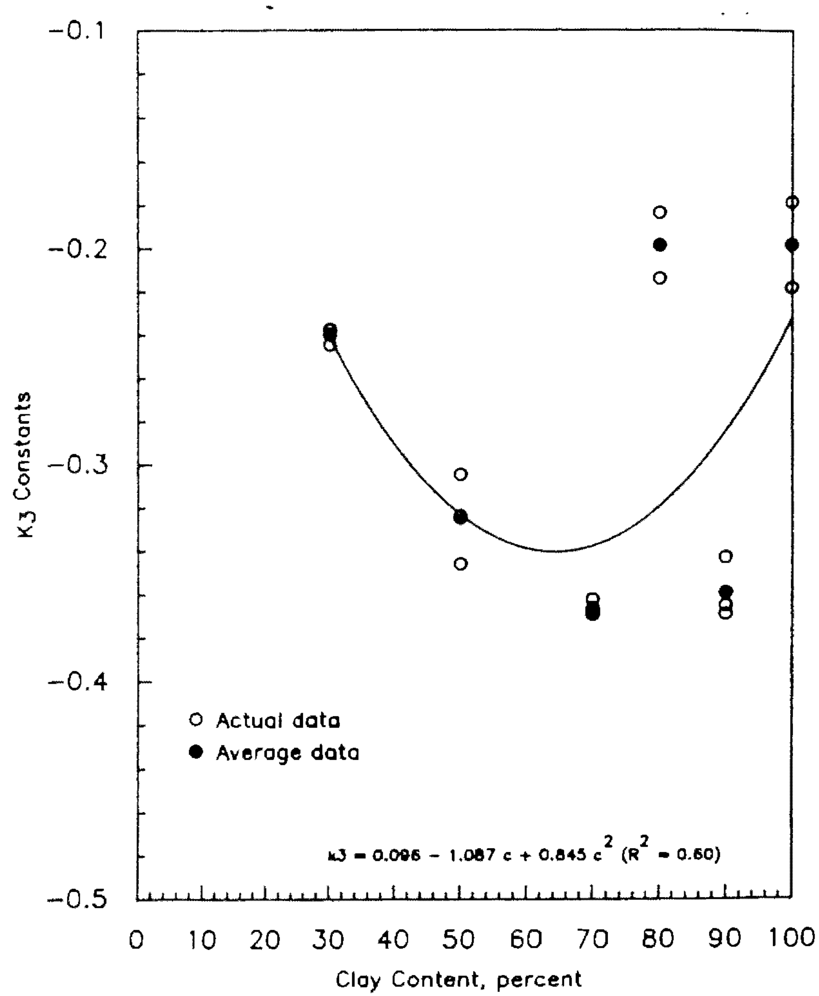

Figure F.36 - Variation in Constant k3 from Model Two with Clay Content at Wet of Optimum Water Content for Cohesive Soil.

APPENDIX G

RESILIENT MODULUS TESTING ON SUBGRADE SOILS

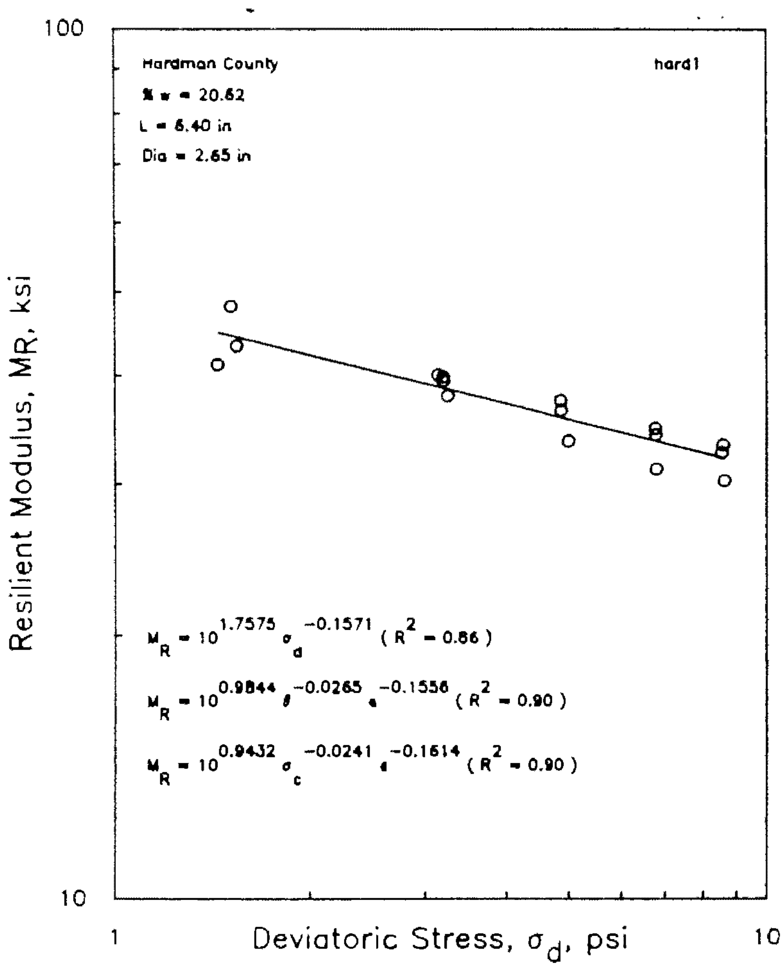

Figure G.1 - Variation in Resilient Modulus with Deviatoric Stress for Hardeman County Specimen at Two Percent Dry of Optimum Water Content Following SHRP Procedure (Specimen 1)

