PARADISE

Ponded Fly Ash (East Cell)
Boiler Slag (Reed Rejects)
Scrubber Gypsum

PARADISE

Ponded Fly Ash (East Cell)

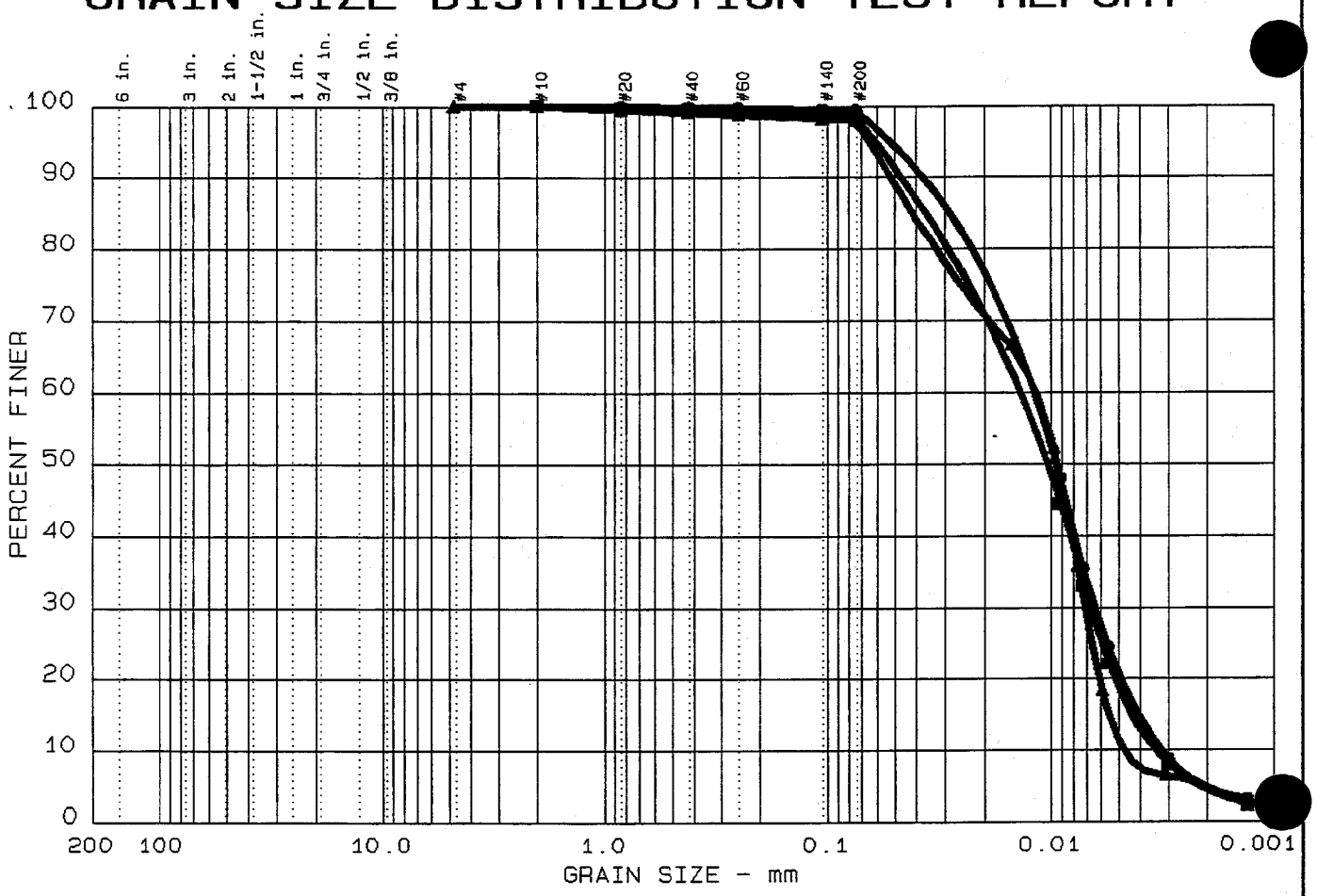
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

TVA - PARADISE
PONDED FLY ASH (EAST CELL)

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve Percent Passing the 0.005 mm Sieve	0.0 99.4 20.9	0.0 98.1 11.4	0.0 98.5 18.7
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C	2.82	2.77	2.93
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	ML A-4(0.0)	ML A-4(0.0)	ML A-4(0.0)
				Composite Sample	
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %		110.0 16.5	
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %		114.4 13.7	
			Result	**Dry Density, pcf**	**Moisture Content, %**
Consolidation	ASTM D2435	Compression Index C_c	0.04	106.9	17.4
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	1.0E-5	104.3	17.0
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ', degrees	0.37 21.2	104.3	17.0
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	0.55 15.6	104.3	17.0
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	2.27 20.2	104.6	16.9
California Bearing Ratio	ASTM D 1883	CBR, %	4	106.7	16.9
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	9,071	104.1	16.7
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	9,421	107.0	14.2
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm		2,600	
pH of Soil	AASHTO T 289	pH		8.1	
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg		340	
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg		<10	

paf-fa.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	0.6	78.5	20.9
▲	4	0.0	0.0	1.9	86.7	11.4
■	5	0.0	0.0	1.5	79.8	18.7

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP			0.01	0.006	0.0041	0.0032	1.08	3.7
▲	NL	NP			0.01	0.007	0.0055	0.0047	0.91	2.5
■	NL	NP			0.01	0.007	0.0044	0.0034	0.96	4.1

MATERIAL DESCRIPTION	USCS	AASHTO
● East Cell	ML	A-4 (0.0)
▲ East Cell	ML	A-4 (0.0)
■ East Cell	ML	A-4 (0.0)

Project No.: 5810860101
Project: TVA - Paradise
● Location: Ponded Fly Ash A & B
▲ Location: Ponded Fly Ash C & D
■ Location: Ponded Fly Ash E & F
Date: July 18, 1995

Remarks:

Tested by: JCR

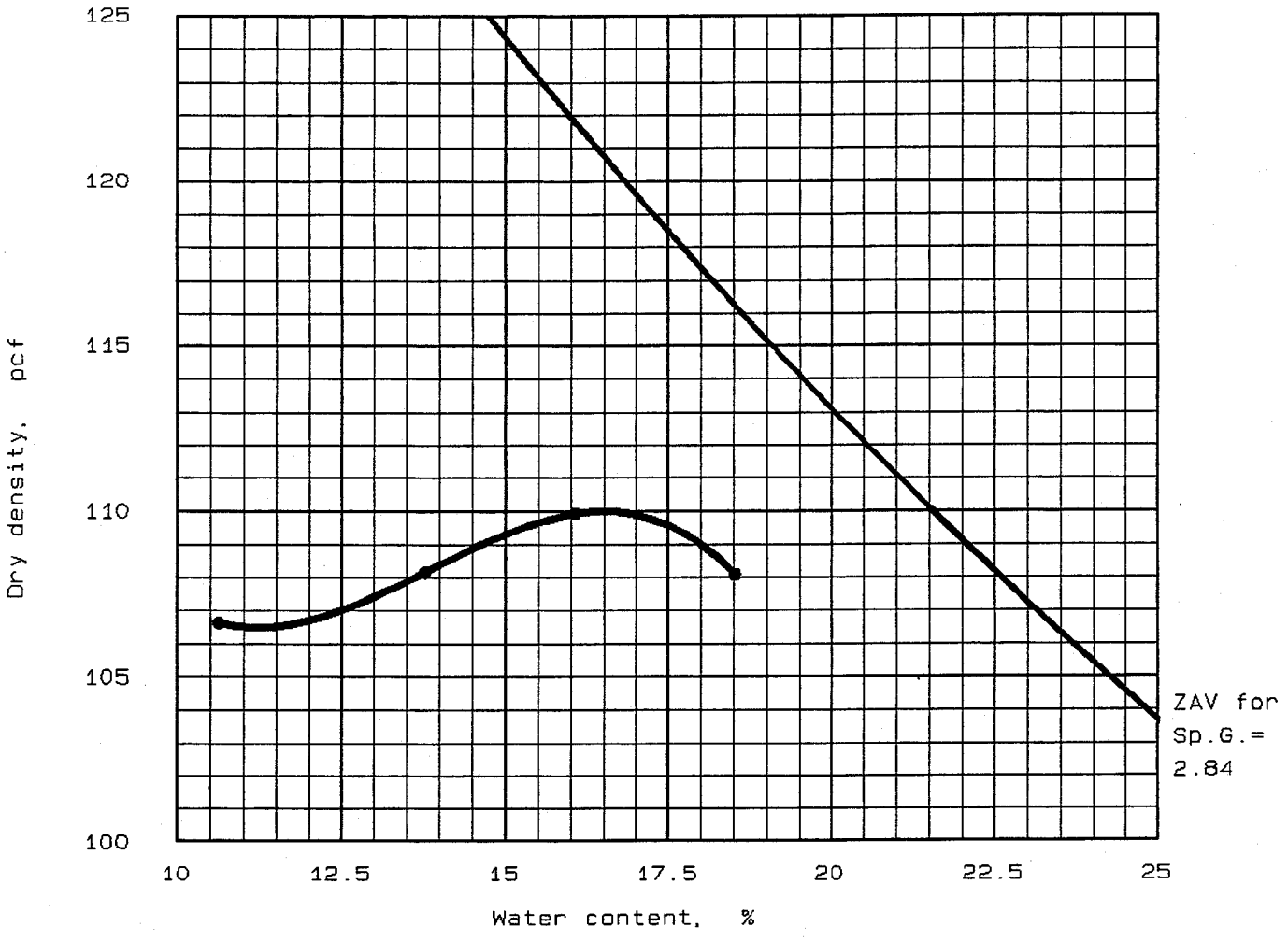
Reviewed by: HS

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

Figure No.

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML	A-4 (0.0)		2.84	NL	NP	0 %	98.7 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 16.5 % Maximum dry density = 110.0 pcf	

Project No.: 5810860101
Project: TVA - Paradise
Location: Ponded Fly Ash
East Cell
Date: July 25, 1995

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

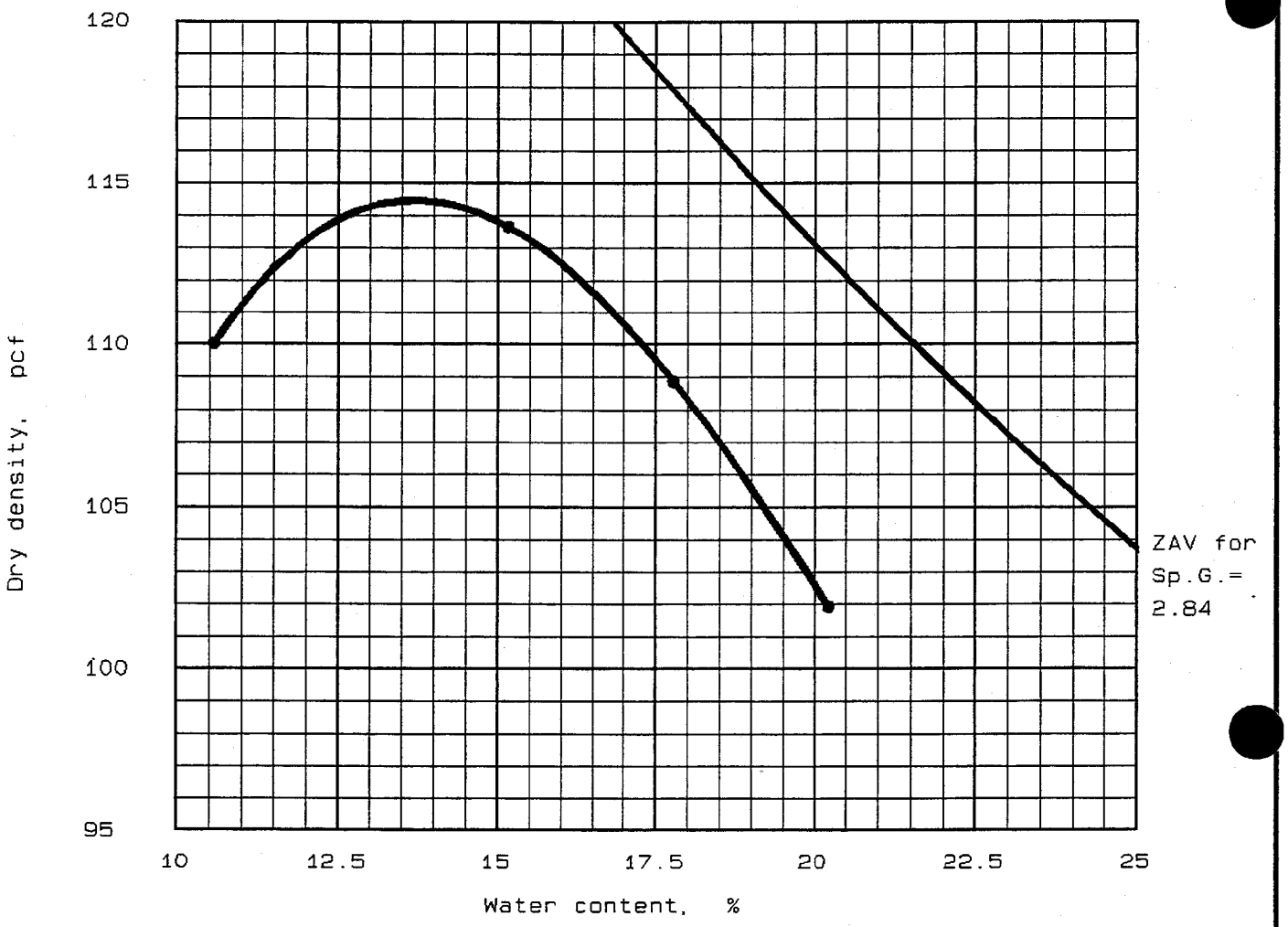
Remarks:

Tested by: JCN

Reviewed by: RWB

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	ML	A-4 (0.0)		2.84	NL	NP	0 %	98.7 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 13.7 % Maximum dry density = 114.4 pcf	

Project No.: 5810860101
Project: TVA - Paradise
Location: Ponded Fly Ash
East Cell
Date: July 25, 1995

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

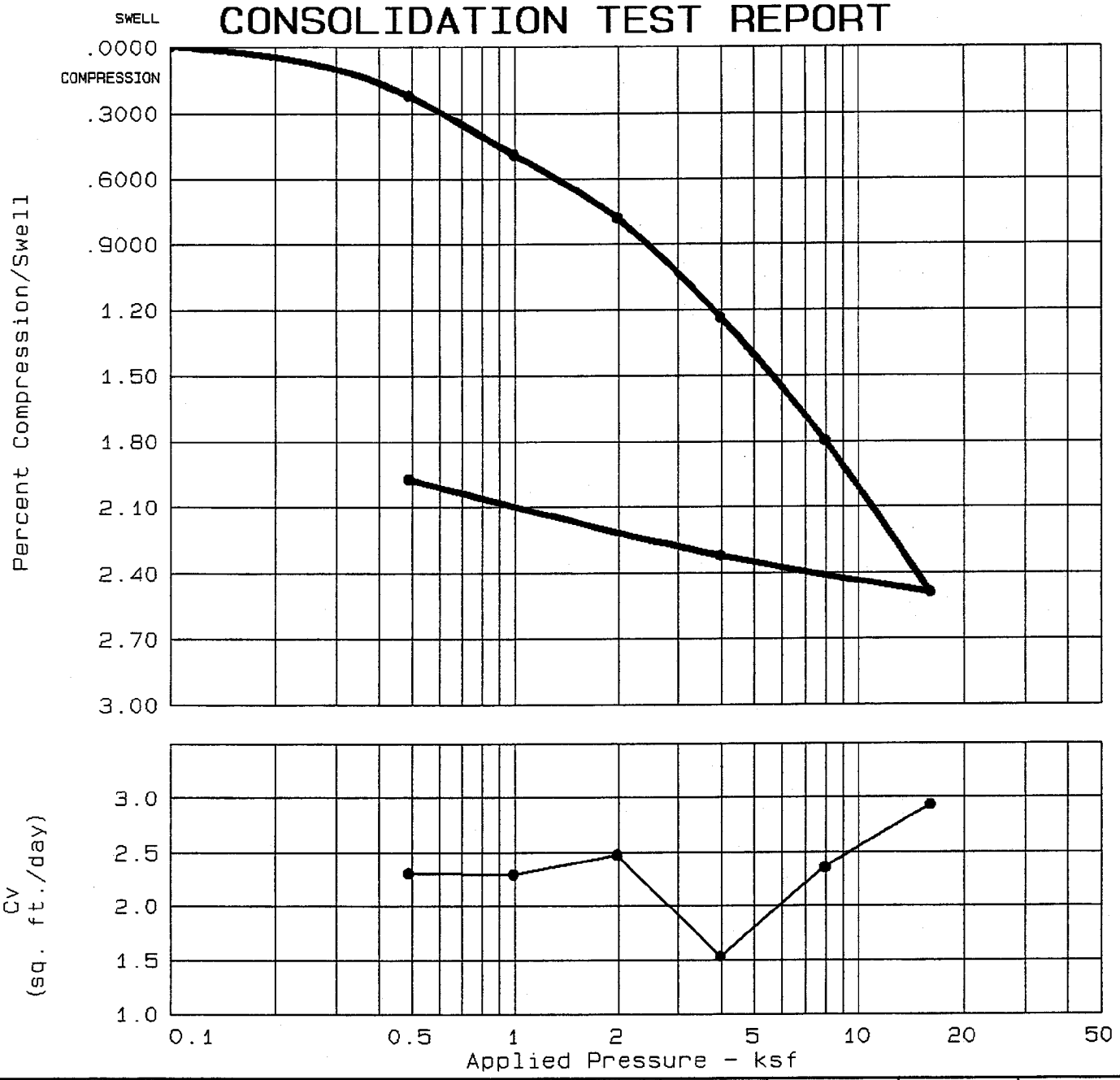
Remarks:

Tested by: JCA

Reviewed by: RLD

Figure No. _____

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Density	LL	PI	Sp. Gr.	Precons. press.	C_c	e_o
77.2 %	17.4	106.9	NL	NP	2.790	3.27	0.04	0.6275

TEST RESULTS

Compression Index = 0.04

MATERIAL DESCRIPTION

Class: USCS: ML

Project No.: 5810860101
Project: TVA - Paradise
Location: Ponded Fly Ash
East Cell
Date: July 11, 1995

Remarks:

Tested by: AGK
Reviewed by: TD

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No. _____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - Paradise*	Test Date	*07/15/95*
Material (Source)	*Ponded Fly Ash (East Cell)*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*17.0*
Wet Unit Weight, pcf:	*122.0*
Dry Unit Weight, pcf:	*104.3*
Compaction, %:	*94.8*
Hydraulic Conductivity, cm/sec. @20 °C:	***1.0E-05***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - Paradise	Test Date	07/15/95
Material (Source)	Ponded Fly Ash (East Cell)	Reviewed By	RLB
		Review Date	09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	6.000	Location 1	2.830	Dry Soil+Pan, grams	1033.26
Location 2	6.000	Location 2	2.830	Pan Weight, grams	0.00
Location3	6.000	Location 3	2.830		
Average	6.000	Average	2.830	Moisture Content, %	17.0
		Wet Soil + Tare, grams	1209.10	Wet Unit Wt, pcf	122.0
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	104.3

Chamber Pressure, psi	34
Back Pressure, psi	20
Confining Pressure, psi	14

Date Start	Date Finish	Time Start	Time Finish	Time (sec)	Division Start	Division Finish	H0 (cm)	Hf (cm)	k cm/sec	Temp (°C)	k cm/sec at 20 °C
				7800	0.0	25.0	127.36	102.36	1.1E-05	21	1.0E-05
				6075	0.0	20.0	127.36	107.36	1.1E-05	21	1.0E-05
				6016	0.0	20.0	127.36	107.36	1.1E-05	21	1.0E-05

No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	110.0	94.8	Vertical

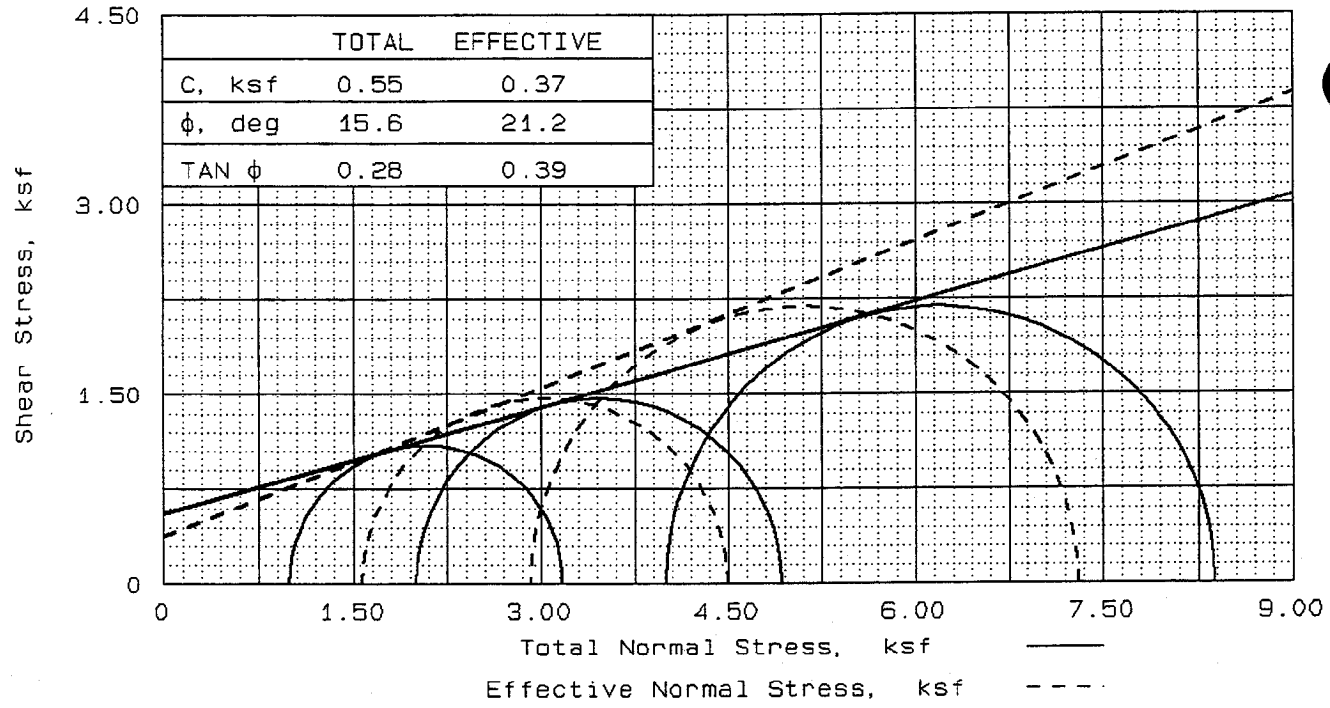
Avg. k at 20 °C 1.0E-05 cm/sec

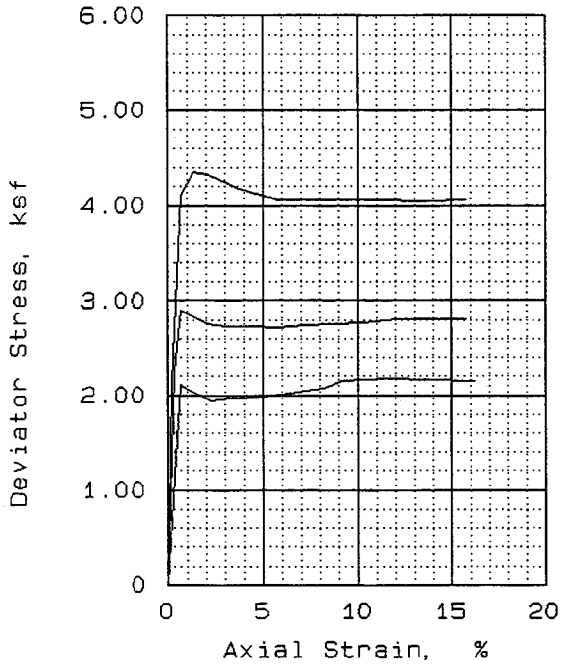
a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H0 = initial head in cm
Hf = final head in cm
t = time in seconds

a = 1.00 cm²
A = 40.582 cm²
L = 15.24 cm

TVA-00012298





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	17.0	17.0	16.9
	DRY DENSITY, pcf	104.3	104.3	104.4
	SATURATION, %	69.1	68.8	68.6
	VOID RATIO	0.700	0.700	0.699
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	24.3	24.1	23.8
	DRY DENSITY, pcf	104.9	105.2	105.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.691	0.685	0.675
	DIAMETER, in	2.83	2.82	2.81
	HEIGHT, in	5.97	5.97	5.99
BACK PRESSURE, ksf		3.60	2.91	3.56
CELL PRESSURE, ksf		5.60	6.91	4.55
FAILURE STRESS, ksf		2.93	4.38	2.18
PORE PRESSURE, ksf		4.03	3.99	3.56
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		4.50	7.30	3.18
$\bar{\sigma}_3$ FAILURE, ksf		1.57	2.92	0.99

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.84
REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

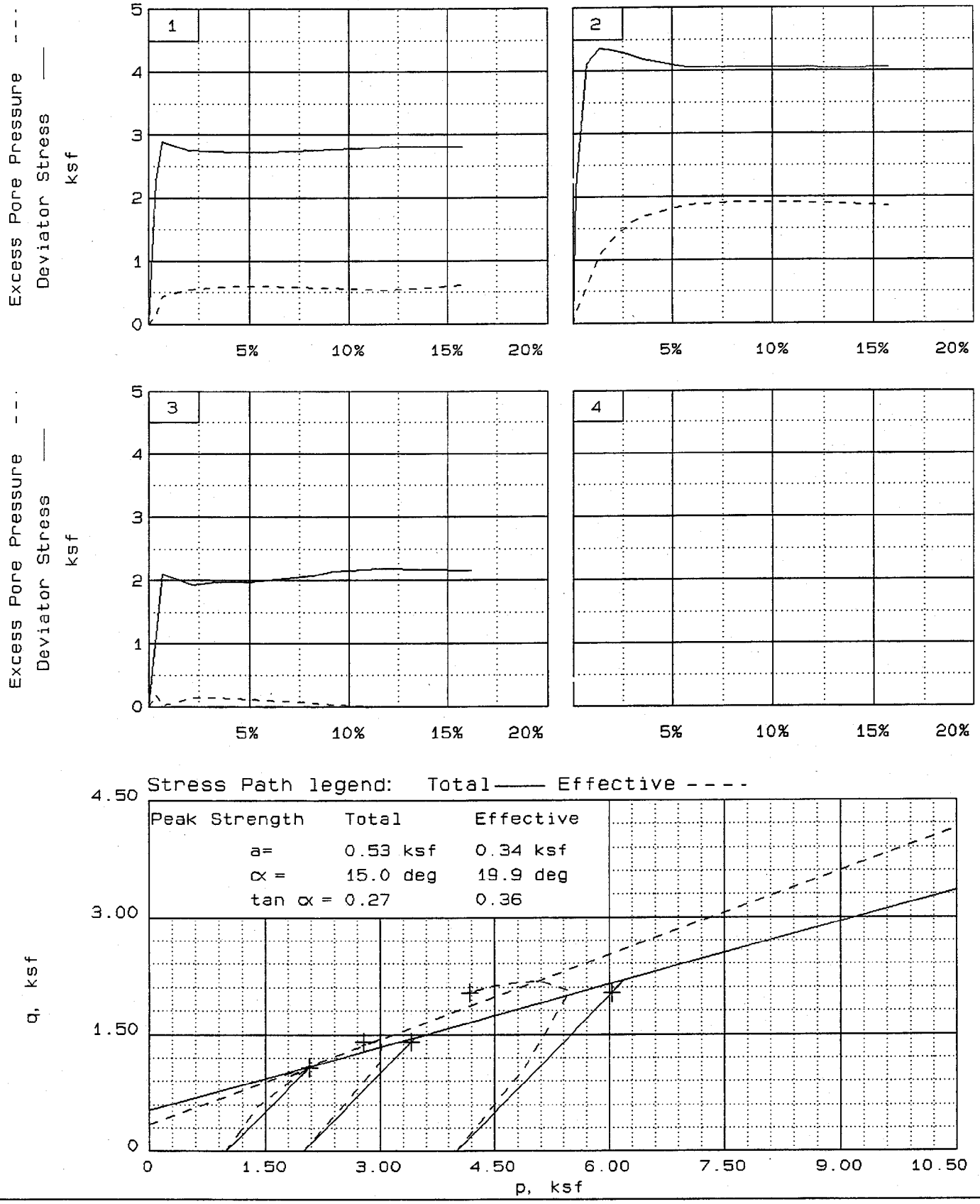
PROJECT: TVA - Paradise

SAMPLE LOCATION: Ponded Fly Ash
East Cell

PROJ. NO.: 5810860101 DATE: August 23, 1995

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.