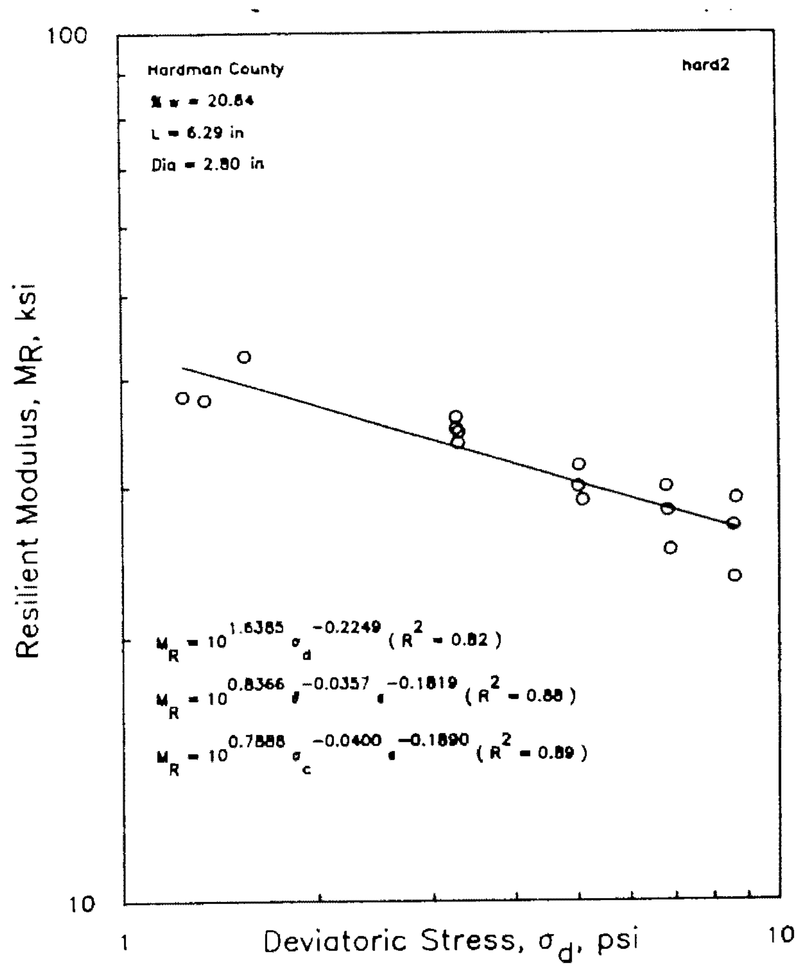

Figure G.2 - Variation in Resilient Modulus with Deviatoric Stress for Hardeman County Specimen at Two Percent Dry of Optimum Water Content Following SHRP Procedure (Specimen 2)

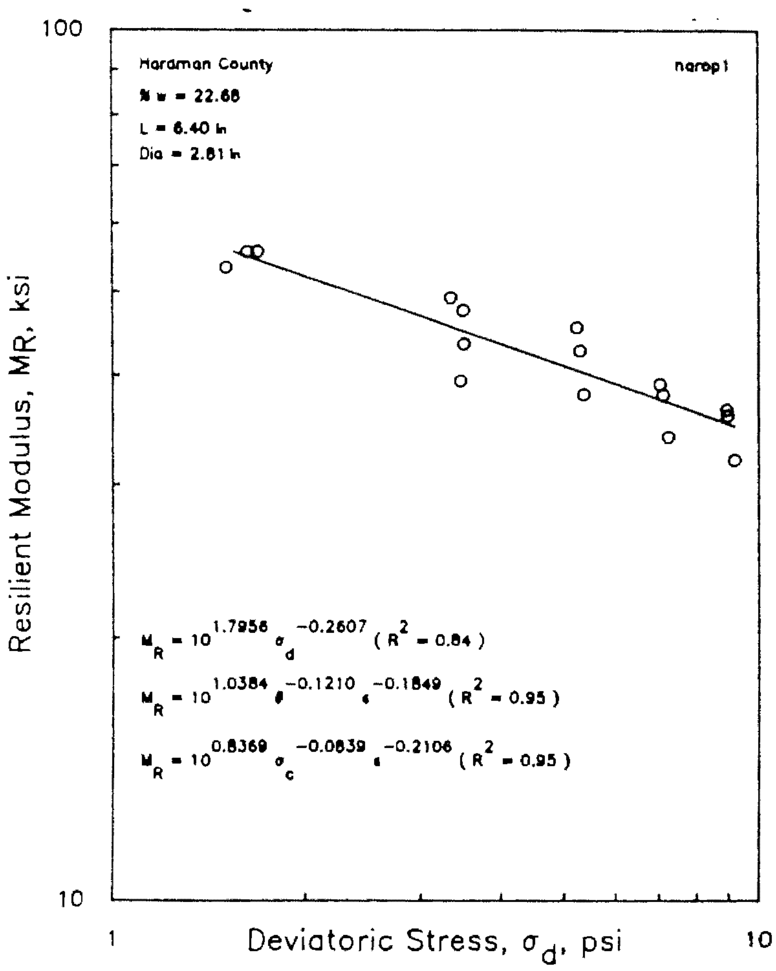

Figure G.3 - Variation in Resilient Modulus with Deviatoric Stress for Hardeman County Specimen at Optimum Water Content Following SHRP Procedure (Specimen 1)

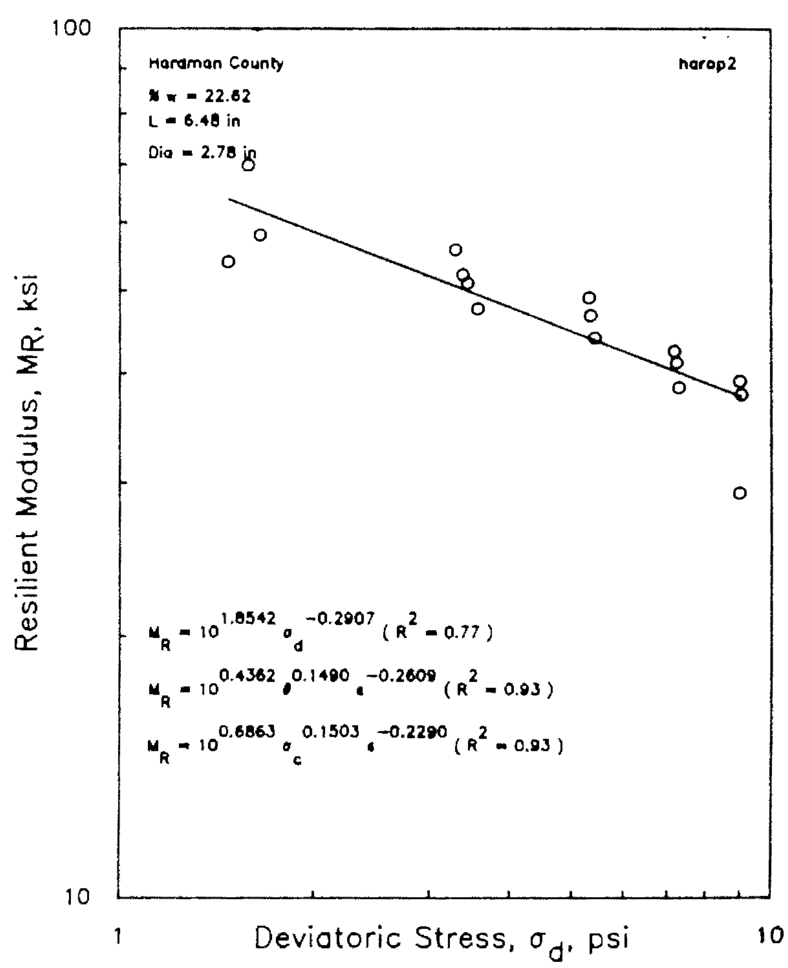

Figure G.4 - Variation in Resilient Modulus with Deviatoric Stress for Hardeman County Specimen at Optimum Water Content Following SHRP Procedure (Specimen 2)

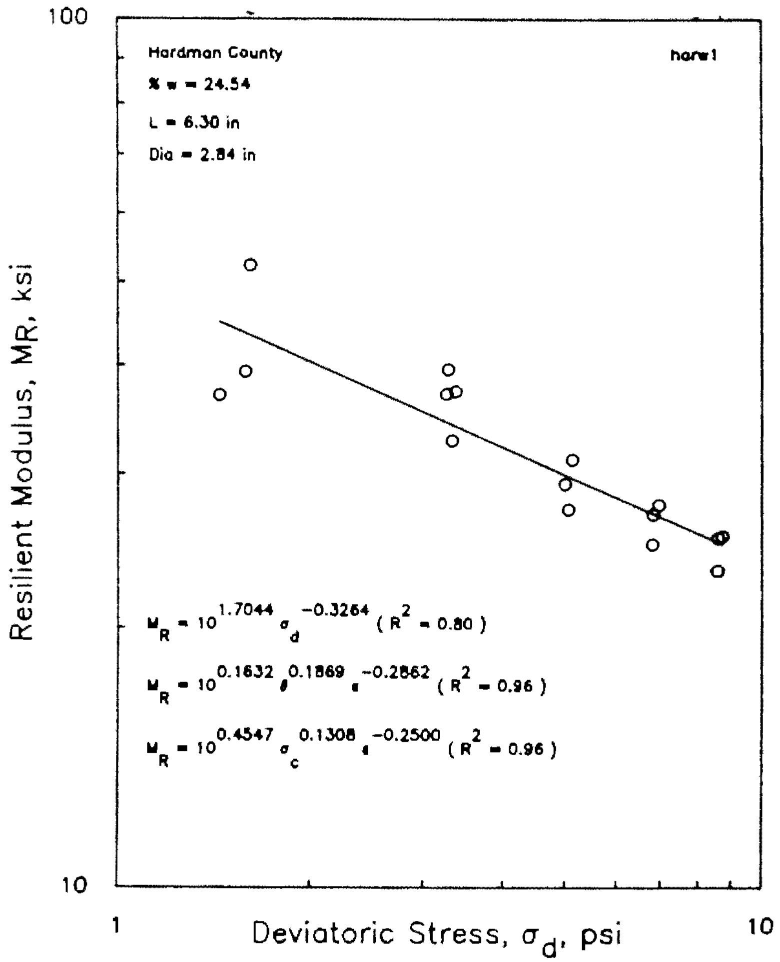

Figure G.5 - Variation in Resilient Modulus with Deviatoric Stress for Hardeman County Specimen at Two Percent Wet of Optimum Water Content Following SHRP Procedure (Specimen 1)

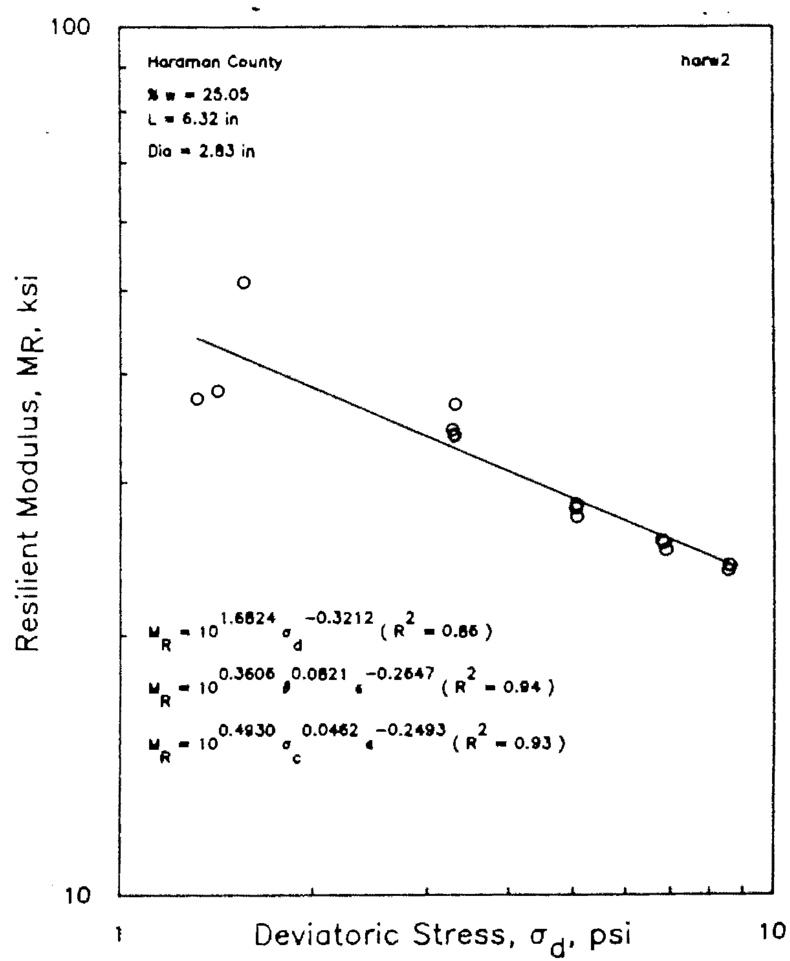

Figure G.6 - Variation in Resilient Modulus with Deviatoric Stress for Hardeman County Specimen at Two Percent Wet of Optimum Water Content Following SHRP Procedure (Specimen 2)