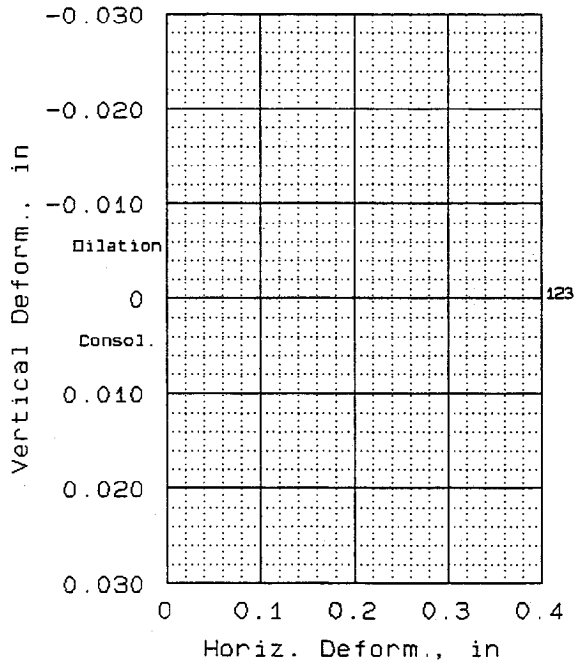


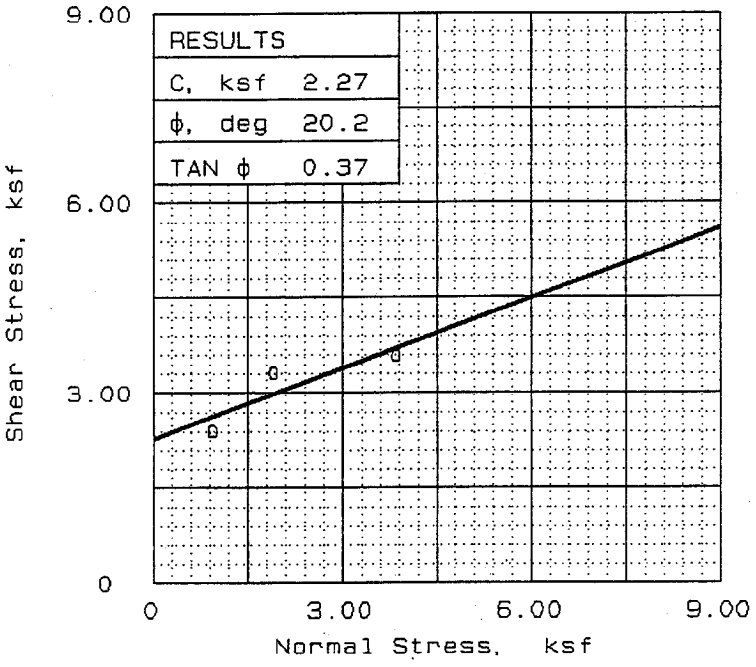
Client:

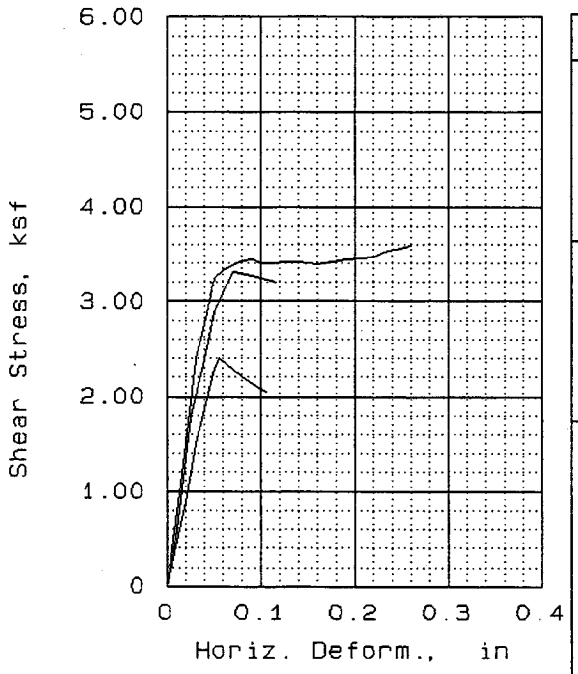
Project: TVA - Paradise

Location: Ponded Fly Ash East Cell

File: 8601I Project No.: 5810860101 Page 2/2 Fig. No. ____







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	16.7	17.1	17.0
	DRY DENSITY, pcf	104.2	105.0	104.5
	SATURATION, %	67.7	70.6	69.3
	VOID RATIO	0.702	0.689	0.697
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	16.7	17.1	17.0
	DRY DENSITY, pcf	104.2	105.0	104.5
	SATURATION, %	67.7	70.6	69.3
	VOID RATIO	0.702	0.689	0.697
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
NORMAL STRESS, ksf		0.97	1.94	3.88
MAX. SHEAR, ksf		2.40	3.32	3.58
STRAIN RATE, %/min.		0.500	0.500	0.500
ULT. SHEAR, ksf				

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION:

LL= NL PL= NP PI=

SPECIFIC GRAVITY= 2.84

REMARKS: Tested by: HJ

Reviewed by: RWB

FIG. NO.

CLIENT:

PROJECT: TVA - Paradise

SAMPLE LOCATION: Ponded Fly Ash
East Cell

PROJ. NO.: 5810860101 DATE: 9/5/95

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

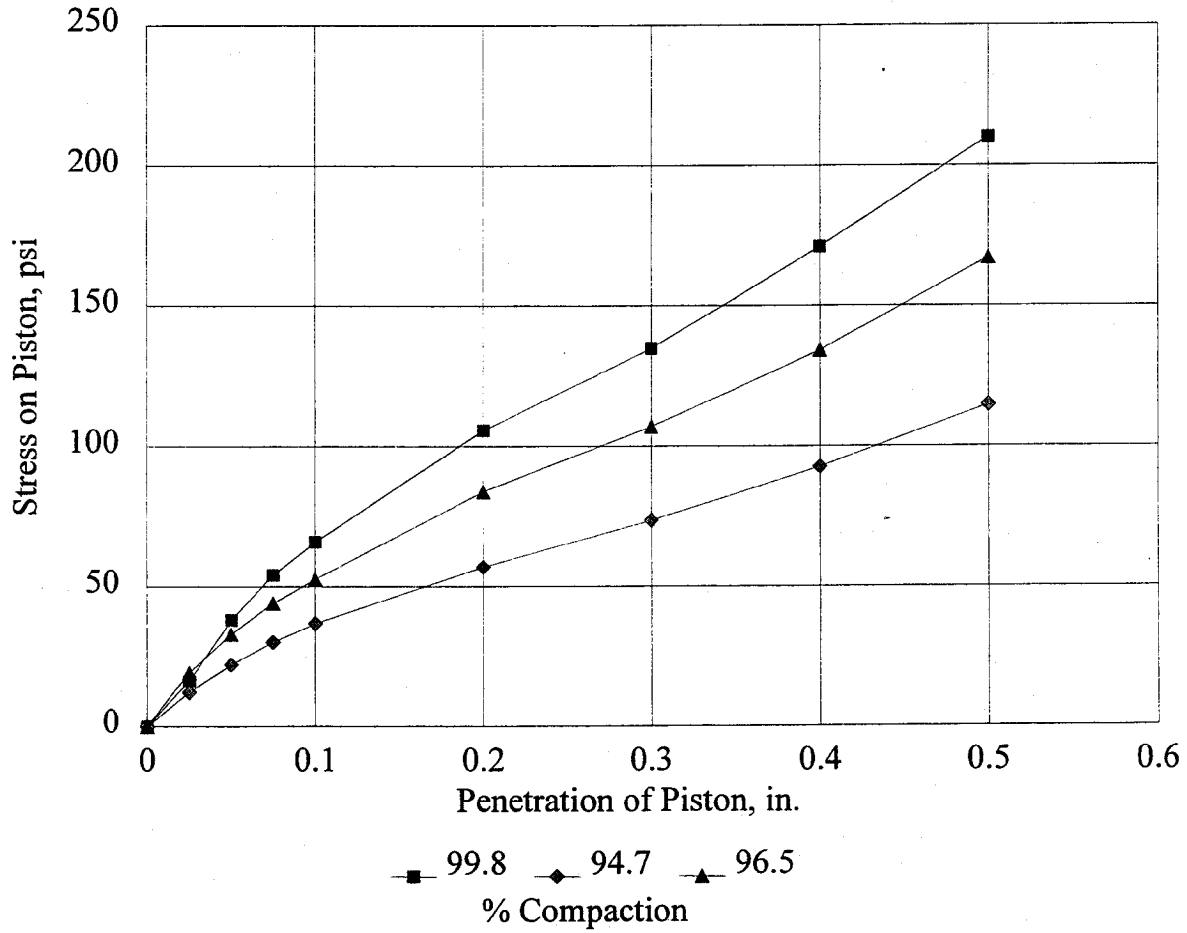
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Paradise	**Test Date**	08/07/95
Material (Source)	Ponded Fly Ash (East Cell)	**Reviewed By**	RLB
		Review Date	08/30/95

Compaction, %	99.8	94.7	96.5
Before Soak Dry Density, pcf	109.8	104.2	106.2
Before Soak Moisture Content,	16.6	17.2	17.0
After Soak Dry Density, pcf	106.7	101.7	103.4
After Soak Moisture Content, %	22.0	24.2	22.7
CBR @ 0.1 in.	6.6	3.7	5.3
CBR @ 0.2 in.	7.0	3.8	5.6



LABORATORY MATERIAL HANDLING AND TESTING SHEET NO 1 OF 2

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE
MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (East Cell)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO .:*	
	SPECIMEN DIAM., inch	
	TOP	2.85
	MIDDLE	2.85
	BOTTOM	2.85
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.03
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.03
	INITIAL AREA, A_0 , in^2	6.29
	INITIAL VOLUME $A_0 L_0$, in^3	37.89
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1209.50
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED , grams	1209.50
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	16.5
	MAX. DRY DENSITY, pcf	110.0
	95 % MAX. DRY DENSITY, pcf	104.5
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	16.7
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	16.7
	COMPACTION DRY DENSITY, γ_d pcf	104.1
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	33.9
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-14-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

K S Bandhu 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Paradise
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (East Cell)
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-14-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ ._	_ _ _ ._	_	_ _ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ _ ._	_ _ ._	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _ _	_ ._ _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	1	12.7	11.4	1.3	2.0	1.8	0.2	0.00083	0.00094	0.00088	0.00015	12,394
			2	12.7	11.4	1.3	2.0	1.8	0.2	0.00087	0.00098	0.00092	0.00015	11,874
			3	12.7	11.5	1.2	2.0	1.8	0.2	0.00086	0.00097	0.00091	0.00015	12,056
			4	12.7	11.4	1.3	2.0	1.8	0.2	0.00084	0.00094	0.00089	0.00015	12,263
			5	12.7	11.4	1.3	2.0	1.8	0.2	0.00083	0.00094	0.00089	0.00015	12,340
	COLUMN AVERAGE			12.7	11.4	1.3	2.0	1.8	0.2	0.00084	0.00095	0.00090	0.00015	12,185
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	216

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.2	22.8	2.5	4.0	3.6	0.4	0.00170	0.00176	0.00173	0.00029	12,630
			2	25.2	22.7	2.5	4.0	3.6	0.4	0.00171	0.00175	0.00173	0.00029	12,599
			3	25.2	22.7	2.5	4.0	3.6	0.4	0.00171	0.00173	0.00172	0.00029	12,665
			4	25.2	22.7	2.5	4.0	3.6	0.4	0.00170	0.00175	0.00172	0.00029	12,612
			5	25.2	22.7	2.5	4.0	3.6	0.4	0.00170	0.00174	0.00172	0.00028	12,697
	COLUMN AVERAGE			25.2	22.7	2.5	4.0	3.6	0.4	0.00170	0.00174	0.00172	0.00029	12,641
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	40
SEQUENCE 3	6.0	6.0	1	37.6	33.9	3.6	6.0	5.4	0.6	0.00278	0.00276	0.00277	0.00046	11,745
			2	37.6	34.0	3.6	6.0	5.4	0.6	0.00279	0.00276	0.00277	0.00046	11,749
			3	37.6	34.0	3.7	6.0	5.4	0.6	0.00281	0.00276	0.00278	0.00046	11,704
			4	37.6	33.9	3.7	6.0	5.4	0.6	0.00278	0.00275	0.00277	0.00046	11,760
			5	37.5	33.9	3.7	6.0	5.4	0.6	0.00278	0.00275	0.00276	0.00046	11,745
	COLUMN AVERAGE			37.6	33.9	3.6	6.0	5.4	0.6	0.00279	0.00275	0.00277	0.00046	11,740
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	21
SEQUENCE 4	6.0	8.0	1	50.1	45.2	4.9	8.0	7.2	0.8	0.00406	0.00399	0.00403	0.00067	10,773
			2	50.1	45.2	4.9	8.0	7.2	0.8	0.00408	0.00400	0.00404	0.00067	10,739
			3	50.1	45.3	4.9	8.0	7.2	0.8	0.00409	0.00399	0.00404	0.00067	10,747
			4	50.1	45.2	4.9	8.0	7.2	0.8	0.00406	0.00399	0.00402	0.00067	10,770
			5	50.0	45.1	4.9	8.0	7.2	0.8	0.00408	0.00397	0.00403	0.00067	10,749
	COLUMN AVERAGE			50.1	45.2	4.9	8.0	7.2	0.8	0.00408	0.00399	0.00403	0.00067	10,756
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	15

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.1	56.9	6.2	10.0	9.0	1.0	0.00542	0.00531	0.00537	0.00089	10,160
			2	63.1	56.9	6.2	10.0	9.0	1.0	0.00543	0.00532	0.00537	0.00089	10,151
			3	63.1	56.8	6.2	10.0	9.0	1.0	0.00543	0.00532	0.00537	0.00089	10,141
			4	63.0	56.8	6.2	10.0	9.0	1.0	0.00542	0.00530	0.00536	0.00089	10,158
			5	63.0	56.8	6.2	10.0	9.0	1.0	0.00543	0.00531	0.00537	0.00089	10,140
	COLUMN AVERAGE			63.1	56.8	6.2	10.0	9.0	1.0	0.00543	0.00531	0.00537	0.00089	10,150
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	9
SEQUENCE 6	4.0	2.0	1	13.1	11.4	1.8	2.1	1.8	0.3	0.00094	0.00108	0.00101	0.00017	10,795
			2	13.1	11.3	1.8	2.1	1.8	0.3	0.00096	0.00109	0.00102	0.00017	10,607
			3	13.1	11.3	1.8	2.1	1.8	0.3	0.00098	0.00109	0.00103	0.00017	10,536
			4	13.2	11.4	1.8	2.1	1.8	0.3	0.00099	0.00110	0.00105	0.00017	10,413
			5	13.1	11.3	1.8	2.1	1.8	0.3	0.00099	0.00112	0.00106	0.00018	10,293
	COLUMN AVERAGE			13.1	11.3	1.8	2.1	1.8	0.3	0.00097	0.00110	0.00103	0.00017	10,529
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	191
SEQUENCE 7	4.0	4.0	1	25.1	22.8	2.4	4.0	3.6	0.4	0.00224	0.00231	0.00228	0.00038	9,595
			2	25.1	22.8	2.4	4.0	3.6	0.4	0.00224	0.00231	0.00227	0.00038	9,617
			3	25.0	22.7	2.4	4.0	3.6	0.4	0.00221	0.00229	0.00225	0.00037	9,660
			4	25.1	22.6	2.4	4.0	3.6	0.4	0.00225	0.00230	0.00227	0.00038	9,550
			5	25.1	22.7	2.4	4.0	3.6	0.4	0.00224	0.00231	0.00227	0.00038	9,575
	COLUMN AVERAGE			25.1	22.7	2.4	4.0	3.6	0.4	0.00223	0.00230	0.00227	0.00038	9,599
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	42

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	37.4	33.7	3.6	5.9	5.4	0.6	0.00362	0.00362	0.00362	0.00060	8,931
			2	37.7	34.2	3.5	6.0	5.4	0.6	0.00367	0.00363	0.00365	0.00061	8,987
			3	37.6	34.1	3.5	6.0	5.4	0.6	0.00365	0.00362	0.00363	0.00060	9,014
			4	37.7	34.1	3.7	6.0	5.4	0.6	0.00365	0.00364	0.00365	0.00060	8,957
			5	37.3	33.7	3.7	5.9	5.4	0.6	0.00361	0.00358	0.00360	0.00060	8,980
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.00364	0.00362	0.00363	0.00060	8,974
	STANDARD DEV.			0.2	0.2	0.1	0.0	0.0	0.0	0.00003	0.00002	0.00002	0.00000	31
SEQUENCE 9	4.0	8.0	1	49.8	45.4	4.3	7.9	7.2	0.7	0.00493	0.00489	0.00491	0.00081	8,866
			2	49.9	45.6	4.3	7.9	7.2	0.7	0.00495	0.00491	0.00493	0.00082	8,865
			3	49.9	45.5	4.3	7.9	7.2	0.7	0.00494	0.00489	0.00491	0.00081	8,893
			4	49.9	45.6	4.3	7.9	7.3	0.7	0.00493	0.00487	0.00490	0.00081	8,913
			5	49.8	45.5	4.3	7.9	7.2	0.7	0.00492	0.00487	0.00490	0.00081	8,916
	COLUMN AVERAGE			49.8	45.5	4.3	7.9	7.2	0.7	0.00494	0.00489	0.00491	0.00081	8,891
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	25
SEQUENCE 10	4.0	10.0	1	63.2	57.2	6.0	10.1	9.1	1.0	0.00610	0.00600	0.00605	0.00100	9,059
			2	63.2	57.2	6.0	10.1	9.1	1.0	0.00609	0.00600	0.00604	0.00100	9,077
			3	63.2	57.1	6.0	10.1	9.1	1.0	0.00609	0.00600	0.00605	0.00100	9,062
			4	63.3	57.2	6.0	10.1	9.1	1.0	0.00610	0.00602	0.00606	0.00101	9,052
			5	63.2	57.2	6.0	10.1	9.1	1.0	0.00609	0.00600	0.00604	0.00100	9,071
	COLUMN AVERAGE			63.2	57.2	6.0	10.1	9.1	1.0	0.00609	0.00601	0.00605	0.00100	9,064
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	10

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.3	11.2	2.1	2.1	1.8	0.3	0.00113	0.00131	0.00122	0.00020	8,856
			2	13.4	11.3	2.1	2.1	1.8	0.3	0.00114	0.00132	0.00123	0.00020	8,787
			3	13.4	11.3	2.1	2.1	1.8	0.3	0.00113	0.00131	0.00122	0.00020	8,895
			4	13.3	11.2	2.1	2.1	1.8	0.3	0.00112	0.00130	0.00121	0.00020	8,921
			5	13.3	11.3	2.1	2.1	1.8	0.3	0.00112	0.00130	0.00121	0.00020	8,890
	COLUMN AVERAGE			13.3	11.3	2.1	2.1	1.8	0.3	0.00113	0.00131	0.00122	0.00020	8,870
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	52
SEQUENCE 12	2.0	4.0	1	25.0	22.6	2.4	4.0	3.6	0.4	0.00265	0.00277	0.00271	0.00045	8,006
			2	25.0	22.6	2.4	4.0	3.6	0.4	0.00261	0.00276	0.00269	0.00045	8,050
			3	24.9	22.5	2.4	4.0	3.6	0.4	0.00262	0.00276	0.00269	0.00045	8,021
			4	25.0	22.6	2.4	4.0	3.6	0.4	0.00260	0.00275	0.00268	0.00044	8,090
			5	25.0	22.6	2.4	4.0	3.6	0.4	0.00264	0.00277	0.00270	0.00045	8,000
	COLUMN AVERAGE			25.0	22.6	2.4	4.0	3.6	0.4	0.00262	0.00276	0.00269	0.00045	8,033
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	37
SEQUENCE 13	2.0	6.0	1	37.8	34.2	3.6	6.0	5.4	0.6	0.00426	0.00430	0.00428	0.00071	7,660
			2	37.8	34.2	3.6	6.0	5.4	0.6	0.00426	0.00431	0.00428	0.00071	7,671
			3	37.9	34.3	3.6	6.0	5.5	0.6	0.00427	0.00432	0.00429	0.00071	7,664
			4	37.9	34.3	3.6	6.0	5.5	0.6	0.00424	0.00429	0.00427	0.00071	7,700
			5	37.9	34.3	3.6	6.0	5.5	0.6	0.00427	0.00430	0.00428	0.00071	7,681
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.5	0.6	0.00426	0.00430	0.00428	0.00071	7,675
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.5	45.6	4.9	8.0	7.3	0.8	0.00562	0.00563	0.00563	0.00093	7,776
			2	50.4	45.5	4.9	8.0	7.2	0.8	0.00560	0.00559	0.00560	0.00093	7,802
			3	50.5	45.6	4.9	8.0	7.3	0.8	0.00564	0.00564	0.00564	0.00094	7,760
			4	50.5	45.6	4.9	8.0	7.2	0.8	0.00564	0.00562	0.00563	0.00093	7,766
			5	50.5	45.5	4.9	8.0	7.2	0.8	0.00559	0.00559	0.00559	0.00093	7,810
	COLUMN AVERAGE			50.5	45.6	4.9	8.0	7.2	0.8	0.00562	0.00561	0.00562	0.00093	7,783
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	22
SEQUENCE 15	2.0	10.0	1	63.4	57.3	6.1	10.1	9.1	1.0	0.00682	0.00678	0.00680	0.00113	8,073
			2	63.5	57.3	6.2	10.1	9.1	1.0	0.00683	0.00676	0.00679	0.00113	8,089
			3	63.4	57.3	6.2	10.1	9.1	1.0	0.00684	0.00674	0.00679	0.00113	8,084
			4	63.5	57.3	6.1	10.1	9.1	1.0	0.00684	0.00678	0.00681	0.00113	8,072
			5	63.4	57.2	6.2	10.1	9.1	1.0	0.00680	0.00674	0.00677	0.00112	8,100
	COLUMN AVERAGE			63.4	57.3	6.2	10.1	9.1	1.0	0.00683	0.00676	0.00679	0.00113	8,084
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00001	0.00000	12

SUBMITTED BY, DATE

R S Bordnum 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (East Cell)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995

$$M_R = K1\ (S_C)^{K2}\ (1+S_3)^{K5}$$

K1 =	5,929
K2 =	-0.09595
K5 =	0.40269
R^2 =	0.91

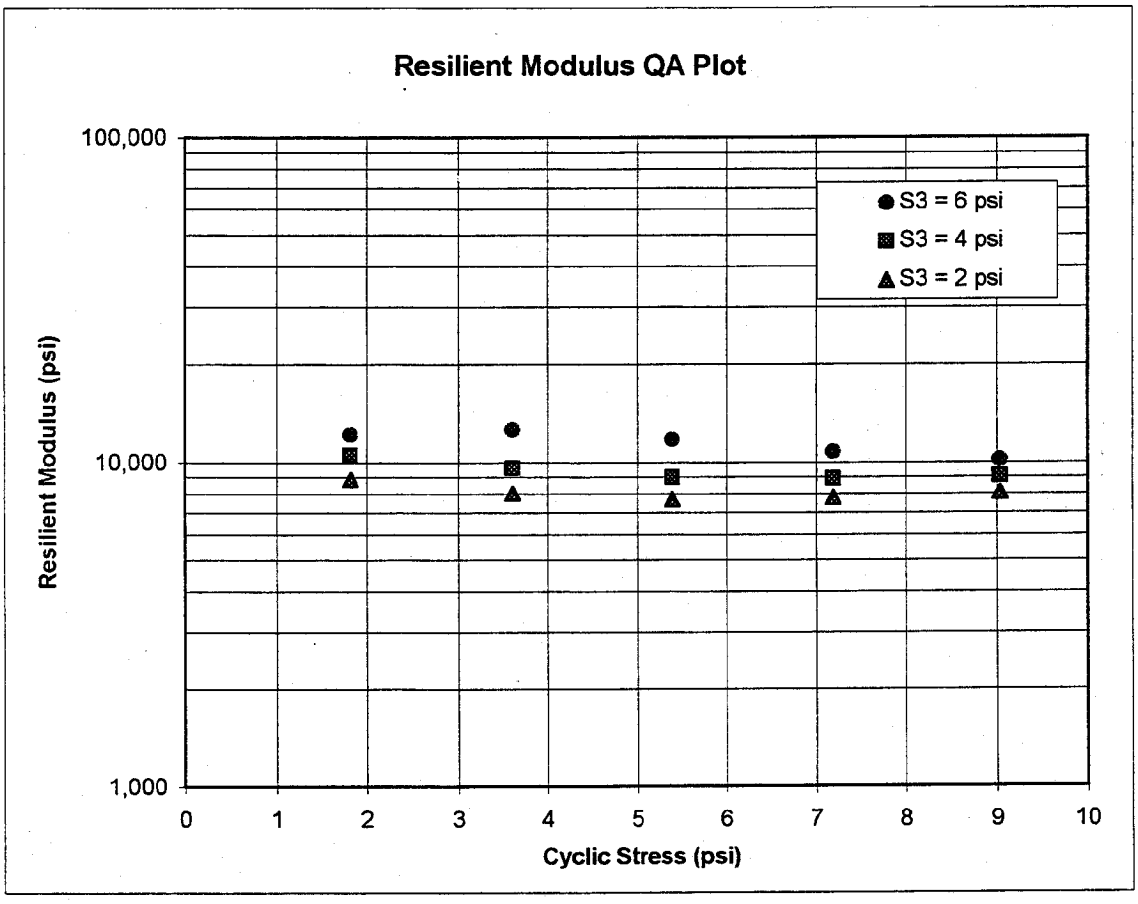
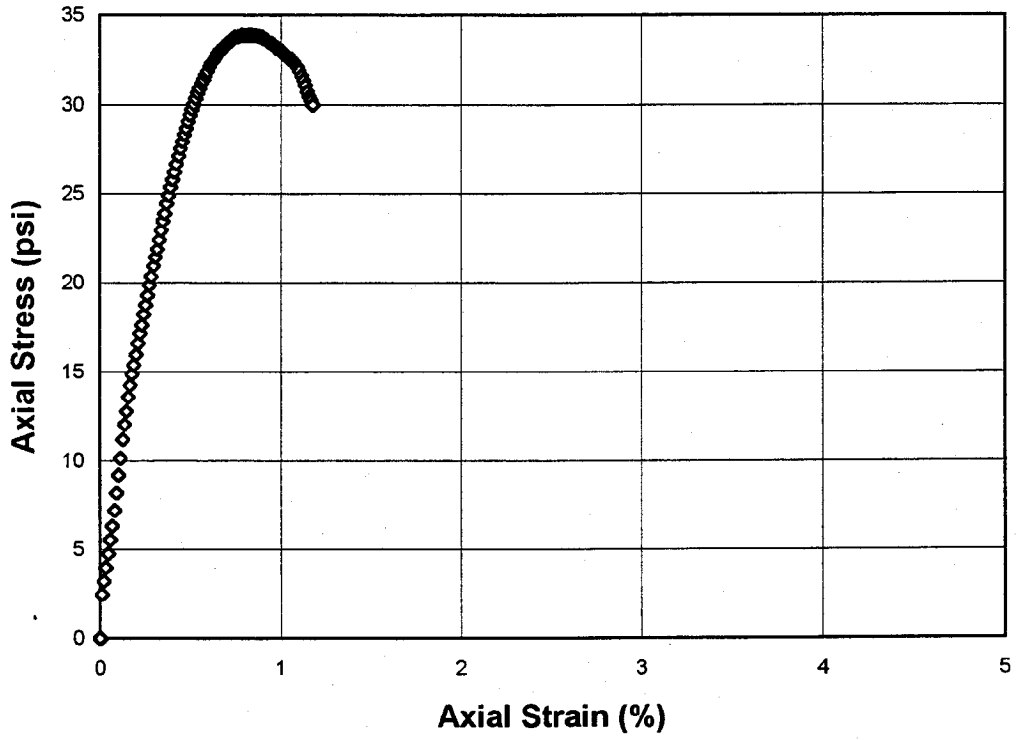


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (East Cell)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: LAW ENGINEERING, INC. - ATLANTA, GEORGIA

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (East Cell)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO .:*	
	SPECIMEN DIAM., inch	
	TOP	2.86
	MIDDLE	2.86
	BOTTOM	2.86
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.05
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.05
	INITIAL AREA, A_0 , in^2	6.30
	INITIAL VOLUME $A_0 L_0$, in^3	38.12
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1223.91
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED , grams	1223.91
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	13.7
	MAX. DRY DENSITY, pcf	114.4
	95 % MAX. DRY DENSITY, pcf	108.7
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	14.2
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	14.2
	COMPACTION DRY DENSITY, γ_d pcf	107.0
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	46.5
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-14-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

R S Bleuchen 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Paradise
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (East Cell)
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-14-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ . _	_ _ _ . _	_	_ _ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ . _	_ . _ _ _ _	_ . _ _ _ _	_ . _ _ _ _	_ . _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	1	12.8	11.5	1.3	2.0	1.8	0.2	0.00093	0.00078	0.00086	0.00014	12,896
			2	12.8	11.5	1.3	2.0	1.8	0.2	0.00091	0.00079	0.00085	0.00014	12,920
			3	12.8	11.5	1.3	2.0	1.8	0.2	0.00092	0.00079	0.00086	0.00014	12,865
			4	12.7	11.4	1.3	2.0	1.8	0.2	0.00092	0.00077	0.00085	0.00014	12,949
			5	12.7	11.4	1.3	2.0	1.8	0.2	0.00093	0.00079	0.00086	0.00014	12,811
	COLUMN AVERAGE			12.8	11.5	1.3	2.0	1.8	0.2	0.00092	0.00078	0.00085	0.00014	12,888
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	53

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.2	22.8	2.4	4.0	3.6	0.4	0.00172	0.00157	0.00164	0.00027	13,313
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00172	0.00156	0.00164	0.00027	13,354
			3	25.2	22.8	2.4	4.0	3.6	0.4	0.00172	0.00158	0.00165	0.00027	13,262
			4	25.3	22.9	2.4	4.0	3.6	0.4	0.00173	0.00156	0.00165	0.00027	13,307
			5	25.2	22.8	2.4	4.0	3.6	0.4	0.00171	0.00156	0.00164	0.00027	13,379
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00172	0.00157	0.00164	0.00027	13,323
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	45
SEQUENCE 3	6.0	6.0	1	37.5	34.3	3.2	6.0	5.4	0.5	0.00274	0.00258	0.00266	0.00044	12,378
			2	37.3	34.1	3.2	5.9	5.4	0.5	0.00273	0.00255	0.00264	0.00044	12,382
			3	37.4	34.2	3.2	5.9	5.4	0.5	0.00274	0.00257	0.00265	0.00044	12,365
			4	37.8	34.6	3.2	6.0	5.5	0.5	0.00277	0.00258	0.00267	0.00044	12,398
			5	37.6	34.4	3.2	6.0	5.5	0.5	0.00274	0.00258	0.00266	0.00044	12,419
	COLUMN AVERAGE			37.5	34.3	3.2	6.0	5.4	0.5	0.00275	0.00257	0.00266	0.00044	12,388
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	21
SEQUENCE 4	6.0	8.0	1	50.2	45.6	4.7	8.0	7.2	0.7	0.00383	0.00368	0.00375	0.00062	11,640
			2	50.2	45.5	4.7	8.0	7.2	0.7	0.00384	0.00368	0.00376	0.00062	11,601
			3	50.0	45.3	4.6	7.9	7.2	0.7	0.00383	0.00368	0.00376	0.00062	11,563
			4	50.1	45.4	4.7	7.9	7.2	0.7	0.00384	0.00368	0.00376	0.00062	11,594
			5	50.2	45.5	4.7	8.0	7.2	0.7	0.00384	0.00368	0.00376	0.00062	11,607
	COLUMN AVERAGE			50.1	45.5	4.7	8.0	7.2	0.7	0.00384	0.00368	0.00376	0.00062	11,601
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	28

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.0	56.9	6.1	10.0	9.0	1.0	0.00497	0.00484	0.00491	0.00081	11,130
			2	63.0	56.9	6.1	10.0	9.0	1.0	0.00497	0.00484	0.00491	0.00081	11,117
			3	63.0	56.9	6.1	10.0	9.0	1.0	0.00500	0.00486	0.00493	0.00081	11,072
			4	62.9	56.9	6.1	10.0	9.0	1.0	0.00499	0.00484	0.00491	0.00081	11,104
			5	63.0	56.9	6.1	10.0	9.0	1.0	0.00497	0.00484	0.00491	0.00081	11,135
	COLUMN AVERAGE			63.0	56.9	6.1	10.0	9.0	1.0	0.00498	0.00484	0.00491	0.00081	11,111
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	25
SEQUENCE 6	4.0	2.0	1	13.3	11.6	1.7	2.1	1.8	0.3	0.00108	0.00098	0.00103	0.00017	10,812
			2	13.2	11.5	1.6	2.1	1.8	0.3	0.00108	0.00098	0.00103	0.00017	10,700
			3	13.2	11.6	1.7	2.1	1.8	0.3	0.00108	0.00098	0.00103	0.00017	10,728
			4	13.2	11.5	1.6	2.1	1.8	0.3	0.00110	0.00099	0.00104	0.00017	10,590
			5	13.2	11.6	1.6	2.1	1.8	0.3	0.00108	0.00098	0.00103	0.00017	10,769
	COLUMN AVERAGE			13.2	11.6	1.7	2.1	1.8	0.3	0.00109	0.00099	0.00104	0.00017	10,720
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	84
SEQUENCE 7	4.0	4.0	1	25.1	22.7	2.4	4.0	3.6	0.4	0.00230	0.00217	0.00223	0.00037	9,740
			2	25.1	22.8	2.4	4.0	3.6	0.4	0.00230	0.00217	0.00223	0.00037	9,782
			3	25.1	22.7	2.4	4.0	3.6	0.4	0.00231	0.00217	0.00224	0.00037	9,724
			4	25.0	22.7	2.4	4.0	3.6	0.4	0.00231	0.00218	0.00225	0.00037	9,677
			5	25.0	22.6	2.4	4.0	3.6	0.4	0.00230	0.00217	0.00223	0.00037	9,717
	COLUMN AVERAGE			25.1	22.7	2.4	4.0	3.6	0.4	0.00230	0.00217	0.00224	0.00037	9,728
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	38

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00354	0.00336	0.00345	0.00057	9,516
			2	37.9	34.2	3.6	6.0	5.4	0.6	0.00352	0.00336	0.00344	0.00057	9,531
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00356	0.00339	0.00347	0.00057	9,507
			4	37.9	34.3	3.7	6.0	5.4	0.6	0.00354	0.00338	0.00346	0.00057	9,498
			5	37.9	34.2	3.6	6.0	5.4	0.6	0.00355	0.00337	0.00346	0.00057	9,494
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.4	0.6	0.00354	0.00337	0.00346	0.00057	9,509
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	15
SEQUENCE 9	4.0	8.0	1	50.5	45.6	4.8	8.0	7.2	0.8	0.00461	0.00445	0.00453	0.00075	9,657
			2	50.4	45.5	4.9	8.0	7.2	0.8	0.00459	0.00444	0.00451	0.00075	9,670
			3	50.4	45.5	4.9	8.0	7.2	0.8	0.00459	0.00446	0.00453	0.00075	9,649
			4	50.5	45.6	4.8	8.0	7.2	0.8	0.00461	0.00447	0.00454	0.00075	9,639
			5	50.5	45.6	4.9	8.0	7.2	0.8	0.00461	0.00446	0.00454	0.00075	9,642
	COLUMN AVERAGE			50.4	45.6	4.9	8.0	7.2	0.8	0.00460	0.00446	0.00453	0.00075	9,652
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	13
SEQUENCE 10	4.0	10.0	1	63.1	56.9	6.2	10.0	9.0	1.0	0.00558	0.00544	0.00551	0.00091	9,908
			2	63.2	57.1	6.1	10.0	9.1	1.0	0.00558	0.00543	0.00550	0.00091	9,948
			3	63.1	56.9	6.2	10.0	9.0	1.0	0.00558	0.00545	0.00551	0.00091	9,908
			4	63.1	57.0	6.1	10.0	9.0	1.0	0.00559	0.00544	0.00551	0.00091	9,919
			5	63.3	57.1	6.2	10.0	9.1	1.0	0.00557	0.00544	0.00551	0.00091	9,946
	COLUMN AVERAGE			63.2	57.0	6.1	10.0	9.0	1.0	0.00558	0.00544	0.00551	0.00091	9,926
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	20

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.4	11.3	2.1	2.1	1.8	0.3	0.00126	0.00118	0.00122	0.00020	8,898
			2	13.4	11.3	2.1	2.1	1.8	0.3	0.00127	0.00117	0.00122	0.00020	8,853
			3	13.4	11.3	2.1	2.1	1.8	0.3	0.00126	0.00117	0.00121	0.00020	8,973
			4	13.4	11.3	2.1	2.1	1.8	0.3	0.00125	0.00116	0.00120	0.00020	8,995
			5	13.4	11.3	2.1	2.1	1.8	0.3	0.00126	0.00117	0.00121	0.00020	8,975
	COLUMN AVERAGE			13.4	11.3	2.1	2.1	1.8	0.3	0.00126	0.00117	0.00121	0.00020	8,939
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	61
SEQUENCE 12	2.0	4.0	1	25.5	23.1	2.4	4.0	3.7	0.4	0.00278	0.00267	0.00272	0.00045	8,141
			2	25.5	23.1	2.4	4.0	3.7	0.4	0.00279	0.00265	0.00272	0.00045	8,152
			3	25.5	23.1	2.4	4.0	3.7	0.4	0.00278	0.00266	0.00272	0.00045	8,156
			4	25.4	23.0	2.4	4.0	3.7	0.4	0.00278	0.00265	0.00272	0.00045	8,130
			5	25.3	22.9	2.4	4.0	3.6	0.4	0.00278	0.00266	0.00272	0.00045	8,084
	COLUMN AVERAGE			25.5	23.0	2.4	4.0	3.7	0.4	0.00278	0.00266	0.00272	0.00045	8,133
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	29
SEQUENCE 13	2.0	6.0	1	38.2	34.5	3.7	6.1	5.5	0.6	0.00427	0.00414	0.00421	0.00070	7,873
			2	38.1	34.4	3.7	6.0	5.5	0.6	0.00426	0.00413	0.00419	0.00069	7,874
			3	38.2	34.5	3.7	6.1	5.5	0.6	0.00427	0.00413	0.00420	0.00069	7,886
			4	38.3	34.6	3.6	6.1	5.5	0.6	0.00427	0.00414	0.00421	0.00070	7,894
			5	38.2	34.6	3.7	6.1	5.5	0.6	0.00427	0.00414	0.00421	0.00070	7,886
	COLUMN AVERAGE			38.2	34.5	3.7	6.1	5.5	0.6	0.00427	0.00414	0.00420	0.00069	7,883
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	9

Source: Paradise Description: Ponded Fly Ash (East Cell) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.4	45.5	4.9	8.0	7.2	0.8	0.00545	0.00529	0.00537	0.00089	8,124
			2	50.3	45.4	4.9	8.0	7.2	0.8	0.00545	0.00529	0.00537	0.00089	8,117
			3	50.4	45.5	4.9	8.0	7.2	0.8	0.00545	0.00531	0.00538	0.00089	8,112
			4	50.5	45.5	4.9	8.0	7.2	0.8	0.00545	0.00529	0.00537	0.00089	8,135
			5	50.4	45.5	4.9	8.0	7.2	0.8	0.00545	0.00532	0.00538	0.00089	8,105
	COLUMN AVERAGE			50.4	45.5	4.9	8.0	7.2	0.8	0.00545	0.00530	0.00537	0.00089	8,119
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	12
SEQUENCE 15	2.0	10.0	1	63.3	57.1	6.2	10.0	9.1	1.0	0.00640	0.00626	0.00633	0.00105	8,654
			2	63.4	57.3	6.2	10.1	9.1	1.0	0.00641	0.00626	0.00633	0.00105	8,672
			3	63.3	57.1	6.2	10.0	9.1	1.0	0.00640	0.00628	0.00634	0.00105	8,646
			4	63.3	57.2	6.2	10.0	9.1	1.0	0.00640	0.00627	0.00633	0.00105	8,659
			5	63.3	57.1	6.1	10.0	9.1	1.0	0.00639	0.00627	0.00633	0.00105	8,662
	COLUMN AVERAGE			63.3	57.2	6.2	10.0	9.1	1.0	0.00640	0.00627	0.00633	0.00105	8,659
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	10

SUBMITTED BY, DATE

R S Bandhan 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:	TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:	5810860101
1. *MATERIAL SOURCE:*	Paradise
2. *MATERIAL DESCRIPTION:*	Ponded Fly Ash (East Cell)
3. *REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE*	2
5. *TEST DATE*	08-14-1995

$$M_R = K1\ (S_C)^{K2}\ (1+S_3)^{K5}$$

K1 =	5,551
K2 =	-0.06155
K5 =	0.44309
R^2 =	0.91

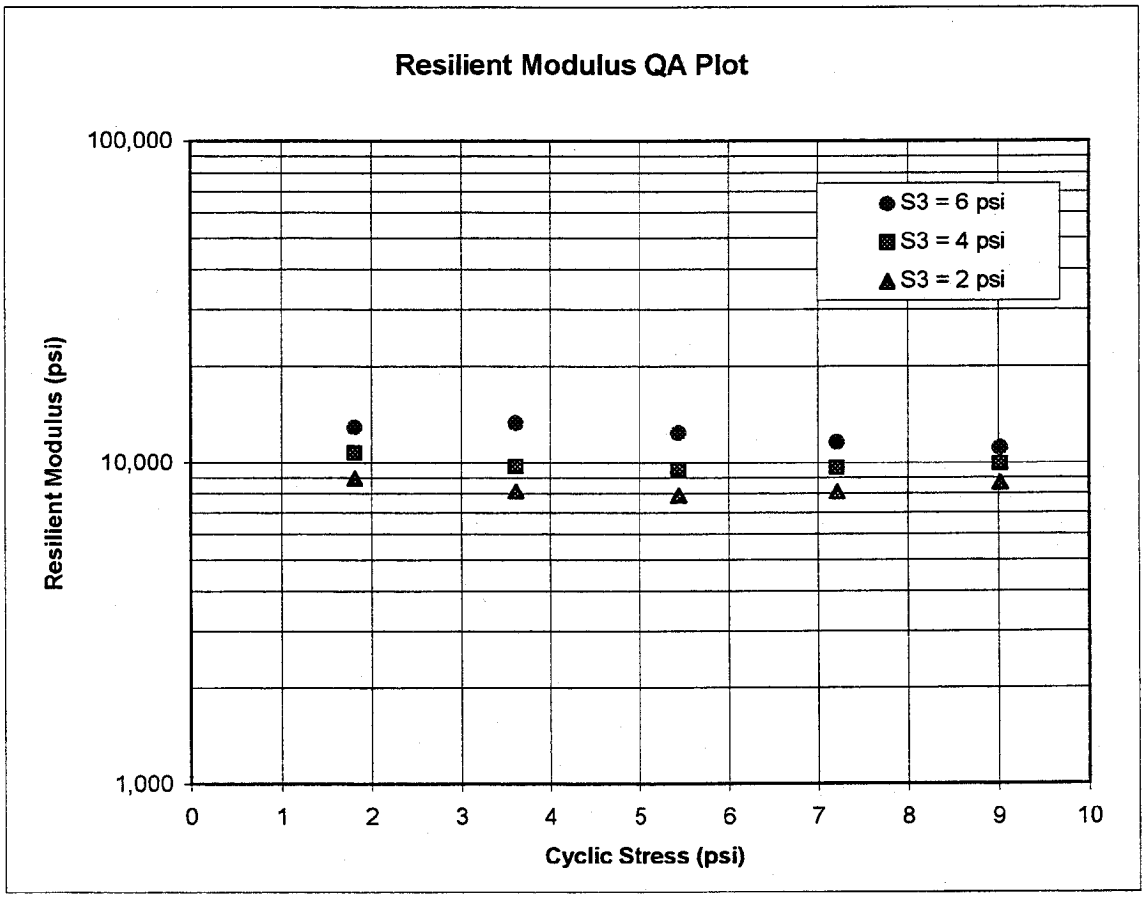
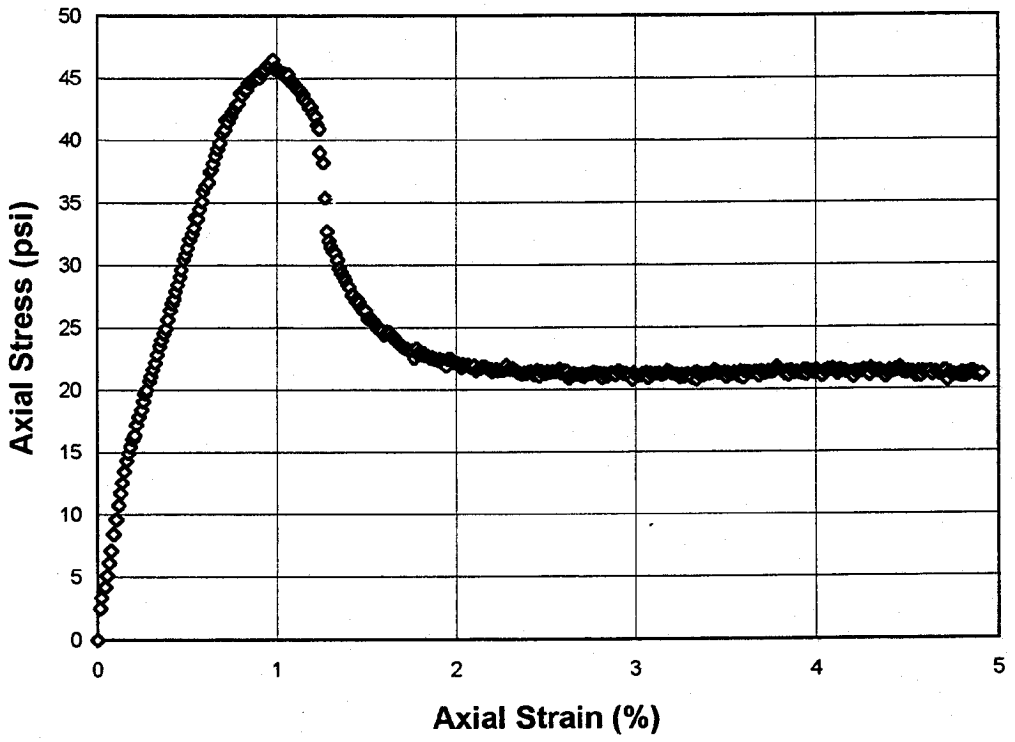


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (East Cell)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995



PARADISE

Boiler Slag (Reed Rejects)

Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test (**Not Performed**)
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test (**Not Performed**)
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