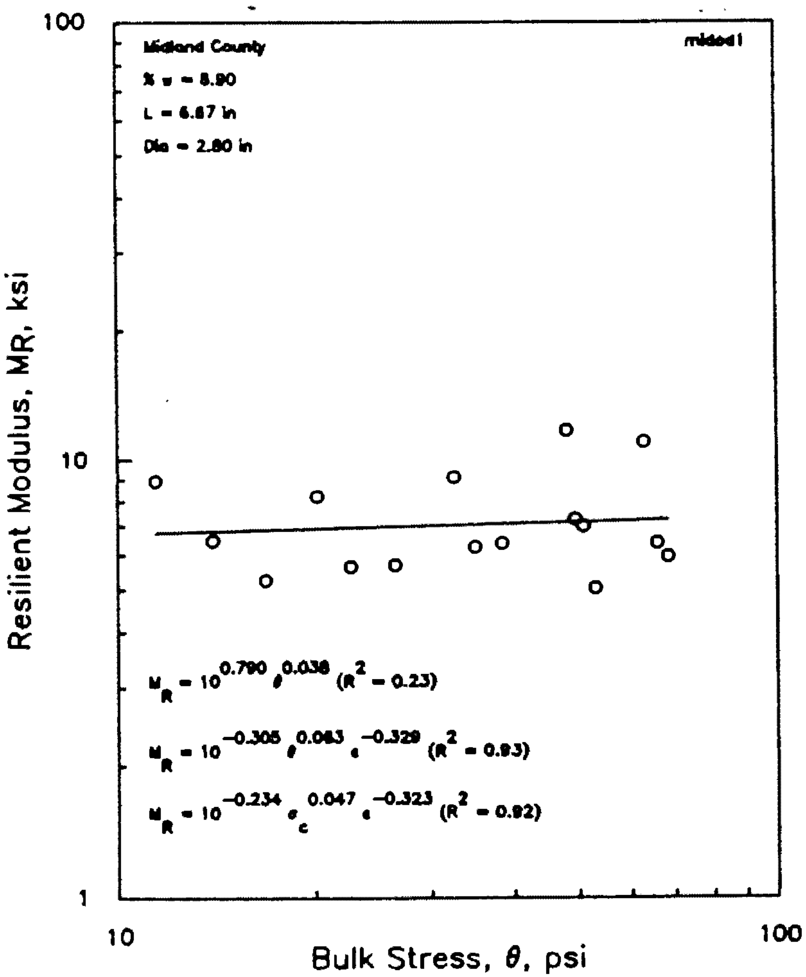

Figure G.7 - Variation in Resilient Modulus with Bulk Stress for Midland County Specimen at Two Percent Dry of Optimum Water Content following UTEP Procedure (Specimen 1)

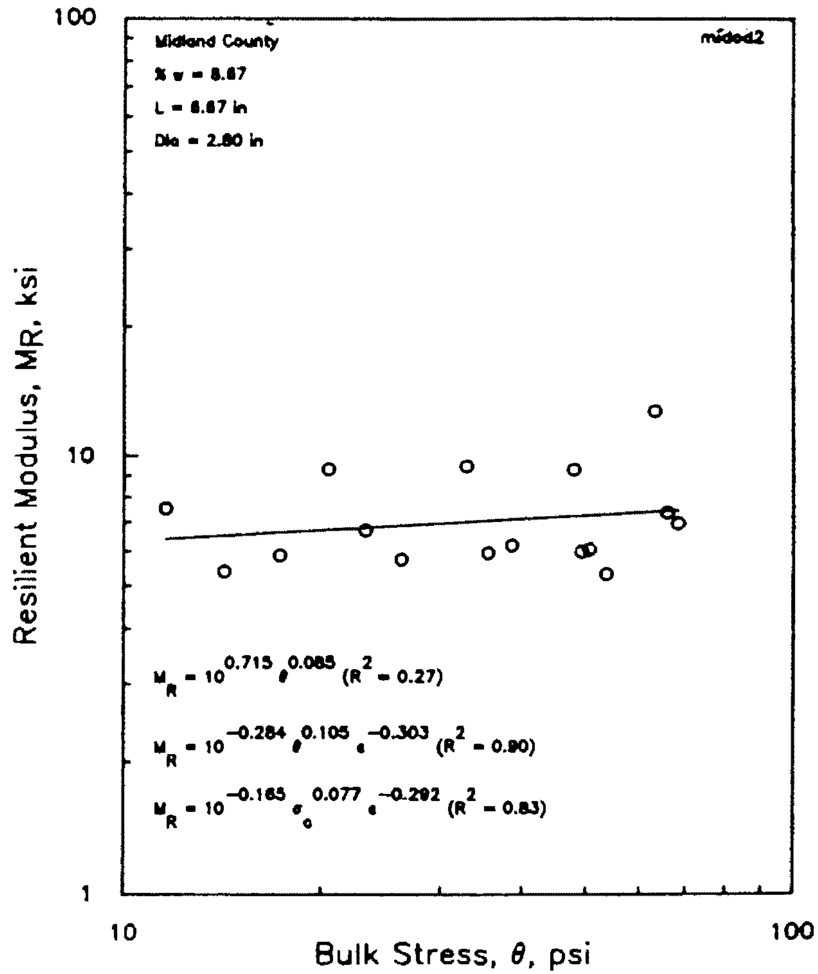

Figure G.8 - Variation in Resilient Modulus with Bulk Stress for Midland County Specimen at Two Percent Dry of Optimum Water Content following UTEP Procedure (Specimen 2)

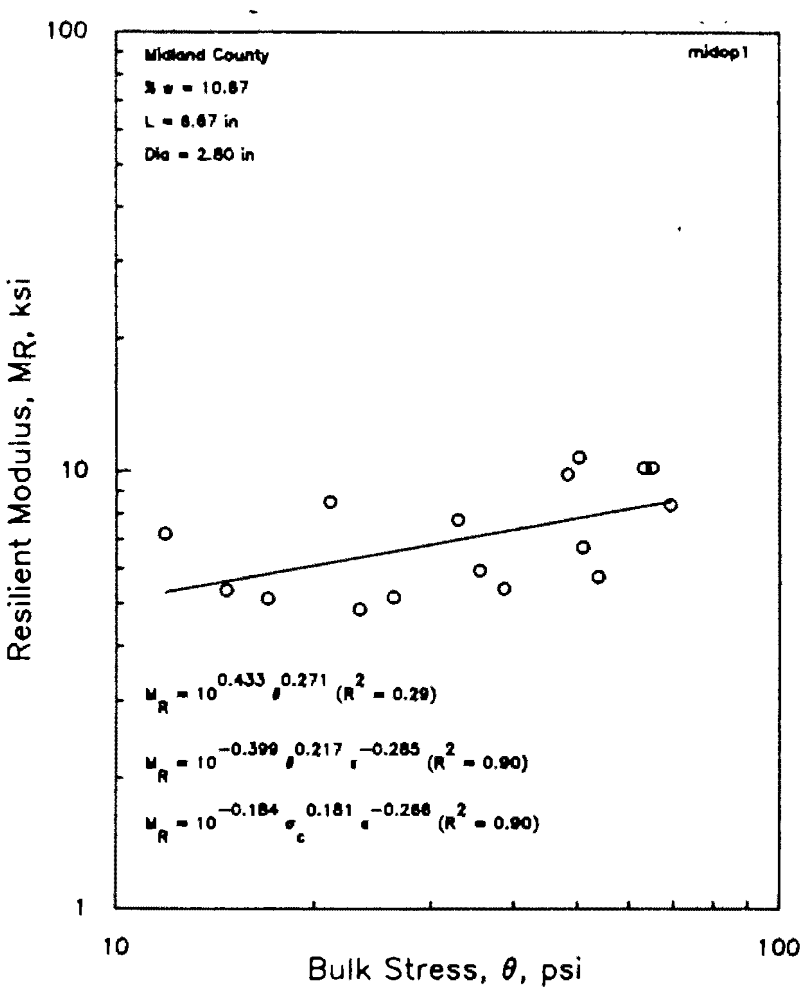

Figure G.9 - Variation in Resilient Modulus with Bulk Stress for Midland County Specimen at Optimum Water Content following UTEP Procedure (Specimen 1)

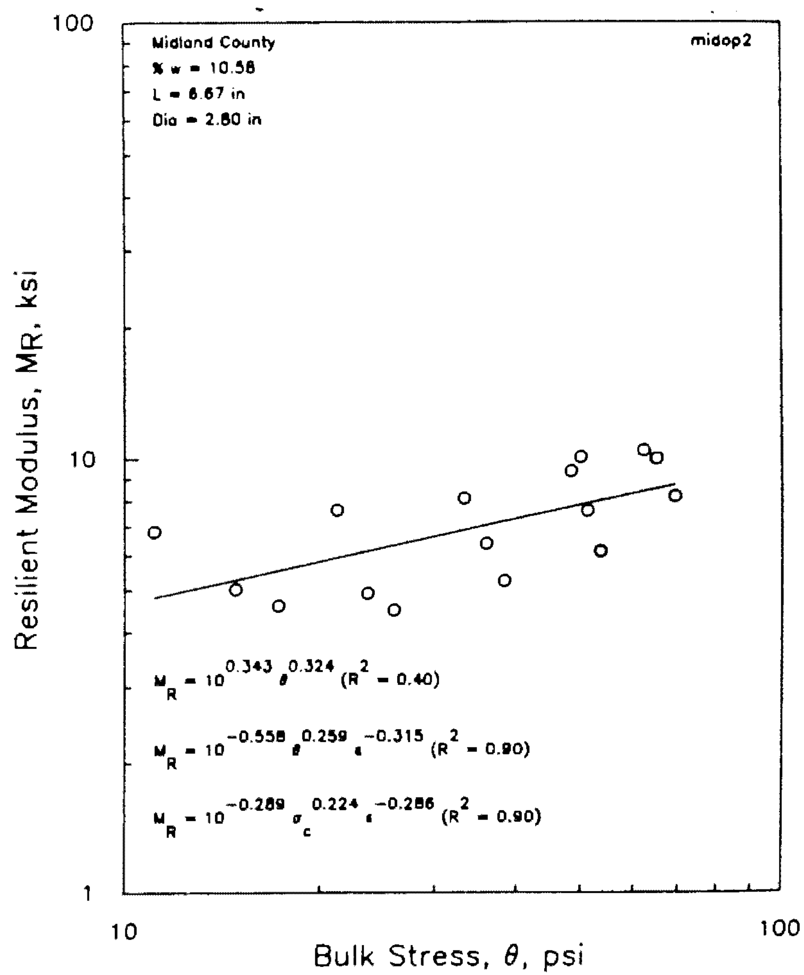

Fig. G.10 - Variation in Resilient Modulus with Bulk Stress for Midland County Specimen at Optimum Water Content following UTEP Procedure (Specimen 2)

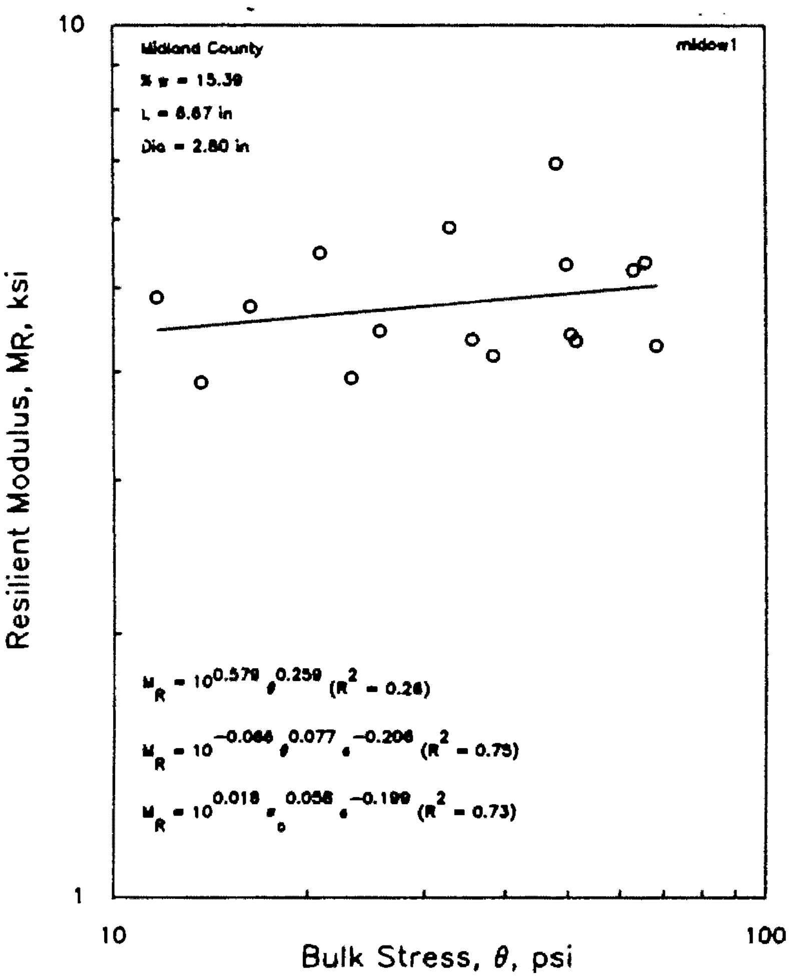

Fig. G.11 - Variation in Resilient Modulus with Bulk Stress for Midland County Specimen at Two Percent Wet of Optimum Water Content following UTEP Procedure (Specimen 1)