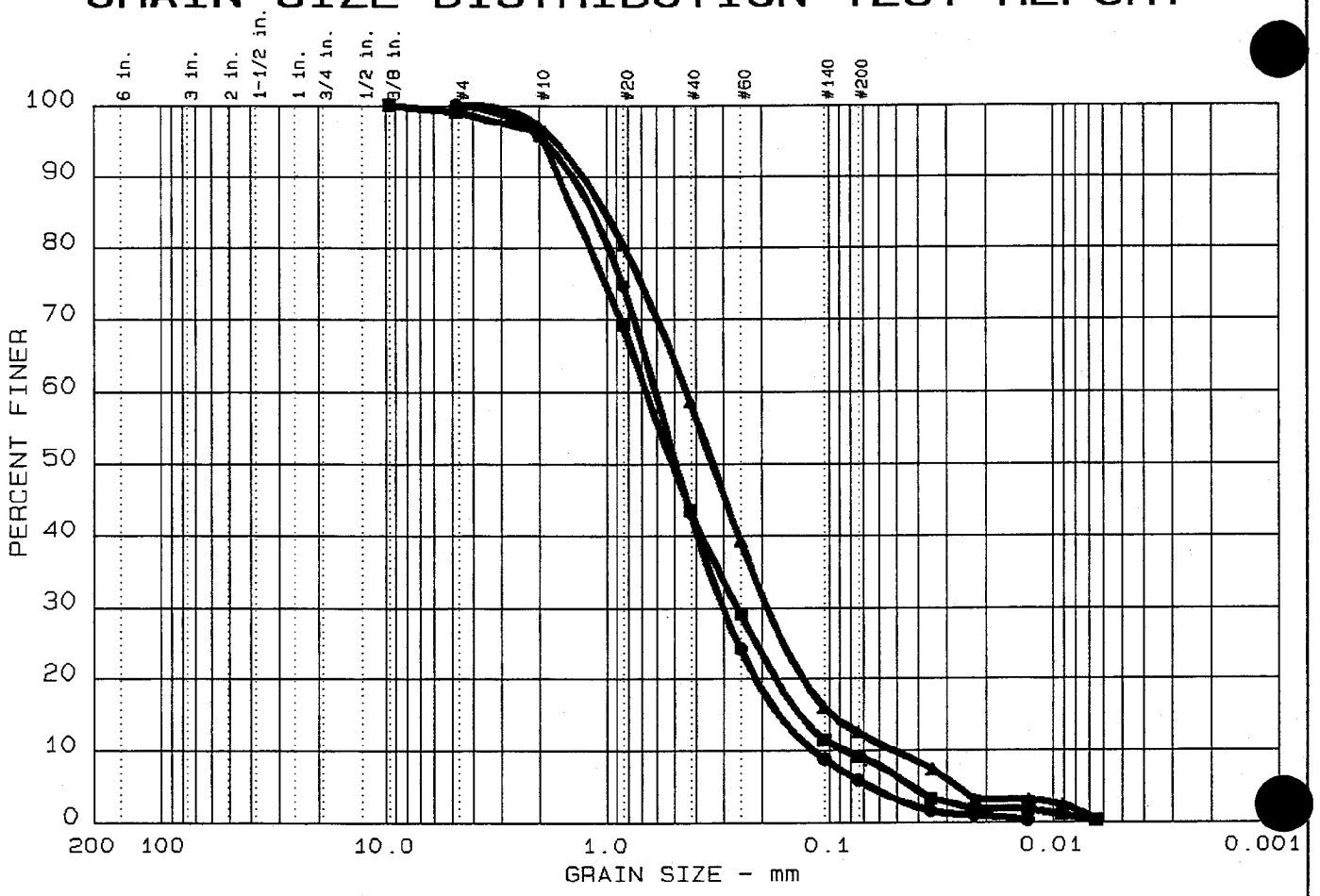
TVA - PARADISE
BOILER SLAG (REED REJECTS)

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve Percent Passing the 0.005 mm Sieve	0.0 5.8 0.0	0.0 12.5 0.0	1.0 10.2 0.0
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C	2.78	2.84	2.73
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	SP-SM A-1-b	SM A-2-4(0.0)	SW-SM A-1-b
				Composite Sample	
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %		112.5 18.2	
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %		116.0 18.7	
			Result	**Dry Density, pcf**	**Moisture Content, %**
Consolidation	ASTM D2435	Compression Index C_c	t.n.p.	t.n.p.	t.n.p.
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	1.1E-3	104.7	17.2
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ', degrees	0.06 40.6	105.3	16.8
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	2.00 40.3	105.3	16.8
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	t.n.p. t.n.p.	t.n.p.	t.n.p.
California Bearing Ratio	ASTM D 1883	CBR, %	55	105.1	15.0
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,460	104.6	15.6
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,529	107.5	14.4
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm		9,700	
pH of Soil	AASHTO T 289	pH		4.3	
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg		220	
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg		<10	

t.n.p. = test not performed

paf-slag.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	94.2	5.8	
▲	7	0.0	0.0	87.5	12.5	
■	8	0.0	1.0	89.8	9.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	NL	NP	1.15	0.60	0.49	0.301	0.1673	0.1171	1.29	5.1
▲	NL	NP	1.00	0.44	0.33	0.190	0.0974	0.0517	1.60	8.4
■	NL	NP	1.38	0.66	0.51	0.260	0.1349	0.0832	1.23	7.9

MATERIAL DESCRIPTION	USCS	AASHTO
● Reed Rejects	SP-SM	A-1-b
▲ Reed Rejects	SM	A-2-4 (0.2)
■ Reed Rejects	SW-SM	A-1-b

Project No.: 5810860101
Project: TVA - Paradise
● Location: Boiler Slag A & B
▲ Location: Boiler Slag C & D
■ Location: Boiler Slag E & F
Date: July 18, 1995

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

Remarks:

Tested by: JCR

Reviewed by: HS

Figure No.

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - Paradise*	Test Date	*07/15/95*
Material (Source)	*Boiler Slag (Reed Rejects)*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*17.2*
Wet Unit Weight, pcf:	*122.7*
Dry Unit Weight, pcf:	*104.7*
Compaction, %:	*93.0*
Hydraulic Conductivity, cm/sec. @20 °C:	***1.1E-03***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - Paradise	Test Date	07/15/95
Material (Source)	Boiler Slag (Reed Rejects)	Reviewed By	RLB
		Review Date	09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	6.000	Location 1	2.830	Dry Soil+Pan, grams	1036.95
Location 2	6.000	Location 2	2.830	Pan Weight, grams	0.00
Location3	6.000	Location 3	2.830		
Average	6.000	Average	2.830	Moisture Content, %	17.2
		Wet Soil + Tare, grams	1215.75	Wet Unit Wt, pcf	122.7
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	104.7

Chamber Pressure, psi	34
Back Pressure, psi	20
Confining Pressure, psi	14

Date Start	Date Finish	Time Start	Time Finish	Time (sec)	Division Start	Division Finish	H0 (cm)	Hf (cm)	k cm/sec	Temp (°C)	k cm/sec at 20 °C
				171	0.0	20.0	50.65	30.65	1.1E-03	21	1.1E-03
				163	0.0	20.0	50.65	30.65	1.2E-03	21	1.1E-03
				166	0.0	20.0	50.65	30.65	1.1E-03	21	1.1E-03

No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	112.5	93.0	Vertical

Avg. k at 20 °C 1.1E-03 cm/sec

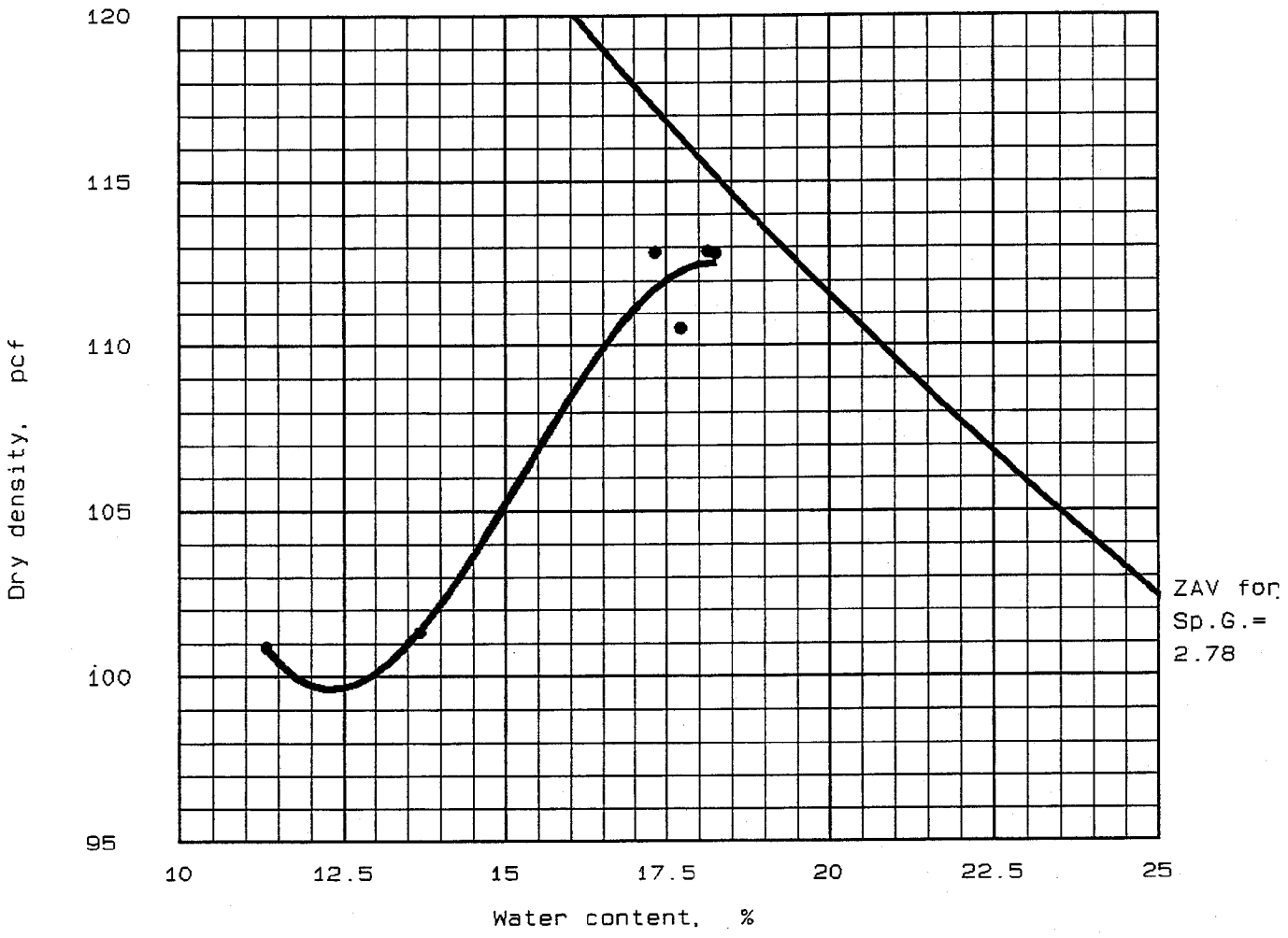
a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H0 = initial head in cm
Hf = final head in cm
t = time in seconds

a = 1.00 cm²
A = 40.582 cm²
L = 15.24 cm

TVA-00012327

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SM*	A-1-b*		2.78	NL	NP	0.33 %	9.5 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 18.2 % Maximum dry density = 112.5 pcf	

Project No.: 5810860101
Project: TVA - Paradise
Location: Boiler Slag
Reed Rejects
Date: July 25, 1995

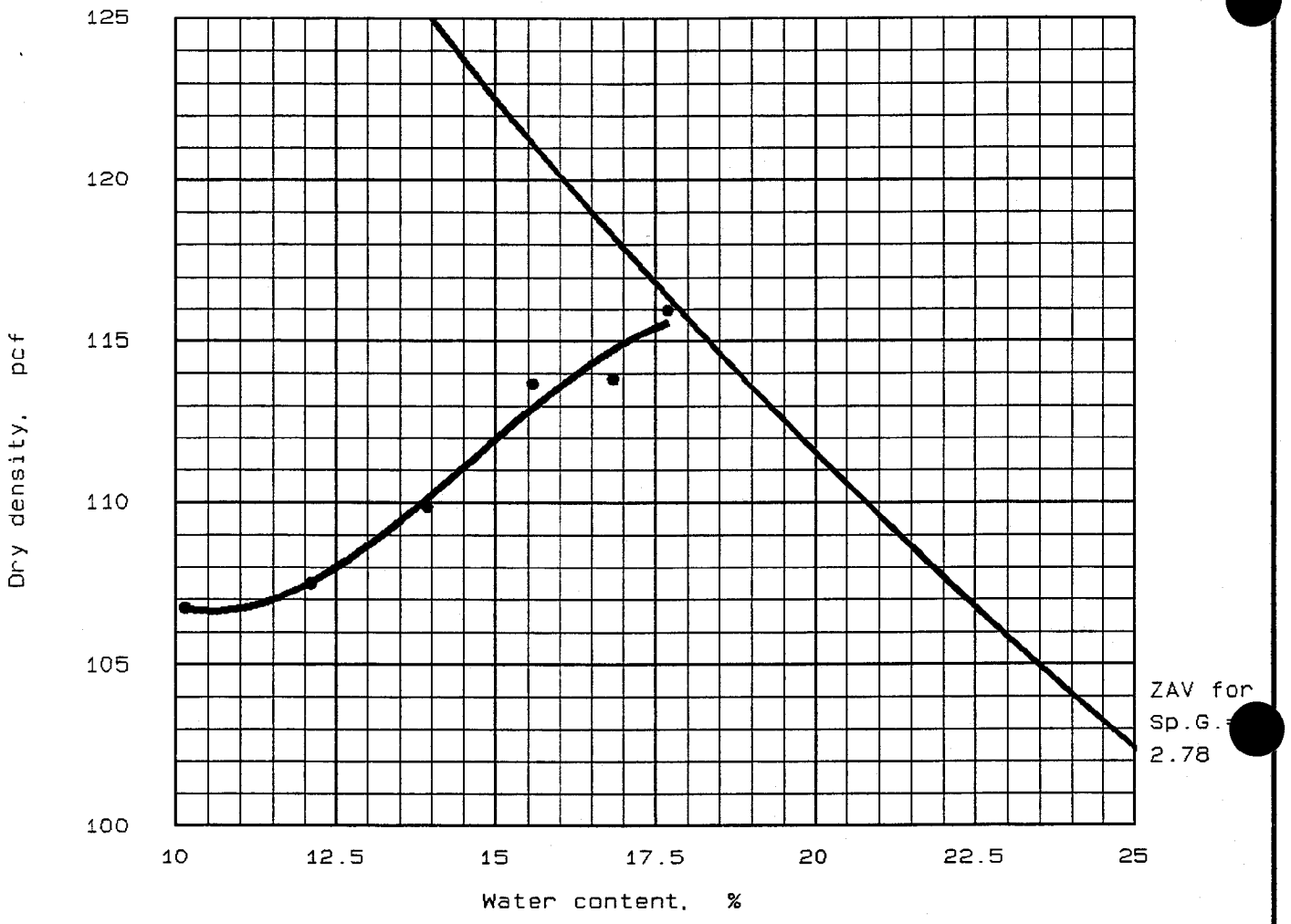
Remarks:
Tested by: JCR
Reviewed by: RLB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SM*	A-1-b*		2.78	NL	NP	0.33 %	9.5 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 18.7 % Maximum dry density = 116.0 pcf	

Project No.: 5810860101
Project: TVA - Paradise
Location: Boiler Slag
Reed Rejects
Date: July 25, 1995

Remarks:

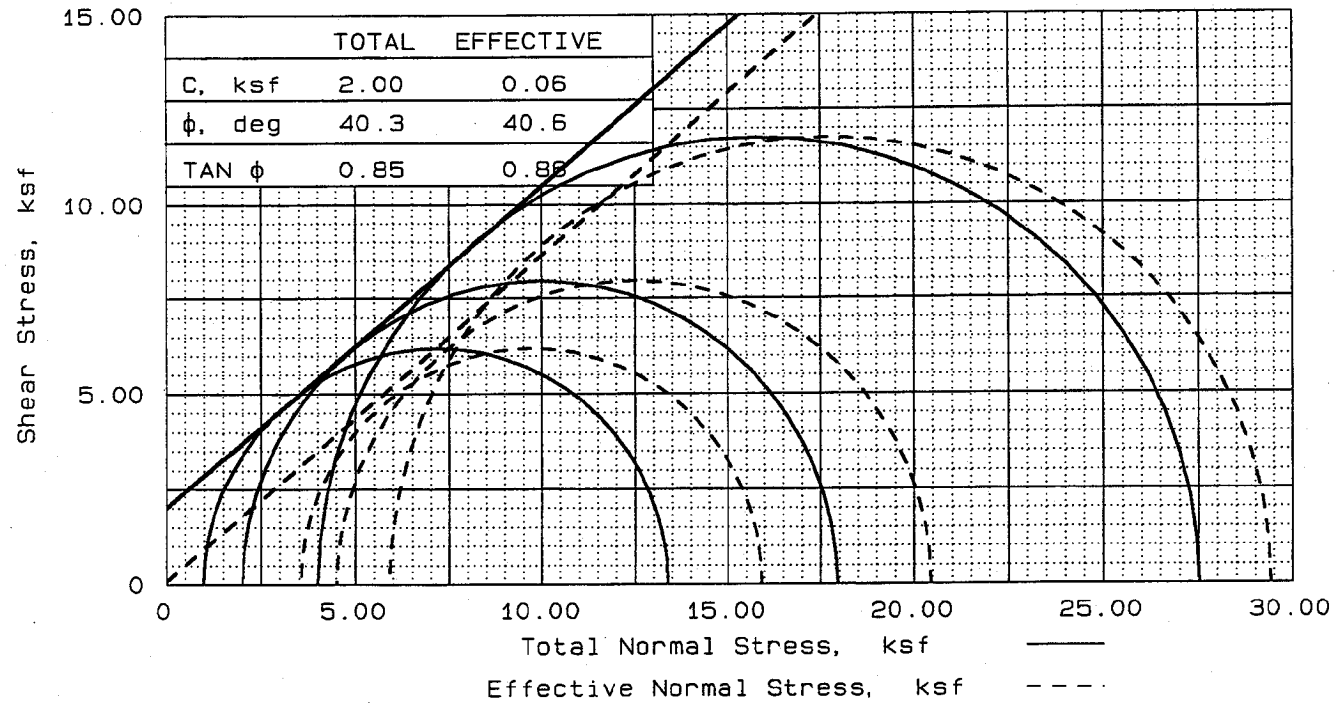
Tested by: JCR

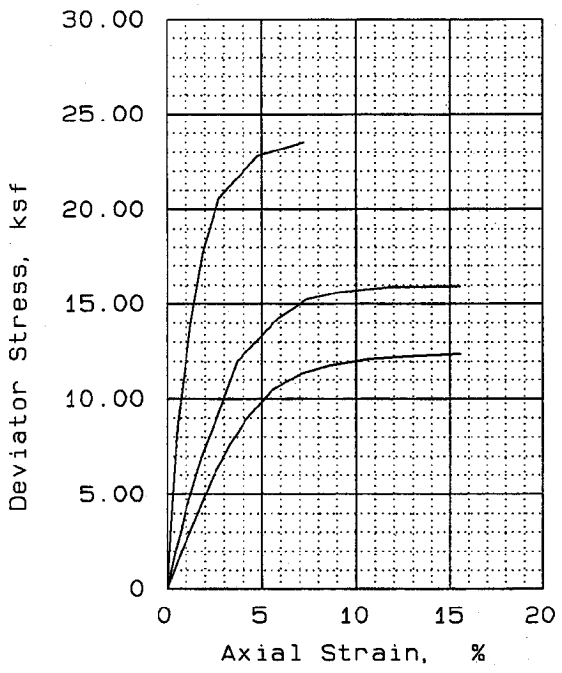
Reviewed by: RLP

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	16.7	16.4	17.2
	DRY DENSITY, pcf	105.7	105.5	104.7
	SATURATION, %	72.3	70.6	72.8
	VOID RATIO	0.641	0.645	0.658
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	22.1	22.7	22.9
	DRY DENSITY, pcf	107.5	106.4	106.0
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.615	0.631	0.637
	DIAMETER, in	2.81	2.82	2.81
	HEIGHT, in	5.99	5.99	5.99
BACK PRESSURE, ksf		2.94	4.31	3.64
CELL PRESSURE, ksf		6.94	5.30	5.64
FAILURE STRESS, ksf		23.52	12.38	15.93
PORE PRESSURE, ksf		1.04	1.76	1.14
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		29.42	15.93	20.44
$\bar{\sigma}_3$ FAILURE, ksf		5.9	3.54	4.51

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION:

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.78
REMARKS: Tested by: HJ

Reviewed by: RWB

FIG. NO.

CLIENT:

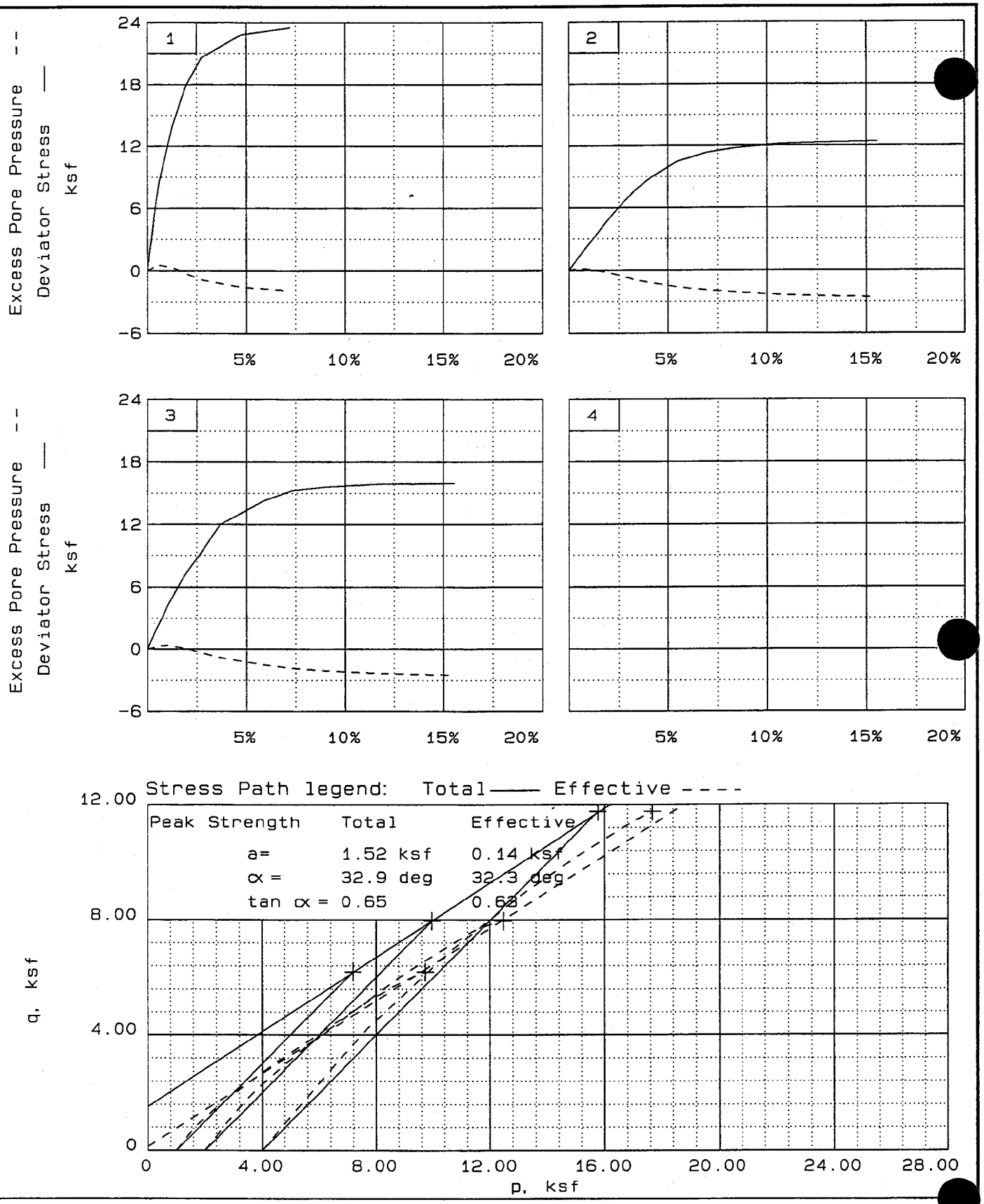
PROJECT: TVA - Paradise

SAMPLE LOCATION: Boiler Slag
Reed Rejects

PROJ. NO.: 5810860101 DATE: August 23, 1995

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.