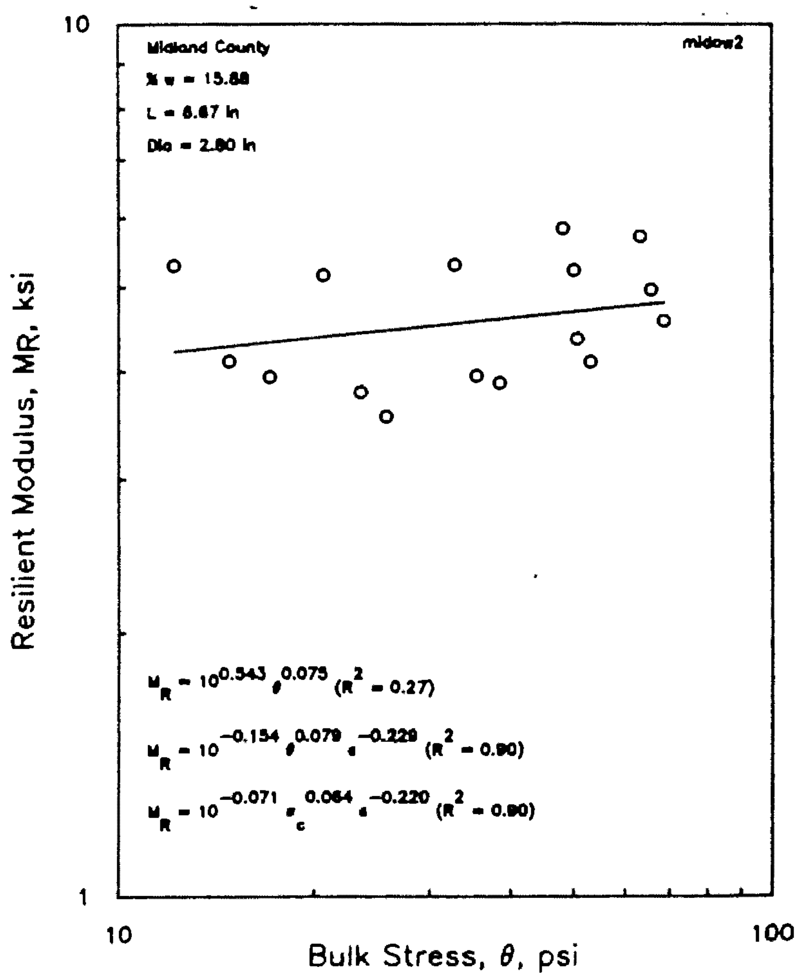

Fig. G.12 - Variation in Resilient Modulus with Bulk Stress for Midland County Specimen at Two Percent Wet of Optimum Water Content following UTEP Procedure (Specimen 2)

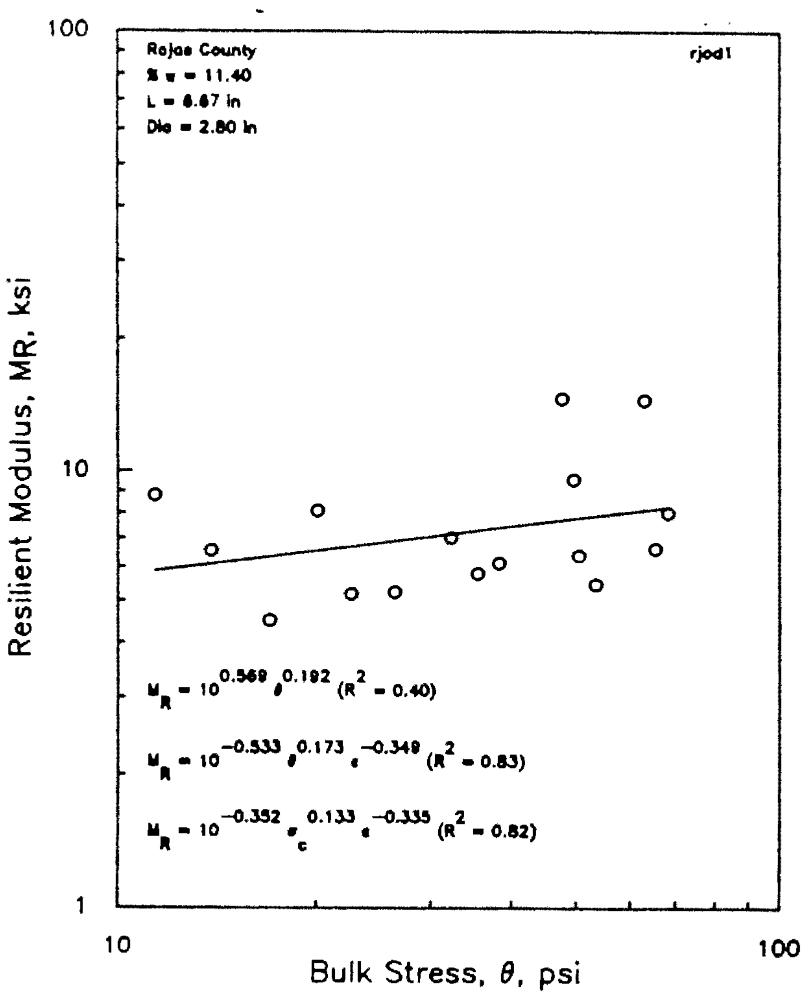

Fig. G.13 - Variation in Resilient Modulus with Bulk Stress for El Paso County Specimen at Two Percent Dry of Optimum Water Content following UTEP Procedure (Specimen 1)