Client:

Project: TVA - Paradise

Location: Boiler Slag Reed Rejects

File: 8601H Project No.: 5810860101 Page 2/2 Fig. No. ____

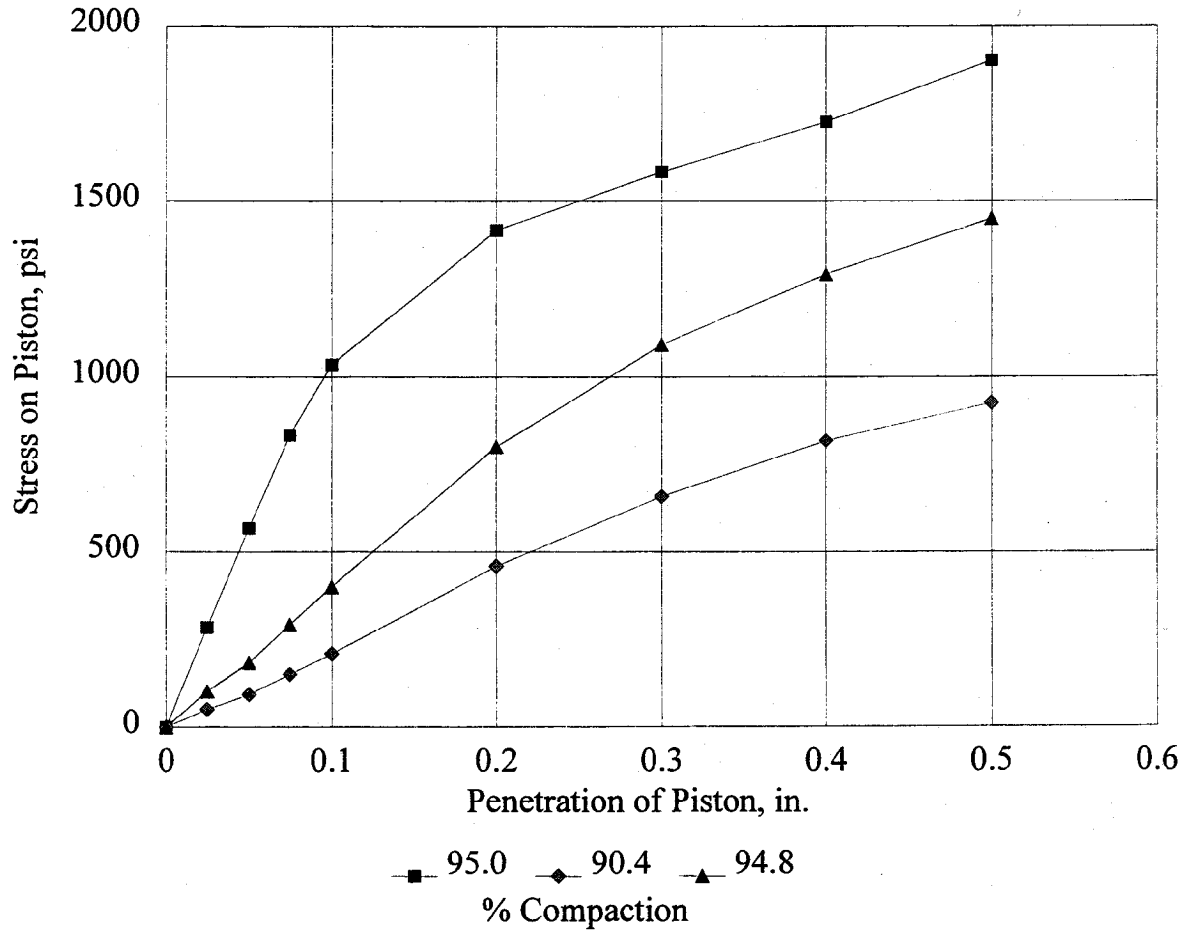
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Paradise	**Test Date**	08/07/95
Material (Source)	Boiler Slag (Reed Rejects)	**Reviewed By**	RLB
		Review Date	08/16/95

Compaction, %	95.0	90.4	94.8
Before Soak Dry Density, pcf	106.9	101.7	106.6
Before Soak Moisture Content,	15.4	15.5	14.2
After Soak Dry Density, pcf	107.5	102.4	107.1
After Soak Moisture Content, %	16.4	17.4	16.3
CBR @ 0.1 in.	103.3	20.8	40.0
CBR @ 0.2 in.	94.4	30.6	53.3



LABORATORY MATERIAL HANDLING AND TESTING SHEET NO 1 OF 2

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE
MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Boiler Slag (Reed Rejects)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO .:*	
	SPECIMEN DIAM., inch	
	TOP	2.84
	MIDDLE	2.86
	BOTTOM	2.84
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.82
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.14
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.14
	INITIAL AREA, A_0 , in^2	6.25
	INITIAL VOLUME $A_0 L_0$, in^3	38.35
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1218.06
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED , grams	1218.06
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	18.2
	MAX. DRY DENSITY, pcf	112.5
	95 % MAX. DRY DENSITY, pcf	106.9
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	15.6
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	15.6
	COMPACTION DRY DENSITY, γ_d pcf	104.6
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	30.1
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-14-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

R S Boudreau 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Paradise
2. *MATERIAL DESCRIPTION:* Boiler Slag (Reed Rejects)
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-14-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	$S_{max.}$	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ . _	_ _ _ . _	_	_ _ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ . _ _ _ _ _	_ . _ _ _ _ _	_ . _ _ _ _ _	. _ _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	1	12.6	11.4	1.2	2.0	1.8	0.2	0.00127	0.00133	0.00130	0.00021	8,610
			2	12.7	11.5	1.2	2.0	1.8	0.2	0.00127	0.00135	0.00131	0.00021	8,587
			3	12.8	11.5	1.3	2.0	1.8	0.2	0.00126	0.00132	0.00129	0.00021	8,735
			4	12.7	11.4	1.3	2.0	1.8	0.2	0.00127	0.00133	0.00130	0.00021	8,621
			5	12.8	11.6	1.2	2.1	1.9	0.2	0.00128	0.00132	0.00130	0.00021	8,746
	COLUMN AVERAGE			12.7	11.5	1.3	2.0	1.8	0.2	0.00127	0.00133	0.00130	0.00021	8,660
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	75

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.1	22.9	2.2	4.0	3.7	0.4	0.00243	0.00258	0.00250	0.00041	8,984
			2	25.1	22.9	2.3	4.0	3.7	0.4	0.00242	0.00257	0.00250	0.00041	8,982
			3	25.1	22.8	2.3	4.0	3.6	0.4	0.00243	0.00256	0.00250	0.00041	8,964
			4	25.1	22.8	2.2	4.0	3.7	0.4	0.00243	0.00257	0.00250	0.00041	8,957
			5	25.1	22.8	2.3	4.0	3.7	0.4	0.00243	0.00258	0.00251	0.00041	8,937
	COLUMN AVERAGE			25.1	22.8	2.3	4.0	3.7	0.4	0.00243	0.00257	0.00250	0.00041	8,965
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	19
SEQUENCE 3	6.0	6.0	1	37.7	34.1	3.6	6.0	5.5	0.6	0.00367	0.00388	0.00377	0.00061	8,884
			2	37.6	34.0	3.6	6.0	5.4	0.6	0.00365	0.00387	0.00376	0.00061	8,885
			3	37.6	34.1	3.5	6.0	5.5	0.6	0.00366	0.00388	0.00377	0.00061	8,871
			4	37.7	34.2	3.5	6.0	5.5	0.6	0.00365	0.00387	0.00376	0.00061	8,934
			5	37.7	34.1	3.5	6.0	5.5	0.6	0.00365	0.00387	0.00376	0.00061	8,919
	COLUMN AVERAGE			37.7	34.1	3.5	6.0	5.5	0.6	0.00365	0.00387	0.00376	0.00061	8,899
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	27
SEQUENCE 4	6.0	8.0	1	50.2	45.4	4.8	8.0	7.3	0.8	0.00495	0.00522	0.00509	0.00083	8,769
			2	50.4	45.6	4.8	8.1	7.3	0.8	0.00496	0.00520	0.00508	0.00083	8,816
			3	50.4	45.6	4.8	8.1	7.3	0.8	0.00496	0.00519	0.00508	0.00083	8,819
			4	50.5	45.7	4.8	8.1	7.3	0.8	0.00498	0.00521	0.00509	0.00083	8,807
			5	50.4	45.6	4.8	8.1	7.3	0.8	0.00495	0.00521	0.00508	0.00083	8,817
	COLUMN AVERAGE			50.4	45.6	4.8	8.1	7.3	0.8	0.00496	0.00521	0.00508	0.00083	8,806
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	21

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.0	57.0	6.0	10.1	9.1	1.0	0.00622	0.00650	0.00636	0.00104	8,796
			2	63.0	56.9	6.0	10.1	9.1	1.0	0.00623	0.00651	0.00637	0.00104	8,774
			3	62.8	56.8	6.1	10.1	9.1	1.0	0.00623	0.00652	0.00637	0.00104	8,746
			4	62.8	56.8	6.1	10.1	9.1	1.0	0.00624	0.00650	0.00637	0.00104	8,752
			5	62.9	56.9	6.0	10.1	9.1	1.0	0.00625	0.00654	0.00639	0.00104	8,734
	COLUMN AVERAGE			62.9	56.9	6.0	10.1	9.1	1.0	0.00623	0.00651	0.00637	0.00104	8,760
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	25
SEQUENCE 6	4.0	2.0	1	13.1	11.5	1.7	2.1	1.8	0.3	0.00181	0.00190	0.00186	0.00030	6,066
			2	13.2	11.5	1.7	2.1	1.8	0.3	0.00179	0.00188	0.00183	0.00030	6,172
			3	13.2	11.5	1.7	2.1	1.8	0.3	0.00180	0.00189	0.00185	0.00030	6,127
			4	13.2	11.5	1.7	2.1	1.8	0.3	0.00180	0.00188	0.00184	0.00030	6,160
			5	13.1	11.5	1.7	2.1	1.8	0.3	0.00179	0.00189	0.00184	0.00030	6,119
	COLUMN AVERAGE			13.2	11.5	1.7	2.1	1.8	0.3	0.00180	0.00189	0.00184	0.00030	6,129
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	41
SEQUENCE 7	4.0	4.0	1	25.2	22.9	2.3	4.0	3.7	0.4	0.00367	0.00386	0.00377	0.00061	5,960
			2	25.2	22.8	2.4	4.0	3.7	0.4	0.00367	0.00386	0.00377	0.00061	5,953
			3	25.2	22.9	2.3	4.0	3.7	0.4	0.00369	0.00386	0.00378	0.00062	5,963
			4	25.1	22.8	2.3	4.0	3.6	0.4	0.00366	0.00387	0.00376	0.00061	5,946
			5	25.1	22.7	2.3	4.0	3.6	0.4	0.00367	0.00386	0.00377	0.00061	5,929
	COLUMN AVERAGE			25.2	22.8	2.3	4.0	3.7	0.4	0.00367	0.00386	0.00377	0.00061	5,950
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	14

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.1	34.6	3.5	6.1	5.5	0.6	0.00527	0.00552	0.00540	0.00088	6,286
			2	38.1	34.5	3.5	6.1	5.5	0.6	0.00528	0.00550	0.00539	0.00088	6,290
			3	38.3	34.8	3.5	6.1	5.6	0.6	0.00531	0.00552	0.00541	0.00088	6,320
			4	38.1	34.6	3.5	6.1	5.5	0.6	0.00529	0.00550	0.00540	0.00088	6,295
			5	38.1	34.6	3.6	6.1	5.5	0.6	0.00527	0.00551	0.00539	0.00088	6,297
	COLUMN AVERAGE			38.2	34.6	3.5	6.1	5.5	0.6	0.00528	0.00551	0.00540	0.00088	6,298
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	13
SEQUENCE 9	4.0	8.0	1	50.5	45.7	4.8	8.1	7.3	0.8	0.00673	0.00701	0.00687	0.00112	6,532
			2	50.4	45.7	4.7	8.1	7.3	0.8	0.00675	0.00699	0.00687	0.00112	6,531
			3	50.4	45.6	4.8	8.1	7.3	0.8	0.00671	0.00701	0.00686	0.00112	6,527
			4	50.4	45.6	4.8	8.1	7.3	0.8	0.00673	0.00699	0.00686	0.00112	6,530
			5	50.5	45.7	4.7	8.1	7.3	0.8	0.00675	0.00699	0.00687	0.00112	6,536
	COLUMN AVERAGE			50.4	45.7	4.8	8.1	7.3	0.8	0.00674	0.00700	0.00687	0.00112	6,531
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00000	0.00000	3
SEQUENCE 10	4.0	10.0	1	62.9	56.9	6.0	10.1	9.1	1.0	0.00812	0.00842	0.00827	0.00135	6,753
			2	62.9	56.9	6.0	10.1	9.1	1.0	0.00813	0.00840	0.00827	0.00135	6,761
			3	63.0	57.0	6.0	10.1	9.1	1.0	0.00815	0.00841	0.00828	0.00135	6,757
			4	63.0	57.0	6.0	10.1	9.1	1.0	0.00814	0.00840	0.00827	0.00135	6,767
			5	63.0	57.0	5.9	10.1	9.1	0.9	0.00816	0.00840	0.00828	0.00135	6,762
	COLUMN AVERAGE			63.0	57.0	6.0	10.1	9.1	1.0	0.00814	0.00841	0.00827	0.00135	6,760
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.3	11.3	2.1	2.1	1.8	0.3	0.00266	0.00279	0.00273	0.00044	4,058
			2	13.4	11.3	2.1	2.1	1.8	0.3	0.00266	0.00279	0.00272	0.00044	4,086
			3	13.4	11.3	2.1	2.1	1.8	0.3	0.00265	0.00280	0.00273	0.00044	4,067
			4	13.5	11.4	2.1	2.2	1.8	0.3	0.00267	0.00280	0.00273	0.00045	4,105
			5	13.4	11.3	2.1	2.1	1.8	0.3	0.00265	0.00279	0.00272	0.00044	4,095
	COLUMN AVERAGE			13.4	11.3	2.1	2.1	1.8	0.3	0.00266	0.00279	0.00273	0.00044	4,082
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	20
SEQUENCE 12	2.0	4.0	1	25.5	23.1	2.4	4.1	3.7	0.4	0.00543	0.00567	0.00555	0.00090	4,086
			2	25.5	23.1	2.4	4.1	3.7	0.4	0.00543	0.00567	0.00555	0.00090	4,091
			3	25.5	23.1	2.4	4.1	3.7	0.4	0.00544	0.00568	0.00556	0.00091	4,087
			4	25.5	23.1	2.3	4.1	3.7	0.4	0.00545	0.00566	0.00556	0.00091	4,082
			5	25.4	23.1	2.4	4.1	3.7	0.4	0.00545	0.00568	0.00557	0.00091	4,068
	COLUMN AVERAGE			25.5	23.1	2.4	4.1	3.7	0.4	0.00544	0.00567	0.00556	0.00091	4,083
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	9
SEQUENCE 13	2.0	6.0	1	37.6	34.0	3.6	6.0	5.4	0.6	0.00736	0.00762	0.00749	0.00122	4,460
			2	37.5	34.0	3.6	6.0	5.4	0.6	0.00736	0.00763	0.00749	0.00122	4,448
			3	37.5	34.0	3.6	6.0	5.4	0.6	0.00734	0.00761	0.00748	0.00122	4,458
			4	37.6	34.1	3.6	6.0	5.4	0.6	0.00735	0.00762	0.00749	0.00122	4,467
			5	37.6	34.0	3.6	6.0	5.4	0.6	0.00736	0.00762	0.00749	0.00122	4,455
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.00735	0.00762	0.00749	0.00122	4,457
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	7

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.2	45.4	4.8	8.0	7.3	0.8	0.00911	0.00938	0.00925	0.00151	4,824
			2	50.2	45.4	4.8	8.0	7.3	0.8	0.00909	0.00938	0.00923	0.00150	4,824
			3	50.2	45.4	4.8	8.0	7.3	0.8	0.00910	0.00940	0.00925	0.00151	4,820
			4	50.1	45.3	4.8	8.0	7.2	0.8	0.00910	0.00940	0.00925	0.00151	4,805
			5	50.1	45.4	4.8	8.0	7.3	0.8	0.00913	0.00938	0.00925	0.00151	4,811
	COLUMN AVERAGE			50.2	45.4	4.8	8.0	7.3	0.8	0.00911	0.00939	0.00925	0.00151	4,817
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8
SEQUENCE 15	2.0	10.0	1	62.5	56.5	6.0	10.0	9.0	1.0	0.01095	0.01123	0.01109	0.00181	5,001
			2	62.4	56.4	6.0	10.0	9.0	1.0	0.01094	0.01121	0.01108	0.00181	5,000
			3	62.5	56.5	6.0	10.0	9.0	1.0	0.01094	0.01122	0.01108	0.00181	5,004
			4	62.4	56.4	6.0	10.0	9.0	1.0	0.01098	0.01122	0.01110	0.00181	4,986
			5	62.3	56.3	6.0	10.0	9.0	1.0	0.01095	0.01121	0.01108	0.00181	4,991
	COLUMN AVERAGE			62.4	56.4	6.0	10.0	9.0	1.0	0.01095	0.01122	0.01109	0.00181	4,996
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	8

SUBMITTED BY, DATE

RS Bowden 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Boiler Slag (Reed Rejects)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995

$$M_R = K1\ (S_C)^{K2}\ (1+S_3)^{K5}$$

K1 =	1,661
K2 =	0.06737
K5 =	0.79102
R^2 =	0.97

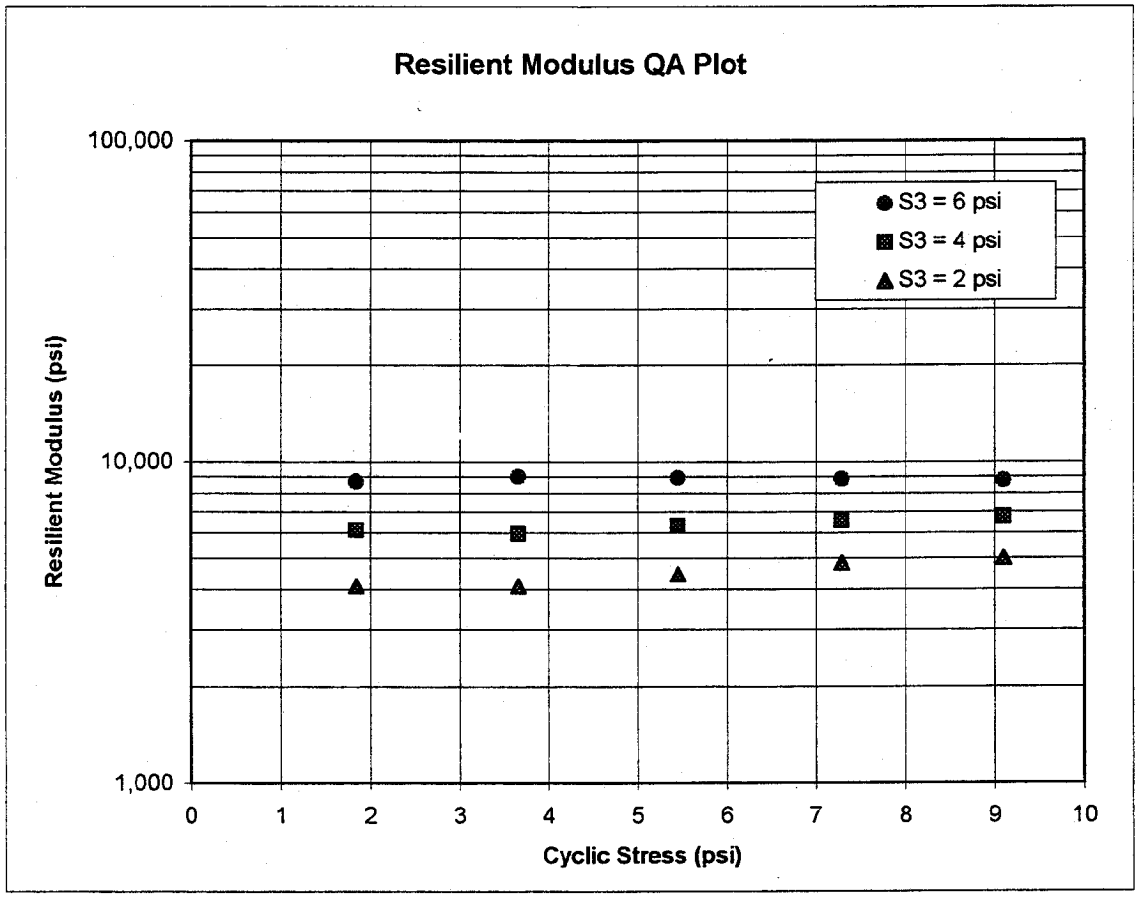
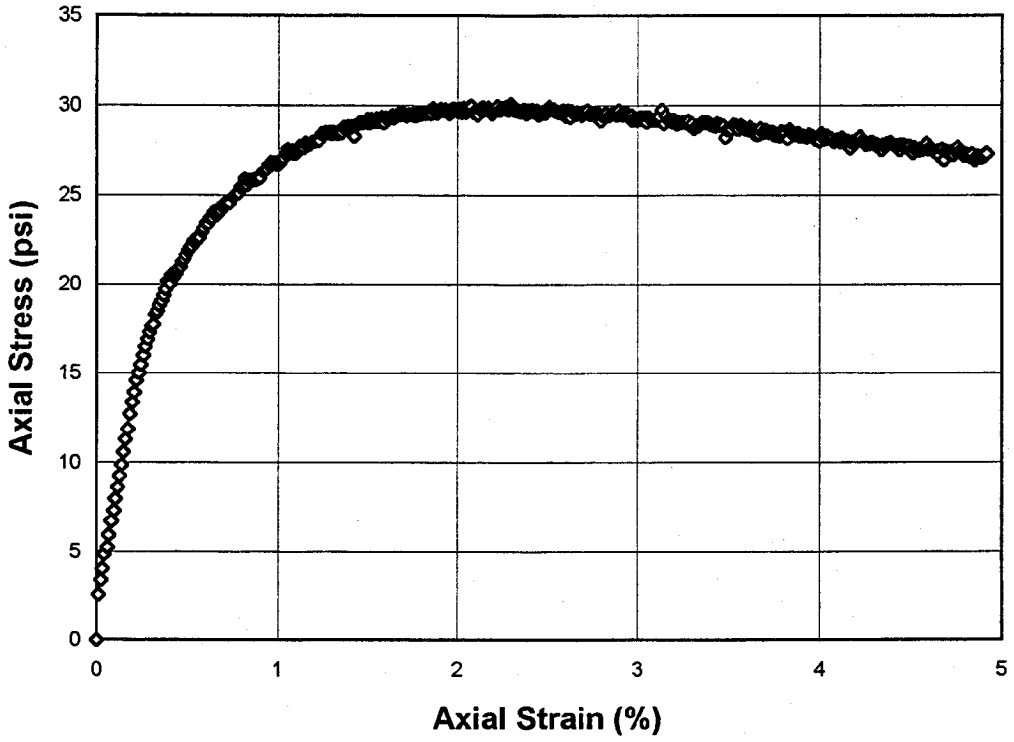


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Boiler Slag (Reed Rejects)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Boiler Slag (Reed Rejects)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.*:	
	SPECIMEN DIAM., inch	
	TOP	2.85
	MIDDLE	2.86
	BOTTOM	2.85
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.14
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0, inch	6.14
	INITIAL AREA, A_0, in^2	6.28
	INITIAL VOLUME $A_0 L_0$, in^3	38.54
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1245.16
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1245.16
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	18.7
	MAX. DRY DENSITY, pcf	116.0
	95 % MAX. DRY DENSITY, pcf	110.2
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	14.4
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	14.4
	COMPACTION DRY DENSITY, γ_d pcf	107.5
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	32.3
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	08-14-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Boudreau 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Paradise
2. *MATERIAL DESCRIPTION:* Boiler Slag (Reed Rejects)
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-14-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	___.__	___.__	_	____.__	___.__	___.__	___.__	___.__	__.__	_.______	_.______	_.______	._____	____.
SEQUENCE 1	6.0	2.0	1	12.6	11.4	1.2	2.0	1.8	0.2	0.00127	0.00135	0.00131	0.00021	8,520
			2	12.6	11.3	1.3	2.0	1.8	0.2	0.00128	0.00132	0.00130	0.00021	8,511
			3	12.6	11.4	1.2	2.0	1.8	0.2	0.00128	0.00132	0.00130	0.00021	8,603
			4	12.6	11.4	1.2	2.0	1.8	0.2	0.00127	0.00131	0.00129	0.00021	8,660
			5	12.6	11.4	1.2	2.0	1.8	0.2	0.00127	0.00133	0.00130	0.00021	8,592
	COLUMN AVERAGE			12.6	11.4	1.2	2.0	1.8	0.2	0.00127	0.00132	0.00130	0.00021	8,577
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	62

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.4	23.1	2.2	4.0	3.7	0.4	0.00243	0.00254	0.00249	0.00041	9,083
			2	25.1	22.8	2.2	4.0	3.6	0.4	0.00242	0.00252	0.00247	0.00040	9,022
			3	25.1	22.9	2.2	4.0	3.6	0.4	0.00242	0.00251	0.00247	0.00040	9,057
			4	25.1	23.0	2.1	4.0	3.7	0.3	0.00243	0.00253	0.00248	0.00040	9,051
			5	25.2	23.0	2.2	4.0	3.7	0.4	0.00242	0.00253	0.00248	0.00040	9,064
	COLUMN AVERAGE			25.2	23.0	2.2	4.0	3.7	0.4	0.00243	0.00253	0.00248	0.00040	9,056
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	22
SEQUENCE 3	6.0	6.0	1	37.8	34.2	3.5	6.0	5.4	0.6	0.00368	0.00382	0.00375	0.00061	8,915
			2	37.7	34.1	3.6	6.0	5.4	0.6	0.00370	0.00382	0.00376	0.00061	8,871
			3	37.8	34.3	3.5	6.0	5.5	0.6	0.00370	0.00383	0.00376	0.00061	8,893
			4	37.7	34.2	3.5	6.0	5.5	0.6	0.00369	0.00383	0.00376	0.00061	8,902
			5	37.7	34.1	3.6	6.0	5.4	0.6	0.00370	0.00383	0.00376	0.00061	8,851
	COLUMN AVERAGE			37.7	34.2	3.5	6.0	5.4	0.6	0.00369	0.00383	0.00376	0.00061	8,887
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	26
SEQUENCE 4	6.0	8.0	1	50.4	45.6	4.8	8.0	7.3	0.8	0.00501	0.00518	0.00509	0.00083	8,753
			2	50.3	45.4	4.8	8.0	7.2	0.8	0.00500	0.00515	0.00508	0.00083	8,746
			3	50.5	45.6	4.8	8.0	7.3	0.8	0.00500	0.00517	0.00508	0.00083	8,774
			4	50.3	45.5	4.8	8.0	7.2	0.8	0.00502	0.00516	0.00509	0.00083	8,735
			5	50.4	45.6	4.8	8.0	7.3	0.8	0.00502	0.00516	0.00509	0.00083	8,746
	COLUMN AVERAGE			50.4	45.6	4.8	8.0	7.3	0.8	0.00501	0.00516	0.00509	0.00083	8,751
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	14

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	62.9	56.8	6.1	10.0	9.0	1.0	0.00626	0.00644	0.00635	0.00103	8,737
			2	63.0	56.9	6.1	10.0	9.1	1.0	0.00628	0.00641	0.00635	0.00103	8,760
			3	63.0	56.9	6.1	10.0	9.1	1.0	0.00628	0.00643	0.00635	0.00104	8,745
			4	63.1	57.0	6.1	10.0	9.1	1.0	0.00628	0.00642	0.00635	0.00103	8,775
			5	63.0	56.9	6.1	10.0	9.1	1.0	0.00628	0.00643	0.00636	0.00104	8,745
	COLUMN AVERAGE			63.0	56.9	6.1	10.0	9.1	1.0	0.00627	0.00642	0.00635	0.00103	8,753
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	15
SEQUENCE 6	4.0	2.0	1	13.5	11.8	1.7	2.1	1.9	0.3	0.00182	0.00185	0.00184	0.00030	6,290
			2	13.4	11.7	1.7	2.1	1.9	0.3	0.00179	0.00185	0.00182	0.00030	6,296
			3	13.4	11.8	1.6	2.1	1.9	0.3	0.00181	0.00187	0.00184	0.00030	6,242
			4	13.3	11.6	1.6	2.1	1.9	0.3	0.00180	0.00185	0.00183	0.00030	6,223
			5	13.3	11.7	1.7	2.1	1.9	0.3	0.00182	0.00191	0.00187	0.00030	6,106
	COLUMN AVERAGE			13.4	11.7	1.7	2.1	1.9	0.3	0.00181	0.00187	0.00184	0.00030	6,231
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00002	0.00000	77
SEQUENCE 7	4.0	4.0	1	24.9	22.5	2.3	4.0	3.6	0.4	0.00371	0.00379	0.00375	0.00061	5,876
			2	24.9	22.5	2.3	4.0	3.6	0.4	0.00370	0.00381	0.00375	0.00061	5,860
			3	24.8	22.5	2.3	3.9	3.6	0.4	0.00371	0.00379	0.00375	0.00061	5,856
			4	24.8	22.5	2.4	4.0	3.6	0.4	0.00371	0.00379	0.00375	0.00061	5,848
			5	25.0	22.6	2.4	4.0	3.6	0.4	0.00368	0.00379	0.00374	0.00061	5,918
	COLUMN AVERAGE			24.9	22.5	2.3	4.0	3.6	0.4	0.00370	0.00379	0.00375	0.00061	5,872
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	28

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.0	34.5	3.5	6.0	5.5	0.6	0.00523	0.00536	0.00529	0.00086	6,368
			2	38.0	34.5	3.5	6.1	5.5	0.6	0.00524	0.00537	0.00531	0.00086	6,344
			3	38.1	34.5	3.6	6.1	5.5	0.6	0.00523	0.00538	0.00531	0.00086	6,358
			4	38.0	34.4	3.6	6.0	5.5	0.6	0.00523	0.00537	0.00530	0.00086	6,344
			5	37.9	34.3	3.5	6.0	5.5	0.6	0.00523	0.00537	0.00530	0.00086	6,332
	COLUMN AVERAGE			38.0	34.5	3.5	6.0	5.5	0.6	0.00523	0.00537	0.00530	0.00086	6,349
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	14
SEQUENCE 9	4.0	8.0	1	50.2	45.4	4.8	8.0	7.2	0.8	0.00663	0.00680	0.00671	0.00109	6,611
			2	50.3	45.5	4.8	8.0	7.3	0.8	0.00662	0.00680	0.00671	0.00109	6,632
			3	50.3	45.5	4.8	8.0	7.2	0.8	0.00663	0.00679	0.00671	0.00109	6,624
			4	50.4	45.6	4.8	8.0	7.3	0.8	0.00663	0.00678	0.00670	0.00109	6,648
			5	50.5	45.7	4.7	8.0	7.3	0.8	0.00663	0.00680	0.00672	0.00109	6,649
	COLUMN AVERAGE			50.4	45.6	4.8	8.0	7.3	0.8	0.00663	0.00679	0.00671	0.00109	6,633
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16
SEQUENCE 10	4.0	10.0	1	62.8	56.9	5.9	10.0	9.1	0.9	0.00794	0.00818	0.00806	0.00131	6,897
			2	62.8	56.9	5.9	10.0	9.1	0.9	0.00795	0.00819	0.00807	0.00132	6,880
			3	62.7	56.7	6.0	10.0	9.0	1.0	0.00797	0.00819	0.00808	0.00132	6,856
			4	62.7	56.7	6.0	10.0	9.0	1.0	0.00796	0.00819	0.00807	0.00132	6,863
			5	62.9	56.9	6.0	10.0	9.1	1.0	0.00796	0.00821	0.00809	0.00132	6,879
	COLUMN AVERAGE			62.8	56.8	6.0	10.0	9.0	1.0	0.00796	0.00819	0.00807	0.00132	6,875
	STANDARD DEV.			0.1	0.1	0.1	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.3	11.2	2.1	2.1	1.8	0.3	0.00265	0.00266	0.00265	0.00043	4,138
			2	13.3	11.2	2.1	2.1	1.8	0.3	0.00265	0.00267	0.00266	0.00043	4,094
			3	13.3	11.2	2.1	2.1	1.8	0.3	0.00265	0.00267	0.00266	0.00043	4,109
			4	13.4	11.3	2.1	2.1	1.8	0.3	0.00268	0.00267	0.00268	0.00044	4,124
			5	13.3	11.2	2.1	2.1	1.8	0.3	0.00265	0.00269	0.00267	0.00043	4,087
	COLUMN AVERAGE			13.3	11.2	2.1	2.1	1.8	0.3	0.00266	0.00267	0.00266	0.00043	4,110
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	21
SEQUENCE 12	2.0	4.0	1	24.9	22.5	2.4	4.0	3.6	0.4	0.00538	0.00545	0.00541	0.00088	4,062
			2	24.9	22.6	2.4	4.0	3.6	0.4	0.00540	0.00546	0.00543	0.00088	4,063
			3	24.9	22.5	2.4	4.0	3.6	0.4	0.00539	0.00547	0.00543	0.00088	4,048
			4	24.8	22.4	2.4	4.0	3.6	0.4	0.00536	0.00547	0.00542	0.00088	4,048
			5	24.8	22.4	2.4	3.9	3.6	0.4	0.00540	0.00546	0.00543	0.00089	4,038
	COLUMN AVERAGE			24.9	22.5	2.4	4.0	3.6	0.4	0.00538	0.00546	0.00542	0.00088	4,052
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	11
SEQUENCE 13	2.0	6.0	1	36.8	33.2	3.6	5.9	5.3	0.6	0.00716	0.00732	0.00724	0.00118	4,479
			2	37.1	33.5	3.6	5.9	5.3	0.6	0.00717	0.00733	0.00725	0.00118	4,515
			3	37.1	33.5	3.6	5.9	5.3	0.6	0.00720	0.00733	0.00727	0.00118	4,509
			4	36.9	33.3	3.6	5.9	5.3	0.6	0.00718	0.00731	0.00725	0.00118	4,488
			5	37.2	33.6	3.6	5.9	5.3	0.6	0.00719	0.00733	0.00726	0.00118	4,517
	COLUMN AVERAGE			37.0	33.4	3.6	5.9	5.3	0.6	0.00718	0.00732	0.00725	0.00118	4,502
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17

Source: Paradise Description: Boiler Slag (Reed Rejects) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	49.5	44.7	4.8	7.9	7.1	0.8	0.00867	0.00888	0.00877	0.00143	4,979
			2	49.6	44.8	4.8	7.9	7.1	0.8	0.00869	0.00887	0.00878	0.00143	4,983
			3	49.6	44.8	4.9	7.9	7.1	0.8	0.00870	0.00888	0.00879	0.00143	4,975
			4	49.6	44.7	4.8	7.9	7.1	0.8	0.00869	0.00886	0.00878	0.00143	4,981
			5	49.5	44.7	4.9	7.9	7.1	0.8	0.00868	0.00886	0.00877	0.00143	4,972
	COLUMN AVERAGE			49.6	44.7	4.8	7.9	7.1	0.8	0.00869	0.00887	0.00878	0.00143	4,978
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	4
SEQUENCE 15	2.0	10.0	1	62.4	56.3	6.0	9.9	9.0	1.0	0.01024	0.01050	0.01037	0.00169	5,309
			2	62.3	56.2	6.0	9.9	9.0	1.0	0.01021	0.01051	0.01036	0.00169	5,300
			3	62.2	56.2	6.1	9.9	8.9	1.0	0.01024	0.01050	0.01037	0.00169	5,294
			4	62.2	56.2	6.0	9.9	8.9	1.0	0.01021	0.01049	0.01035	0.00169	5,303
			5	62.1	56.0	6.0	9.9	8.9	1.0	0.01023	0.01048	0.01036	0.00169	5,287
	COLUMN AVERAGE			62.2	56.2	6.0	9.9	8.9	1.0	0.01022	0.01050	0.01036	0.00169	5,299
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8

SUBMITTED BY, DATE

RS Blackburn 9/10/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Boiler Slag (Reed Rejects)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995

$$M_R = K1\,(S_C)^{K2}\,(1+S_3)^{K5}$$

K1 =	1,715
K2 =	0.08023
K5 =	0.76411
R^2 =	0.95

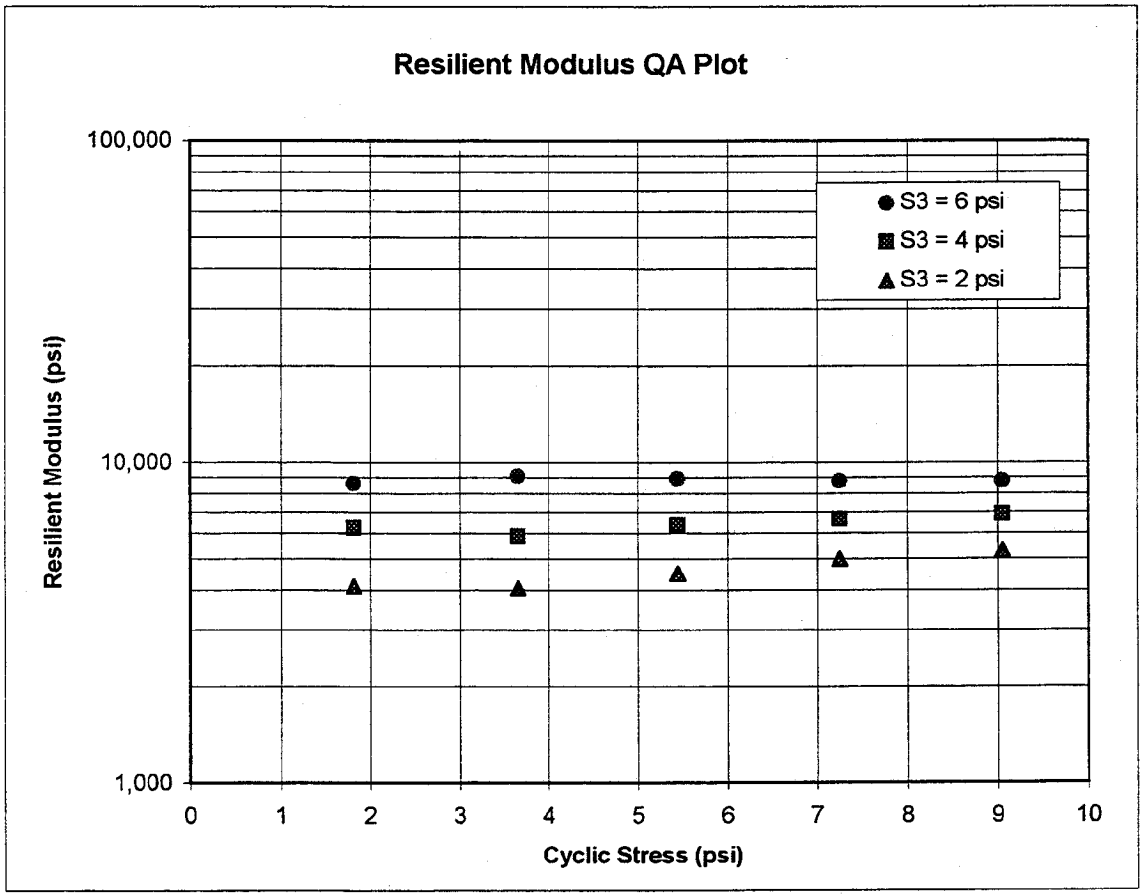
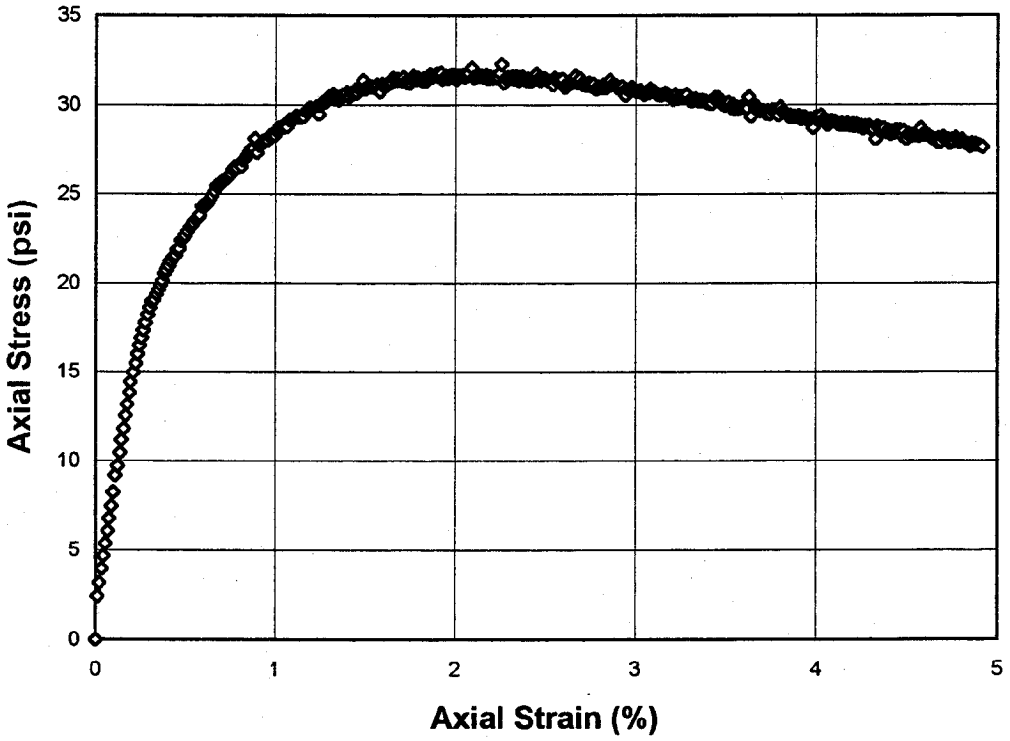


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Boiler Slag (Reed Rejects)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-14-1995



PARADISE

Scrubber Gypsum

Grain Size Distribution Test Report (**Not Performed**)
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

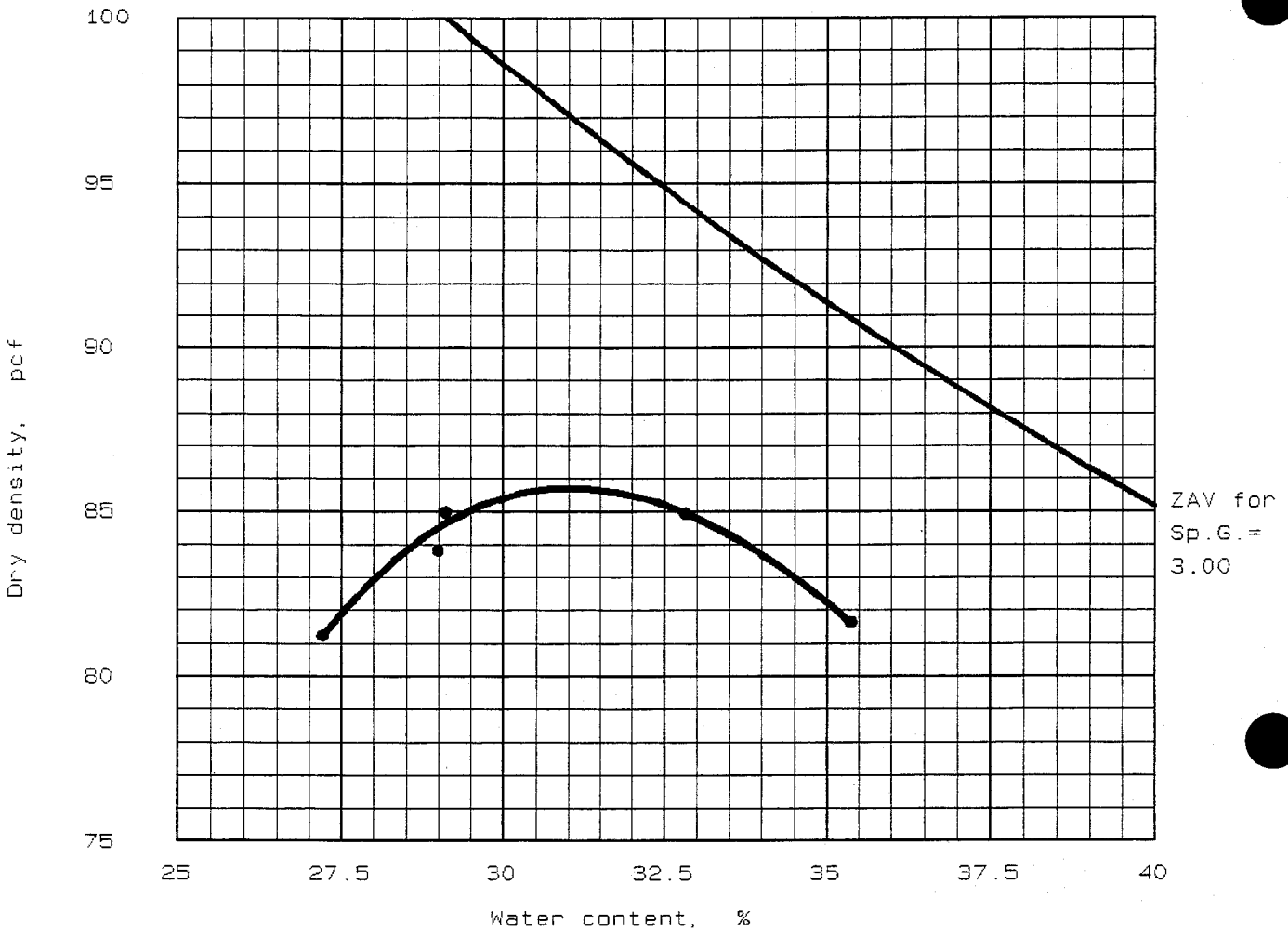
TVA - PARADISE
SCRUBBER GYPSUM

Description	Test Method	Property	Sample 1	Sample 2	Sample 3
Grain Size	ASTM D 422	Percent Retained on the #4 Sieve Percent Passing the #200 Sieve Percent Passing the 0.005 mm Sieve	see note 1 see note 1 see note 1	see note 1 see note 1 see note 1	see note 1 see note 1 see note 1
Atterberg Limits	ASTM D 4318	Liquid Limit Plastic Limit Plasticity Index	NL NP N/A	NL NP N/A	NL NP N/A
Specific Gravity	ASTM D 854	Specific Gravity at 20°C		3.00 (see note 2)	
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	see note 3 see note 3	see note 3 see note 3	see note 3 see note 3
				Composite Sample	
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %		85.7 31.1	
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %		87.4 30.8	
			Result	**Dry Density, pcf**	**Moisture Content, %**
Consolidation	ASTM D2435	Compression Index C_c	0.13	77.9	35.9
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	1.5E-4	77.7	37.1
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ',degrees	0.00 39.7	78.0	36.4
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	3.07 35.5	78.0	36.4
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	0.97 45.7	75.5	35.7
California Bearing Ratio	ASTM D 1883	CBR, %	14	80.0	32.0
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	15,110	79.3	33.8
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	16,325	81.4	32.6
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm		1,100	
pH of Soil	AASHTO T 289	pH		7.7	
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg		4630	
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg		10	

Note 1: Material observed to chrystalize/set-up upon wetting. Test could not be performed.
Note 2: A test was performed on a composite sample from the 3 independant samples.
Note 3: A classification could not be performed without the ASTM D 422 results.

paf-gy.xls

MOISTURE-DENSITY RELATIONSHIP



"Standard" Proctor, ASTM D 698, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				3.00	NL	NP		

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 31.1 % Maximum dry density = 85.7 pcf	Gypsum

Project No.: 5810860101
Project: TVA - Paradise
Location: Scrubber Gypsum

Date: September 27, 1995

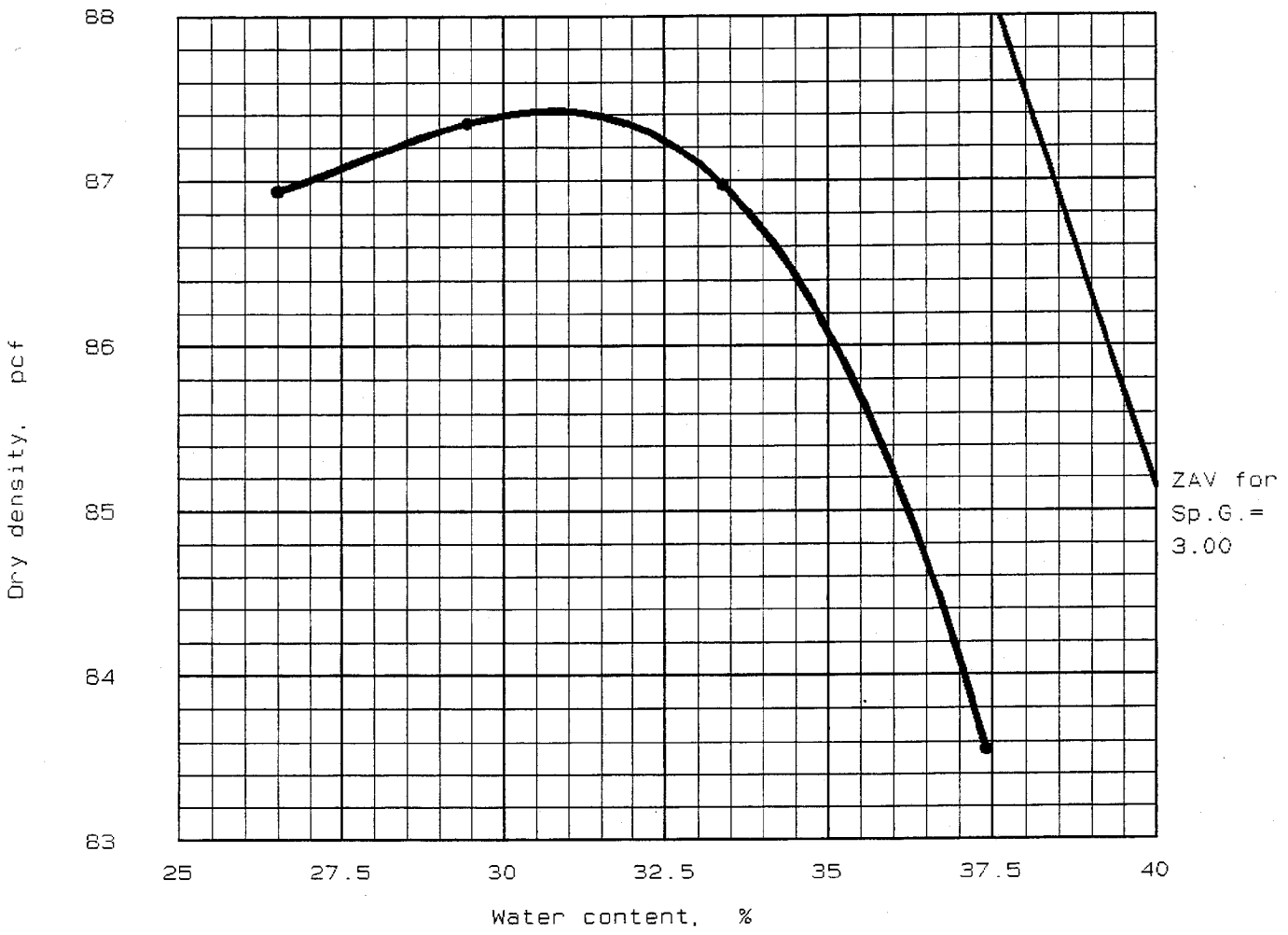
Remarks:
Tested by: CS
Reviewed by: HB

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP



"Modified" Proctor, ASTM D 1557, Method A

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				3.00	- NL	NP		

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 30.8 % Maximum dry density = 87.4 pcf	Gypsum

Project No.: 5810860101
Project: TVA - Paradise
Location: Scrubber Gypsum

Date: September 28, 1995

Remarks:

Tested by: EM

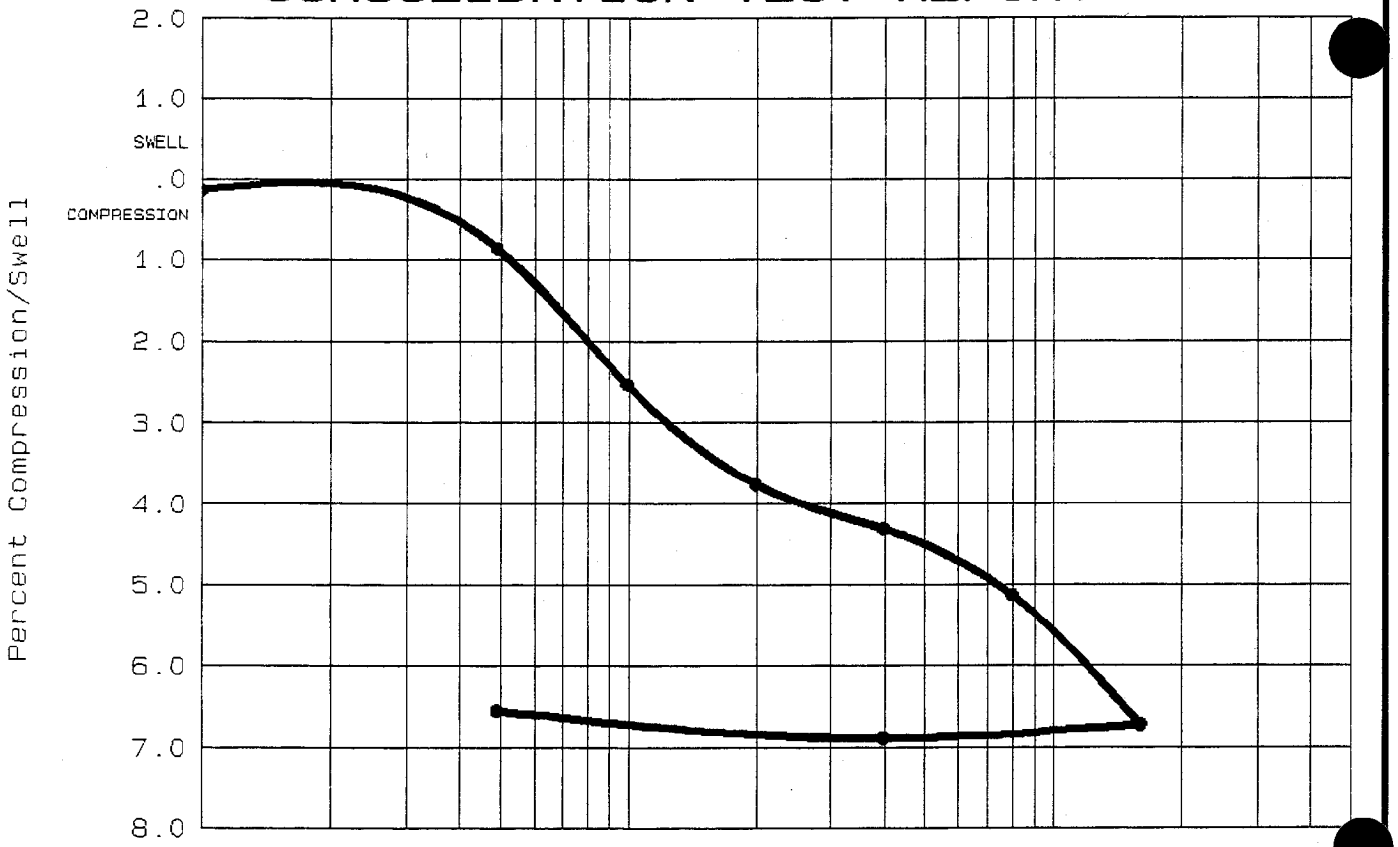
Reviewed by: HS

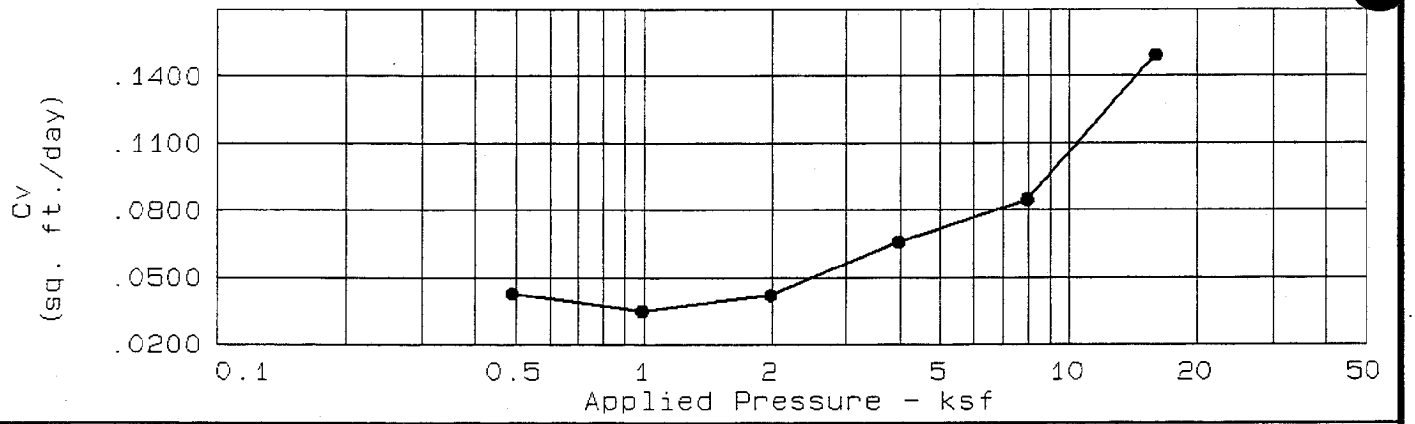
MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Figure No. _____

CONSOLIDATION TEST REPORT





Natural Saturation	Natural Moisture	Dry Density	LL	PI	Sp.Gr.	Precons. press.	C_C	e_0
76.6 %	35.9	77.9	NL	NP	3.000	1.80	0.13	1.4047

TEST RESULTS

Compression Index = 0.13

MATERIAL DESCRIPTION

Project No.: 5810860101
Project: TVA - Paradise
Location: Scrubber Gypsum

Date: 9/28/95

Remarks:

Tested by: AdK
Reviewed by: HS

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No._____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA-Paradise*	Test Date	*10/17/95*
Boring No.	*Scrubber Gypsum*	Reviewed By	*RLB*
Sample No.	*Bag*	Review Date	*10/19/95*
Sample Depth			
Sample Description	*Gypsum*		

ASTM D5084 - Falling Head

Sample Type:	*Bag*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*37.1*
Wet Unit Weight, pcf:	*106.5*
Dry Unit Weight, pcf:	*77.7*
Compaction, %:	*90.7*
Hydraulic Conductivity, cm/sec. @20 °C:	***1.5E-04***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number 5810860101
Project Name TVA-Paradise
Boring No. Scrubber Gypsum
Sample No. Bag
Sample Depth
Sample Description Gypsum

Tested By HEJ
Test Date 10/17/95
Reviewed By RLB
Review Date 10/19/95

Sample Data

Length, in		Diameter, in		Pan No.	T-19
Location 1	6.000	Location 1	2.830	Dry Soil+Pan, grams	820.30
Location 2	6.000	Location 2	2.830	Pan Weight, grams	50.64
Location3	6.000	Location 3	2.830		
Average	6.000	Average	2.830	Moisture Content, %	37.1
		Wet Soil + Tare, grams	1055.51	Wet Unit Wt, pcf	106.5
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	77.7

Chamber Pressure, psi	44
Back Pressure, psi	30
Confining Pressure, psi	14

Date Start	Date Finish	Time Start	Time Finish	Time (sec)	Division Start	Division Finish	H0 (cm)	Hf (cm)	k cm/sec	Temp (°C)	k cm/sec at 20 °C
				452	0.0	22.0	127.11	105.11	1.6E-04	21	1.5E-04
				455	0.0	22.0	127.11	105.11	1.6E-04	21	1.5E-04
				453	0.0	22.0	127.11	105.11	1.6E-04	21	1.5E-04

No. of Tria	Sample Type	Max. Densit (pcf)	Compaction %	Sample Orientation
3	Bag	86	90.7	Vertical

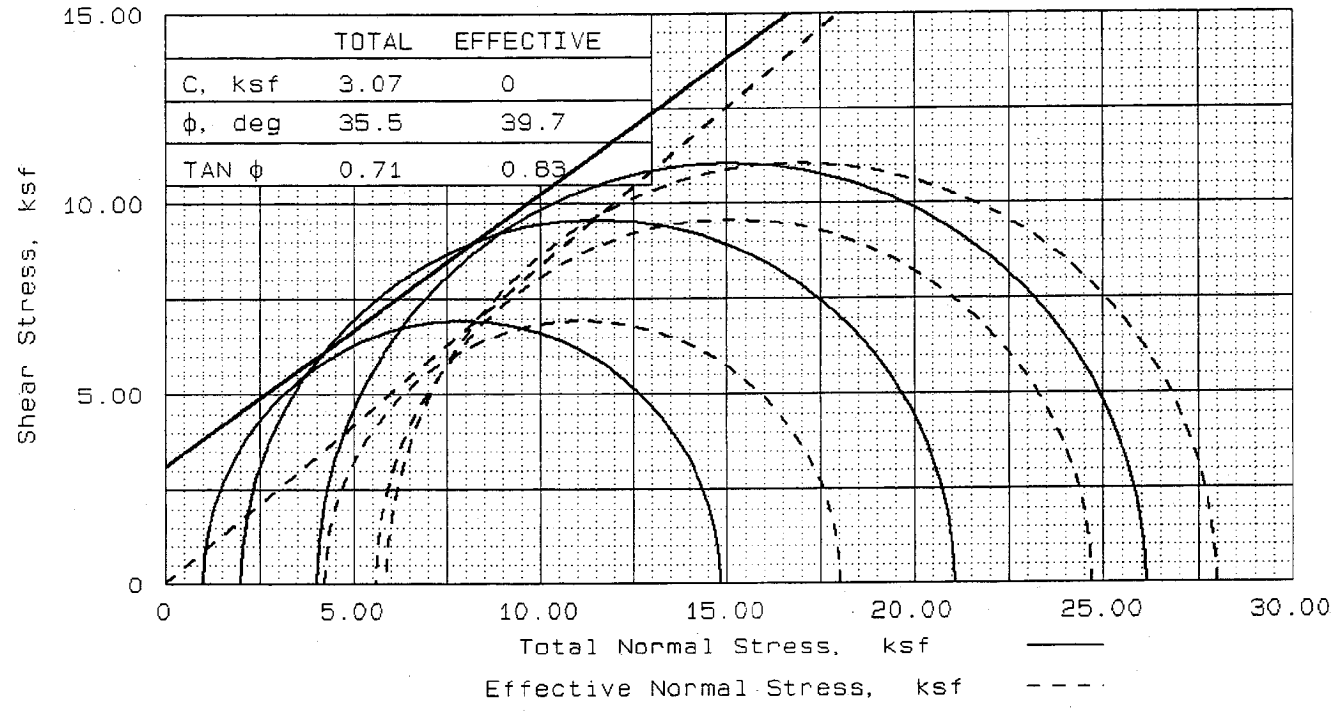
Avg. k at 20 °C 1.5E-04 cm/sec

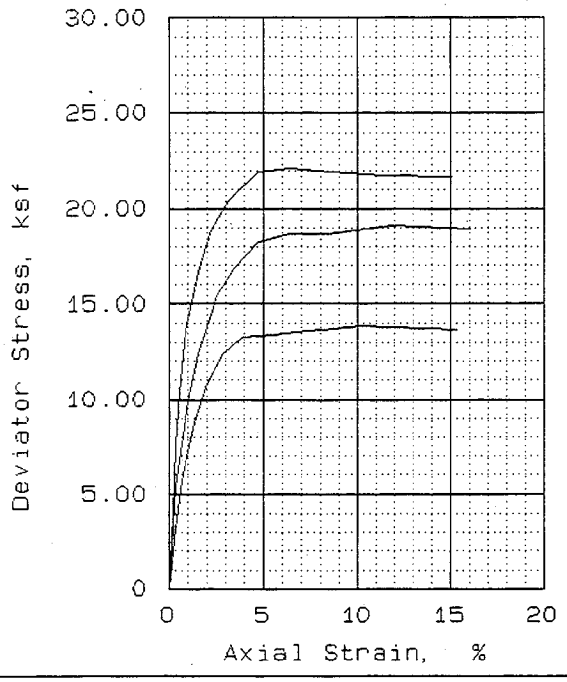
a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H0 = initial head in cm
Hf = final head in cm
t = time in seconds

a = 1.00 cm²
A = 40.582 cm²
L = 15.24 cm

TVA-00012359





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	36.0	37.1	35.2
	DRY DENSITY, pcf	78.1	77.7	78.1
	SATURATION, %	77.2	79.0	77.6
	VOID RATIO	1.399	1.411	1.398
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	46.1	46.6	44.2
	DRY DENSITY, pcf	78.6	78.1	80.6
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.383	1.399	1.325
	DIAMETER, in	2.82	2.83	2.79
	HEIGHT, in	5.99	5.98	5.97
BACK PRESSURE, ksf		5.23	4.29	5.34
CELL PRESSURE, ksf		6.23	6.29	9.34
FAILURE STRESS, ksf		13.84	19.11	22.11
PORE PRESSURE, ksf		2.02	0.71	3.47
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		18.06	24.70	27.98
$\bar{\sigma}_3$ FAILURE, ksf		4.21	5.58	5.87

TYPE OF TEST:
CU with pore pressures
SAMPLE TYPE: Remolded
DESCRIPTION: Gypsum

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 3.00
REMARKS: Tested by: HB

Reviewed by:

FIG. NO.

CLIENT:

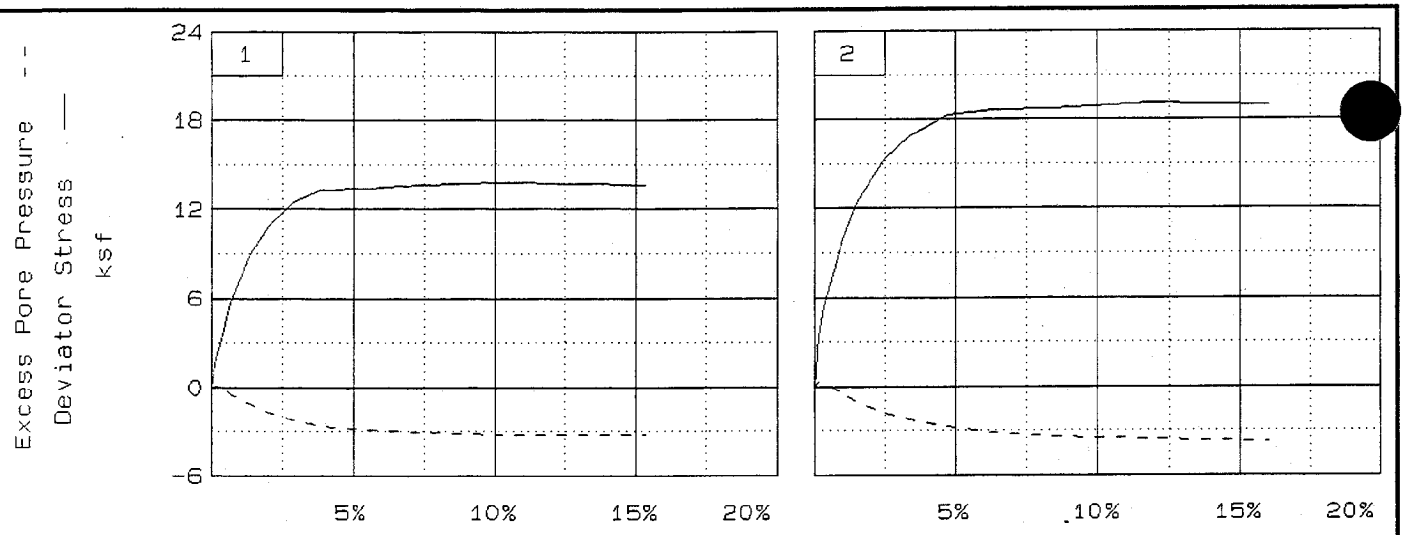
PROJECT: TVA - Paradise

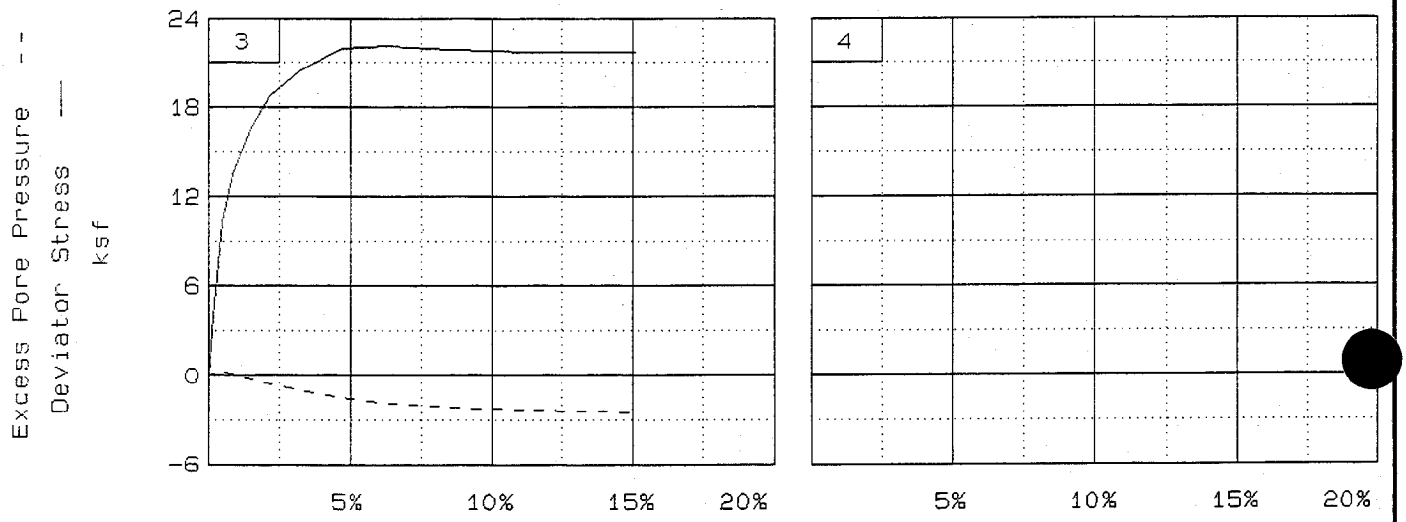
SAMPLE LOCATION: Scrubber Gypsum

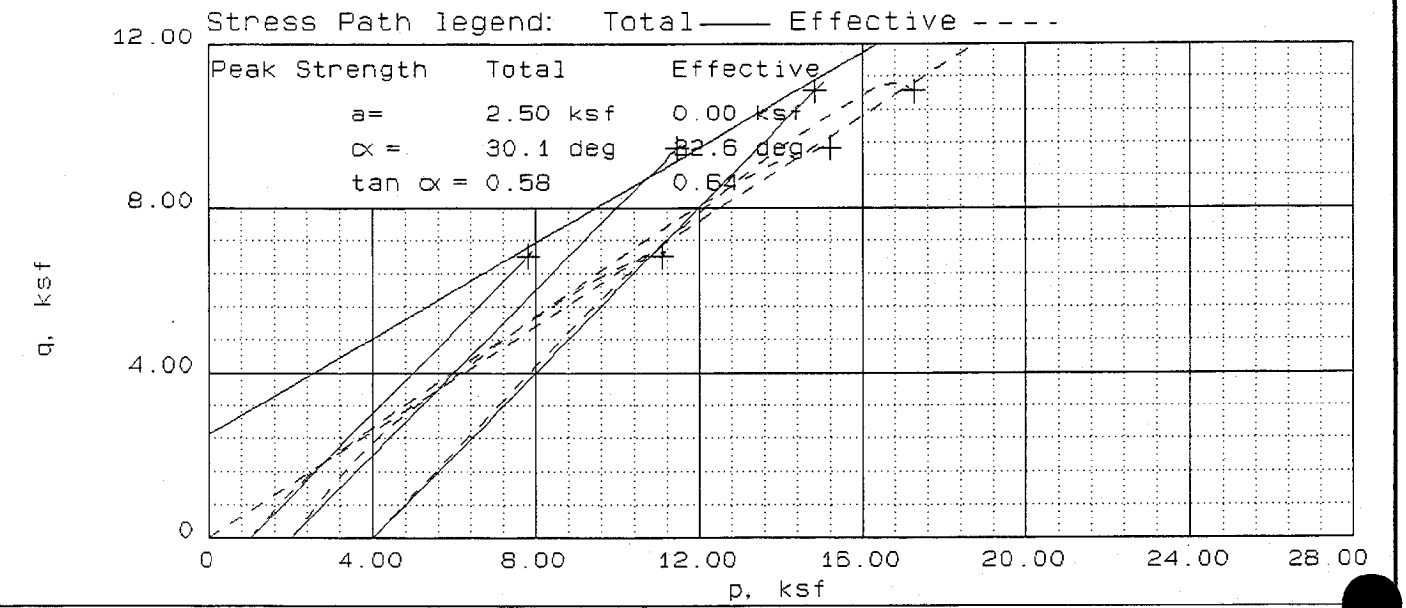
PROJ. NO.: 5810860101 DATE: 10/23/95

TRIAXIAL COMPRESSION TEST

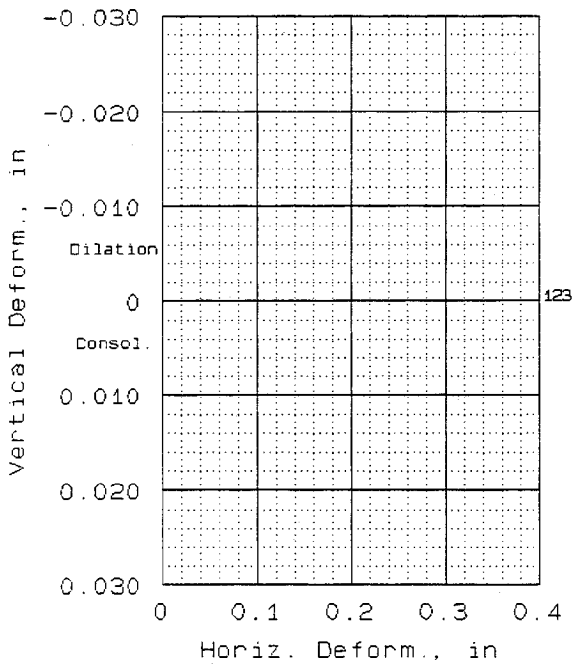
LAW ENGINEERING, INC.

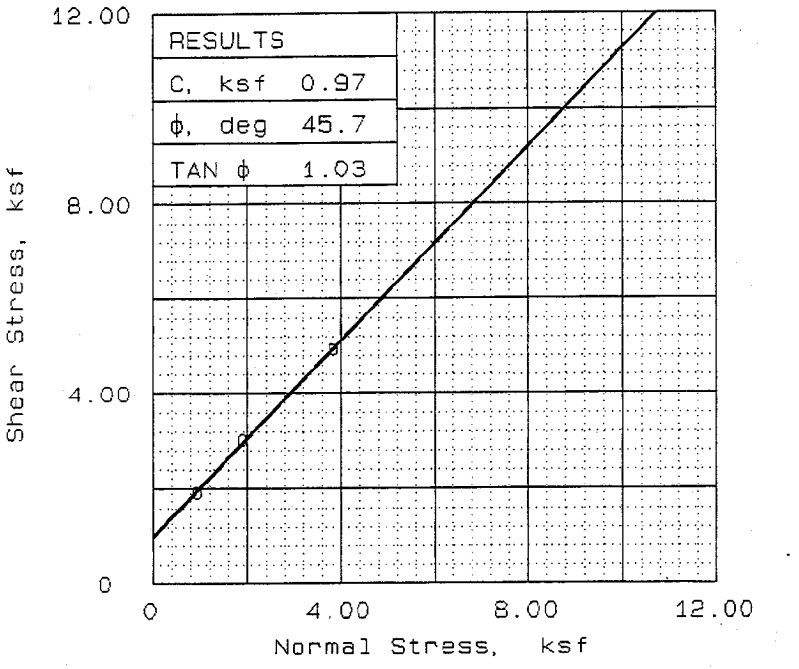


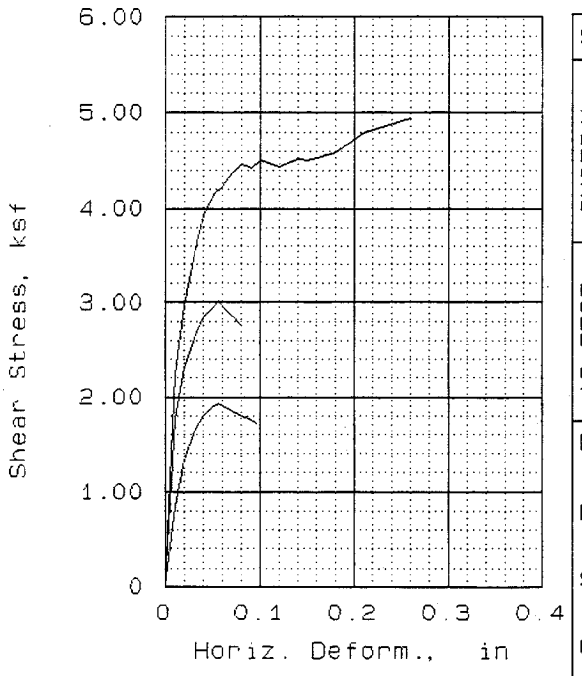




Client:
Project: TVA - Paradise
Location: Scrubber Gypsum
File: 8601Q Project No.: 5810860101 Page 2/2 Fig. No. ____







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	36.1	35.9	35.2
	DRY DENSITY, pcf	75.5	75.1	75.8
	SATURATION, %	80.2	79.1	78.8
	VOID RATIO	1.192	1.203	1.182
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	36.1	35.9	35.2
	DRY DENSITY, pcf	75.5	75.1	75.8
	SATURATION, %	80.2	79.1	78.8
	VOID RATIO	1.192	1.203	1.182
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
NORMAL STRESS, ksf		0.97	1.94	3.88
MAX. SHEAR, ksf		1.93	3.02	4.94
STRAIN RATE, %/min.		0.500	0.500	0.500
ULT. SHEAR, ksf				