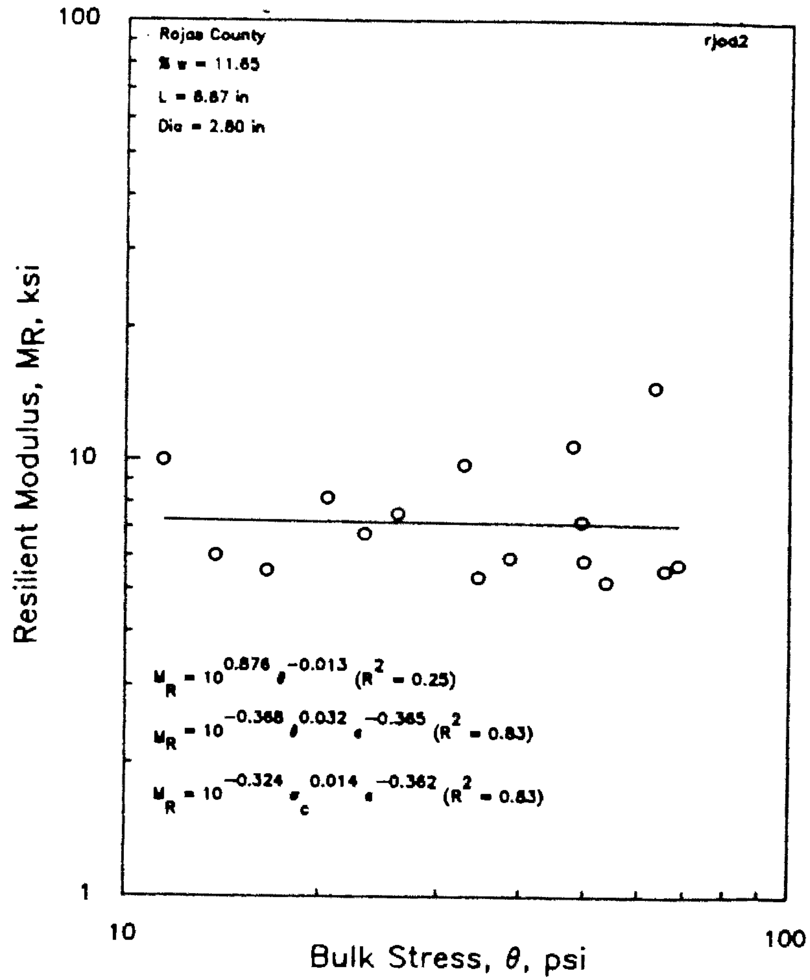

Fig. G.14 - Variation in Resilient Modulus with Bulk Stress for El Paso County Specimen at Two Percent Dry of Optimum Water Content following UTEP Procedure (Specimen 2)

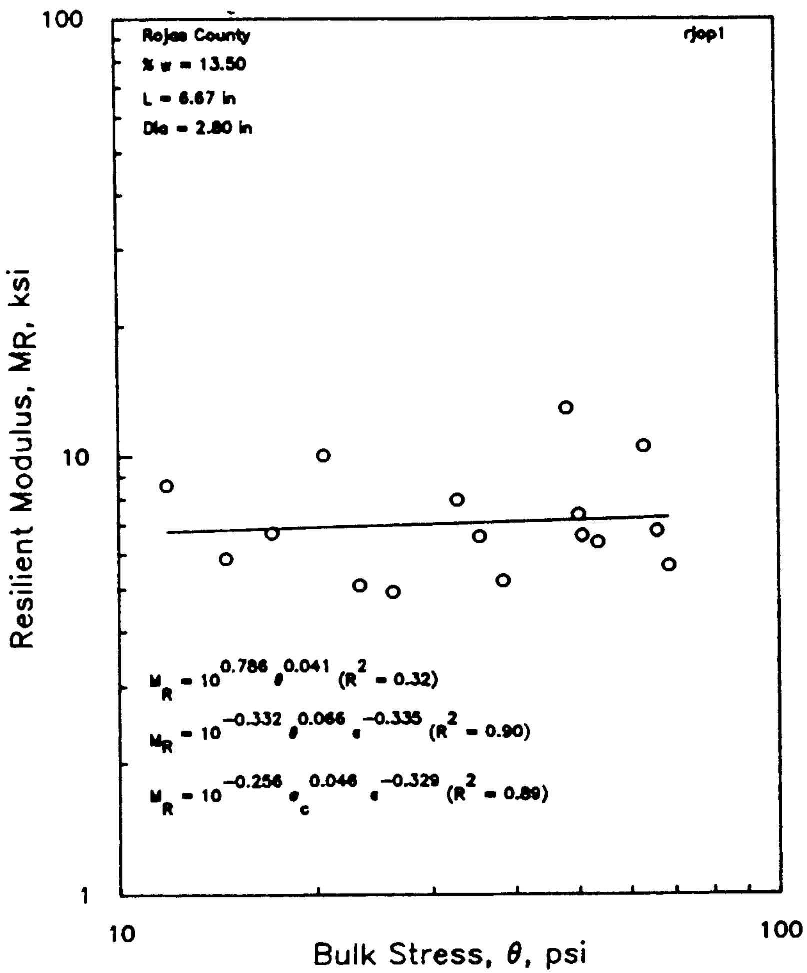

Fig. G.15 - Variation in Resilient Modulus with Bulk Stress for El Paso County Specimen at Optimum Water Content following UTEP Procedure (Specimen 1)

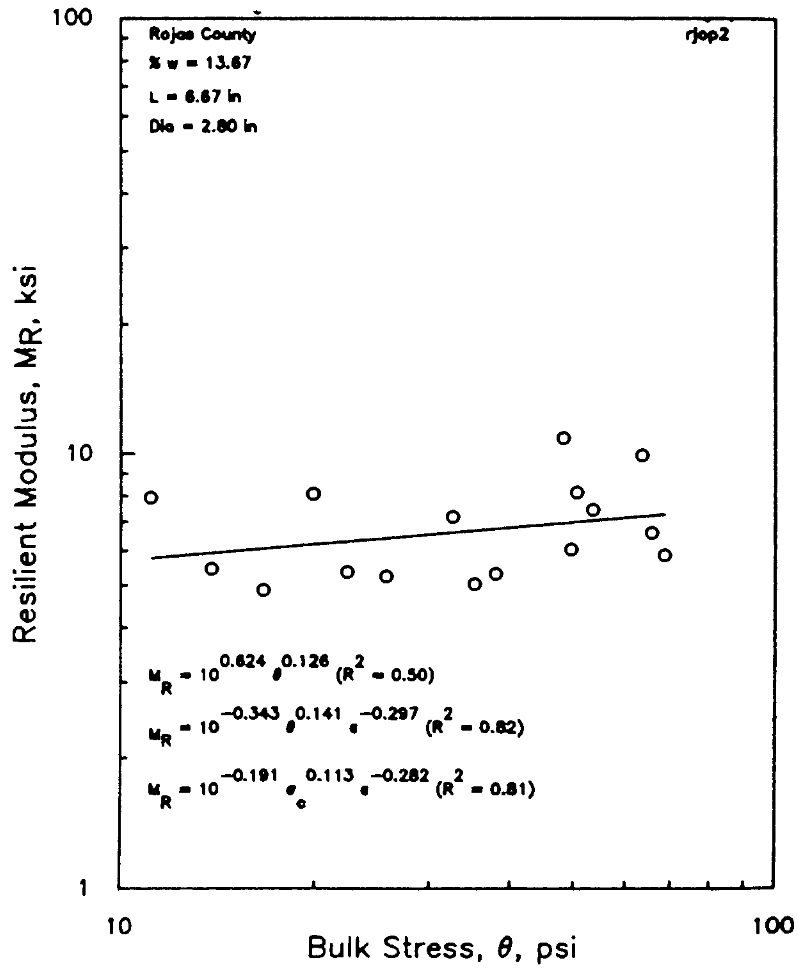

Fig. G.16 - Variation in Resilient Modulus with Bulk Stress for El Paso County Specimen at Optimum Water Content following UTEP Procedure (Specimen 2)

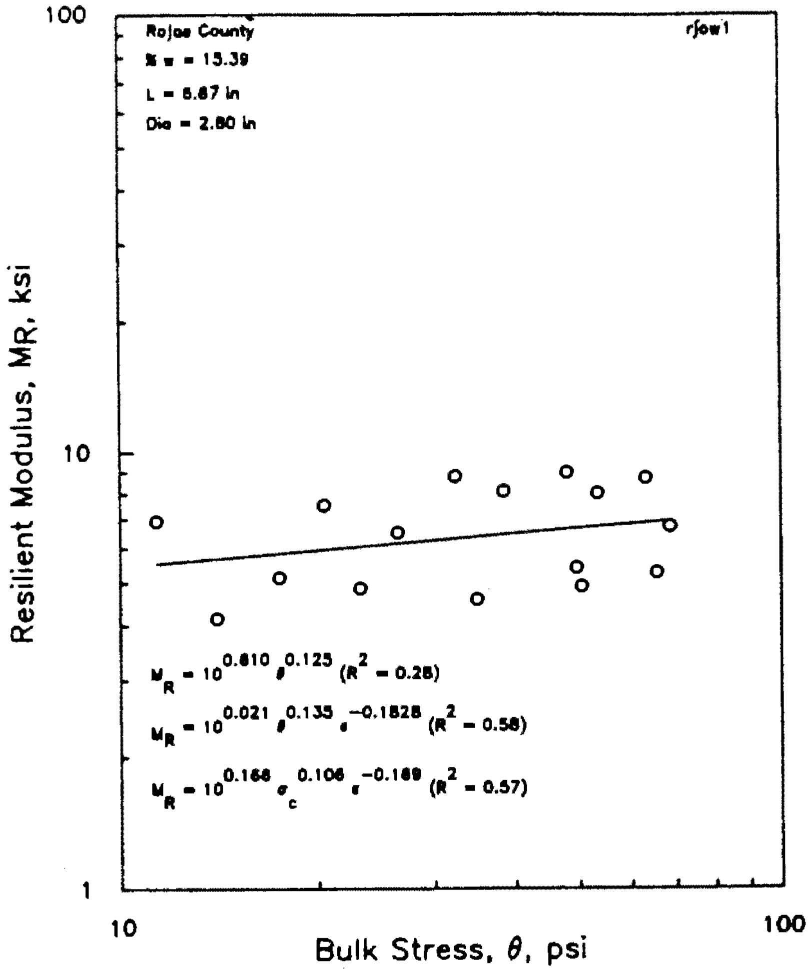

Fig. G.17 - Variation in Resilient Modulus with Bulk Stress for El Paso County Specimen at Two Percent Wet of Optimum Water Content following UTEP Procedure (Specimen 1)

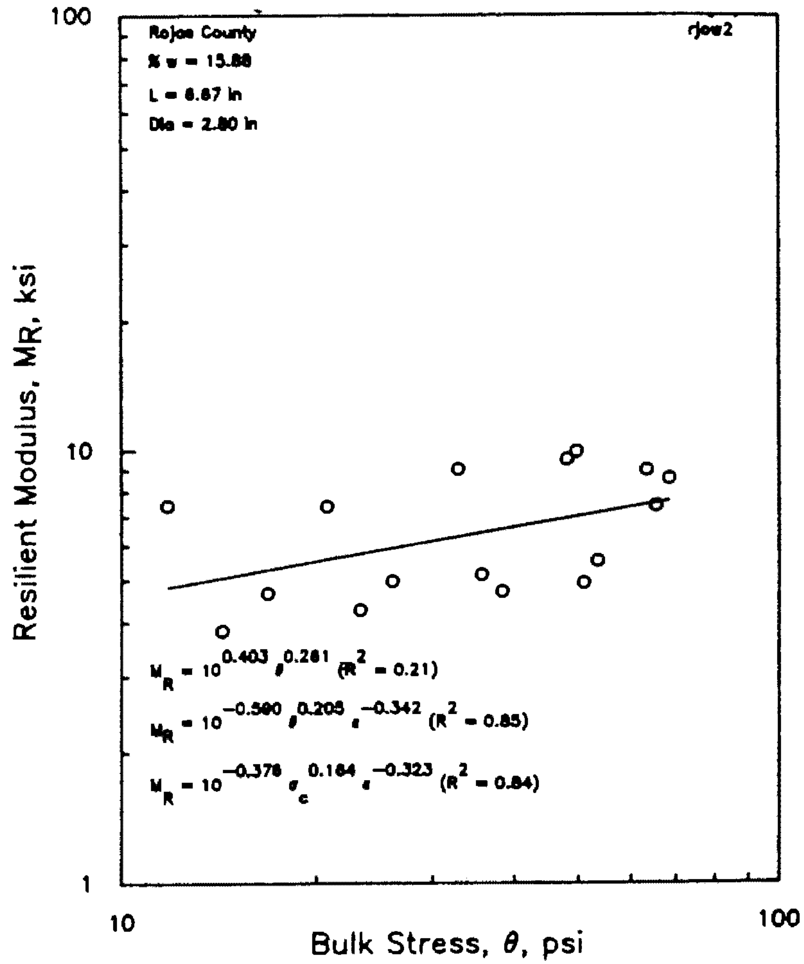

Fig. G.18 - Variation in Resilient Modulus with Bulk Stress for El Paso County Specimen at Two Percent Wet of Optimum Water Content following UTEP Procedure (Specimen 2)