SAMPLE DATA

SAMPLE TYPE: Remolded

DESCRIPTION: Gypsum

LL= NL PL= NP PI=

SPECIFIC GRAVITY= 3.00

REMARKS: Tested by: HB

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: TVA - Paradise

SAMPLE LOCATION: Scrubber Gypsum

PROJ. NO.: 5810860101 DATE: 10/10/95

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

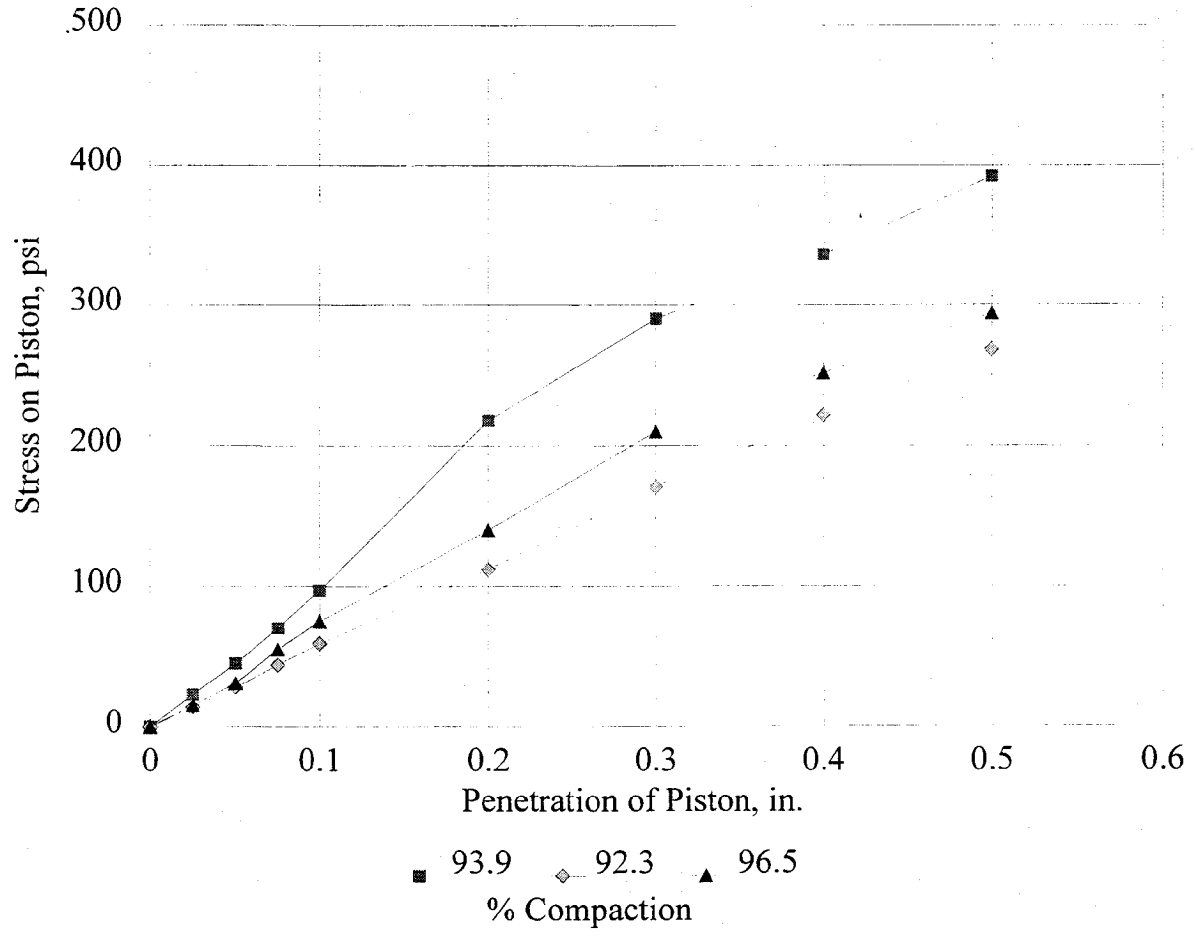
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Paradise	**Test Date**	10/09/95
Material (Source)	Gypsum	**Reviewed By**	RLB
		Review Date	10/10/95

Compaction, %	93.9	92.3	96.5
Before Soak Dry Density, pcf	80.5	79.1	82.7
Before Soak Moisture Content,	33.2	31.5	29.7
After Soak Dry Density, pcf	79.8	76.6	82.0
After Soak Moisture Content, %	40.8	40.9	36.7
CBR @ 0.1 in.	9.7	5.9	7.5
CBR @ 0.2 in.	14.5	7.5	9.3



LABORATORY MATERIAL HANDLING AND TESTING

LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: **LAW ENGINEERING, INC. - ATLANTA, GEORGIA**

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.:*	
	SPECIMEN DIAM., inch	
	TOP	2.85
	MIDDLE	2.85
	BOTTOM	2.85
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.02
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0, inch	6.02
	INITIAL AREA, A_0, in^2	6.28
	INITIAL VOLUME $A_0 L_0$, in^3	37.78
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1053.35
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1053.35
8.	*SOIL PROPERTIES.:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	30.8
	MAX. DRY DENSITY, pcf	85.9
	95 % MAX. DRY DENSITY, pcf	81.6
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	33.8
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	33.8
	COMPACTION DRY DENSITY, γ_d pcf	79.3
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	39.1
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	10-05-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

Richard S. Bradshaw 10/18/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Paradise
2. *MATERIAL DESCRIPTION:* Gypsum
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 10-05-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ . _	_ _ _ . _	_	_ _ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	_ . _ _ _ _ _	_ . _ _ _ _ _	. _ _ _ _ _	. _ _ _ _ _	_ _ _ _ .
SEQUENCE 1	6.0	2.0	95	12.7	11.3	1.3	2.0	1.8	0.2	0.00070	0.00068	0.00069	0.00011	15,805
			96	12.7	11.3	1.4	2.0	1.8	0.2	0.00070	0.00067	0.00069	0.00011	15,806
			97	12.7	11.3	1.3	2.0	1.8	0.2	0.00070	0.00069	0.00070	0.00012	15,607
			98	12.7	11.3	1.3	2.0	1.8	0.2	0.00070	0.00066	0.00068	0.00011	15,904
			100	12.7	11.3	1.4	2.0	1.8	0.2	0.00070	0.00067	0.00069	0.00011	15,831
	COLUMN AVERAGE			12.7	11.3	1.3	2.0	1.8	0.2	0.00070	0.00067	0.00069	0.00011	15,791
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	111

Source: Paradise Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	95	25.1	22.7	2.5	4.0	3.6	0.4	0.00128	0.00125	0.00126	0.00021	17,186
			96	25.1	22.7	2.5	4.0	3.6	0.4	0.00129	0.00124	0.00126	0.00021	17,214
			97	25.1	22.7	2.5	4.0	3.6	0.4	0.00129	0.00123	0.00126	0.00021	17,224
			98	25.1	22.6	2.5	4.0	3.6	0.4	0.00129	0.00123	0.00126	0.00021	17,238
			100	25.1	22.7	2.5	4.0	3.6	0.4	0.00129	0.00123	0.00126	0.00021	17,273
	COLUMN AVERAGE			25.1	22.7	2.5	4.0	3.6	0.4	0.00129	0.00124	0.00126	0.00021	17,227
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	32
SEQUENCE 3	6.0	6.0	95	37.7	34.0	3.7	6.0	5.4	0.6	0.00184	0.00180	0.00182	0.00030	17,889
			96	37.7	34.0	3.7	6.0	5.4	0.6	0.00183	0.00182	0.00183	0.00030	17,867
			97	37.7	34.0	3.7	6.0	5.4	0.6	0.00183	0.00180	0.00182	0.00030	17,928
			98	37.7	34.0	3.7	6.0	5.4	0.6	0.00183	0.00181	0.00182	0.00030	17,915
			100	37.7	34.0	3.7	6.0	5.4	0.6	0.00184	0.00180	0.00182	0.00030	17,878
	COLUMN AVERAGE			37.7	34.0	3.7	6.0	5.4	0.6	0.00184	0.00181	0.00182	0.00030	17,896
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	25
SEQUENCE 4	6.0	8.0	95	50.2	45.3	4.9	8.0	7.2	0.8	0.00235	0.00239	0.00237	0.00039	18,319
			96	50.2	45.2	5.0	8.0	7.2	0.8	0.00235	0.00239	0.00237	0.00039	18,308
			97	50.2	45.2	4.9	8.0	7.2	0.8	0.00235	0.00239	0.00237	0.00039	18,268
			98	50.2	45.2	4.9	8.0	7.2	0.8	0.00236	0.00239	0.00238	0.00039	18,244
			100	50.2	45.3	4.9	8.0	7.2	0.8	0.00235	0.00239	0.00237	0.00039	18,280
	COLUMN AVERAGE			50.2	45.3	4.9	8.0	7.2	0.8	0.00235	0.00239	0.00237	0.00039	18,284
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	30

Source: Paradise Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	95	62.8	56.6	6.2	10.0	9.0	1.0	0.00284	0.00296	0.00290	0.00048	18,710
			96	62.7	56.5	6.2	10.0	9.0	1.0	0.00285	0.00295	0.00290	0.00048	18,694
			97	62.7	56.5	6.2	10.0	9.0	1.0	0.00284	0.00294	0.00289	0.00048	18,746
			98	62.8	56.6	6.2	10.0	9.0	1.0	0.00284	0.00294	0.00289	0.00048	18,768
			100	62.7	56.5	6.2	10.0	9.0	1.0	0.00284	0.00294	0.00289	0.00048	18,754
	COLUMN AVERAGE			62.7	56.5	6.2	10.0	9.0	1.0	0.00284	0.00295	0.00289	0.00048	18,734
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	31
SEQUENCE 6	4.0	2.0	95	13.1	11.3	1.7	2.1	1.8	0.3	0.00072	0.00074	0.00073	0.00012	14,913
			96	13.1	11.3	1.7	2.1	1.8	0.3	0.00072	0.00075	0.00073	0.00012	14,817
			97	13.1	11.3	1.7	2.1	1.8	0.3	0.00072	0.00074	0.00073	0.00012	14,881
			98	13.1	11.3	1.7	2.1	1.8	0.3	0.00072	0.00074	0.00073	0.00012	14,893
			100	13.0	11.3	1.7	2.1	1.8	0.3	0.00072	0.00074	0.00073	0.00012	14,853
	COLUMN AVERAGE			13.1	11.3	1.7	2.1	1.8	0.3	0.00072	0.00074	0.00073	0.00012	14,871
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	37
SEQUENCE 7	4.0	4.0	95	25.1	22.6	2.5	4.0	3.6	0.4	0.00139	0.00137	0.00138	0.00023	15,754
			96	25.1	22.6	2.5	4.0	3.6	0.4	0.00140	0.00137	0.00138	0.00023	15,708
			97	25.1	22.6	2.5	4.0	3.6	0.4	0.00139	0.00138	0.00138	0.00023	15,689
			98	25.1	22.6	2.5	4.0	3.6	0.4	0.00140	0.00136	0.00138	0.00023	15,729
			100	25.1	22.6	2.5	4.0	3.6	0.4	0.00140	0.00137	0.00138	0.00023	15,653
	COLUMN AVERAGE			25.1	22.6	2.5	4.0	3.6	0.4	0.00140	0.00137	0.00138	0.00023	15,706
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	39

Source: Paradise Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	95	37.7	34.0	3.7	6.0	5.4	0.6	0.00198	0.00198	0.00198	0.00033	16,423
			96	37.6	33.9	3.7	6.0	5.4	0.6	0.00197	0.00198	0.00198	0.00033	16,451
			97	37.7	34.0	3.7	6.0	5.4	0.6	0.00199	0.00200	0.00199	0.00033	16,336
			98	37.7	34.0	3.7	6.0	5.4	0.6	0.00198	0.00201	0.00199	0.00033	16,362
			100	37.7	34.0	3.7	6.0	5.4	0.6	0.00199	0.00199	0.00199	0.00033	16,408
	COLUMN AVERAGE			37.7	34.0	3.7	6.0	5.4	0.6	0.00198	0.00199	0.00199	0.00033	16,396
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	47
SEQUENCE 9	4.0	8.0	95	50.2	45.2	4.9	8.0	7.2	0.8	0.00252	0.00258	0.00255	0.00042	17,001
			96	50.1	45.2	4.9	8.0	7.2	0.8	0.00253	0.00258	0.00255	0.00042	16,971
			97	50.2	45.3	4.9	8.0	7.2	0.8	0.00253	0.00258	0.00256	0.00042	16,982
			98	50.2	45.3	4.9	8.0	7.2	0.8	0.00252	0.00259	0.00255	0.00042	16,990
			100	50.2	45.2	4.9	8.0	7.2	0.8	0.00251	0.00258	0.00255	0.00042	17,034
	COLUMN AVERAGE			50.2	45.2	4.9	8.0	7.2	0.8	0.00252	0.00258	0.00255	0.00042	16,996
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	24
SEQUENCE 10	4.0	10.0	95	62.8	56.6	6.2	10.0	9.0	1.0	0.00307	0.00315	0.00311	0.00052	17,476
			96	62.8	56.6	6.2	10.0	9.0	1.0	0.00306	0.00314	0.00310	0.00052	17,499
			97	62.7	56.6	6.2	10.0	9.0	1.0	0.00307	0.00315	0.00311	0.00052	17,453
			98	62.7	56.6	6.2	10.0	9.0	1.0	0.00307	0.00313	0.00310	0.00051	17,497
			100	62.7	56.5	6.2	10.0	9.0	1.0	0.00306	0.00314	0.00310	0.00052	17,473
	COLUMN AVERAGE			62.7	56.6	6.2	10.0	9.0	1.0	0.00306	0.00314	0.00310	0.00052	17,480
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	19

Source: Paradise Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	95	13.4	11.3	2.1	2.1	1.8	0.3	0.00081	0.00083	0.00082	0.00014	13,265
			96	13.4	11.3	2.1	2.1	1.8	0.3	0.00081	0.00083	0.00082	0.00014	13,291
			97	13.4	11.4	2.1	2.1	1.8	0.3	0.00082	0.00084	0.00083	0.00014	13,151
			98	13.4	11.3	2.1	2.1	1.8	0.3	0.00081	0.00084	0.00082	0.00014	13,154
			100	13.4	11.3	2.1	2.1	1.8	0.3	0.00081	0.00084	0.00082	0.00014	13,150
	COLUMN AVERAGE			13.4	11.3	2.1	2.1	1.8	0.3	0.00081	0.00083	0.00082	0.00014	13,202
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	70
SEQUENCE 12	2.0	4.0	95	25.2	23.1	2.1	4.0	3.7	0.3	0.00161	0.00164	0.00162	0.00027	13,626
			96	24.8	22.7	2.1	3.9	3.6	0.3	0.00158	0.00162	0.00160	0.00027	13,619
			97	25.0	23.0	2.1	4.0	3.7	0.3	0.00160	0.00164	0.00162	0.00027	13,587
			98	24.8	22.7	2.1	4.0	3.6	0.3	0.00156	0.00159	0.00158	0.00026	13,807
			100	24.7	22.6	2.1	3.9	3.6	0.3	0.00158	0.00161	0.00159	0.00026	13,595
	COLUMN AVERAGE			24.9	22.8	2.1	4.0	3.6	0.3	0.00159	0.00162	0.00160	0.00027	13,647
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	91
SEQUENCE 13	2.0	6.0	95	37.5	33.9	3.6	6.0	5.4	0.6	0.00226	0.00227	0.00226	0.00038	14,375
			96	37.5	33.9	3.6	6.0	5.4	0.6	0.00225	0.00228	0.00227	0.00038	14,349
			97	37.6	33.9	3.6	6.0	5.4	0.6	0.00226	0.00226	0.00226	0.00038	14,377
			98	37.5	33.9	3.6	6.0	5.4	0.6	0.00226	0.00226	0.00226	0.00038	14,408
			100	37.5	33.9	3.6	6.0	5.4	0.6	0.00226	0.00227	0.00226	0.00038	14,357
	COLUMN AVERAGE			37.5	33.9	3.6	6.0	5.4	0.6	0.00226	0.00227	0.00226	0.00038	14,373
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	22

Source: Paradise Description: Gypsum 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	95	50.1	45.3	4.9	8.0	7.2	0.8	0.00286	0.00290	0.00288	0.00048	15,072
			96	50.1	45.3	4.9	8.0	7.2	0.8	0.00284	0.00292	0.00288	0.00048	15,090
			97	50.2	45.3	4.9	8.0	7.2	0.8	0.00285	0.00291	0.00288	0.00048	15,100
			98	50.2	45.3	4.9	8.0	7.2	0.8	0.00285	0.00291	0.00288	0.00048	15,087
			100	50.2	45.3	4.9	8.0	7.2	0.8	0.00285	0.00290	0.00288	0.00048	15,106
	COLUMN AVERAGE			50.2	45.3	4.9	8.0	7.2	0.8	0.00285	0.00291	0.00288	0.00048	15,091
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	13
SEQUENCE 15	2.0	10.0	95	62.7	56.6	6.1	10.0	9.0	1.0	0.00345	0.00353	0.00349	0.00058	15,573
			96	62.7	56.5	6.2	10.0	9.0	1.0	0.00345	0.00353	0.00349	0.00058	15,533
			97	62.7	56.6	6.1	10.0	9.0	1.0	0.00345	0.00352	0.00349	0.00058	15,554
			98	62.7	56.6	6.1	10.0	9.0	1.0	0.00344	0.00352	0.00348	0.00058	15,585
			100	62.7	56.6	6.1	10.0	9.0	1.0	0.00343	0.00354	0.00349	0.00058	15,564
	COLUMN AVERAGE			62.7	56.6	6.1	10.0	9.0	1.0	0.00344	0.00353	0.00349	0.00058	15,562
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	20

SUBMITTED BY, DATE

Richard S. Boudreau 10/18/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995

$$M_R = K1\ (S_C)^{K2}(1+S_3)^{K5}$$

K1 =	9,420
K2 =	0.10296
K5 =	0.23879
R^2 =	0.99

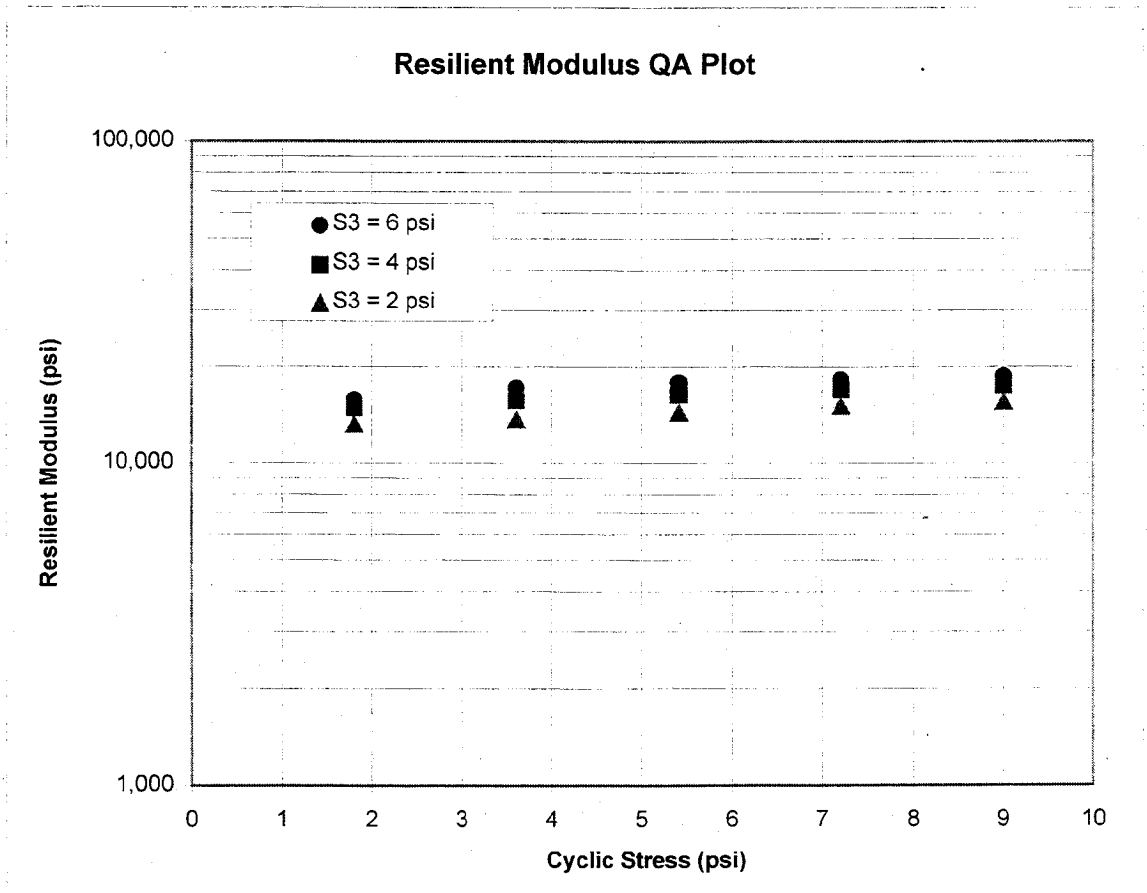
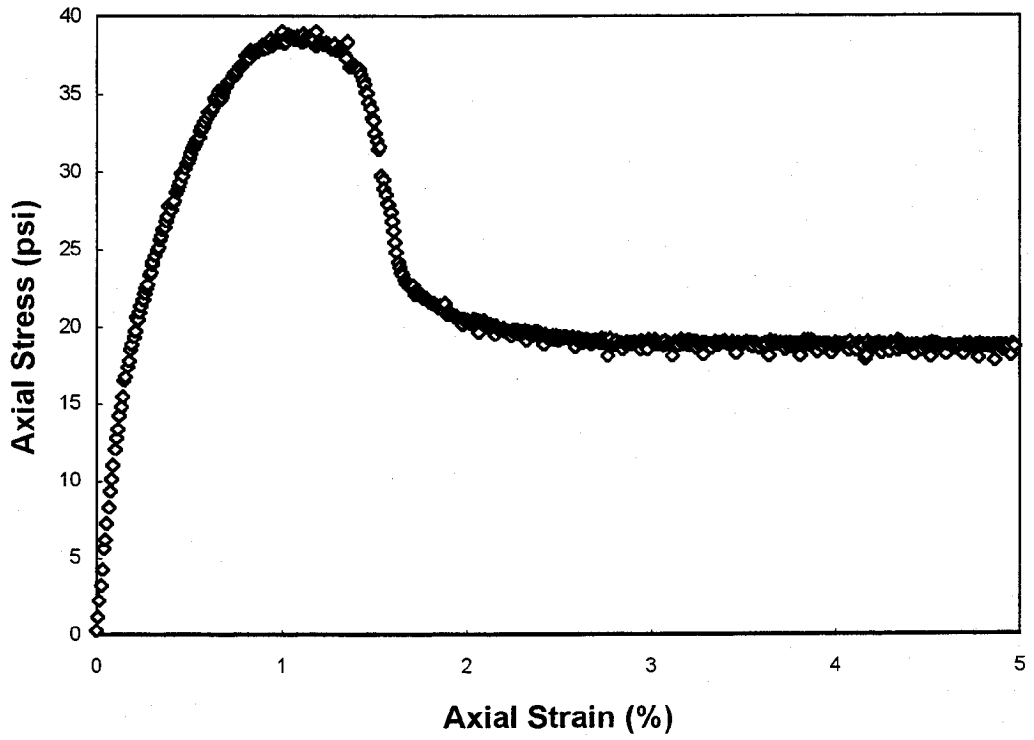


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995



LABORATORY MATERIAL HANDLING AND TESTING
LABORATORY MATERIAL TEST DATA
RESILIENT MODULUS OF UNBOUND GRANULAR BASE/SUBBASE MATERIALS AND SUBGRADE SOILS
LAB DATA SHEET T46 - RECOMPACTED SAMPLES

UNBOUND GRANULAR BASE/SUBBASE LAYERS AND SUBGRADE SOILS
SHRP TEST DESIGNATION UG07, SS07/SHRP PROTOCOL P46

LABORATORY PERFORMING TEST: LAW ENGINEERING, INC. - ATLANTA, GEORGIA

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study

LAW PROJECT NO.: 5810860101

1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE* (Type 1 or Type 2)	2
5.	*TEST INFORMATION*	
	PRECONDITIONING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - GREATER THAN 5% PERM. STRAIN? (Y = YES OR N = NO)	N
	TESTING - NUMBER OF LOAD SEQUENCES COMPLETED (0 - 15)	15
6.	*SPECIMEN INFO.:*	
	SPECIMEN DIAM., inch	
	TOP	2.85
	MIDDLE	2.85
	BOTTOM	2.85
	AVERAGE	2.85
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.83
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.03
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.03
	INITIAL AREA, A_0 , in^2	6.27
	INITIAL VOLUME A_0L_0 , in^3	37.80
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1071.77
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1071.77
8.	*SOIL PROPERTIES.:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	30.8
	MAX. DRY DENSITY, pcf	87.4
	95 % MAX. DRY DENSITY, pcf	83.0
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	32.6
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	32.6
	COMPACTION DRY DENSITY, γ_d pcf	81.4
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	46.1
	SPECIMEN FAIL DURING TRIAXIAL SHEAR? (Y = YES, N = NO)	Y
11.	*COMMENTS* (Section 10.4 of Protocol P46)	
	(a) *CODE*	0 0 0 0 0 0
	(b) *NOTE*	
12.	*TEST DATE*	10-05-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

Michael S. Bradley 10/18/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Paradise
2. *MATERIAL DESCRIPTION:* Gypsum
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 10-05-1995
6. *RESILIENT MODULUS TESTING*

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	*Chamber Confining Pressure*	*Nominal Maximum Axial Stress*	*Cycle No.*	*Actual Applied Max. Axial Load*	*Actual Applied Cyclic Load*	*Actual Applied Contact Load*	*Actual Applied Max. Axial Stress*	*Actual Applied Cyclic Stress*	*Actual Applied Contact Stress*	*Recov. Def. LVDT #1 Reading*	*Recov. Def. LVDT #2 Reading*	*Average Recov Def. LVDT 1 and 2*	*Resilient Strain*	*Resilient Modulus*
DESIGNATION	S_3	S_{cyclic}	c_1	P_{max}	P_{cyclic}	$P_{contact}$	S_{max}	S_{cyclic}	$S_{contact}$	H_1	H_2	H_{avg}	ε_r	M_r
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	_ _ _ . _	_ _ _ . _	_	_ _ _ _ . _	_ _ _ . _	_ _ _ _ . _	_ _ _ . _	_ _ _ . _	_ _ _ . _	. _ _ _ _ _	. _ _ _ _ _	. _ _ _ _ _	. _ _ _ _ _	_ _ _ .
SEQUENCE 1	6.0	2.0	95	12.6	11.2	1.3	2.0	1.8	0.2	0.00067	0.00059	0.00063	0.00010	17,082
			96	12.7	11.3	1.3	2.0	1.8	0.2	0.00067	0.00059	0.00063	0.00010	17,299
			97	12.6	11.3	1.3	2.0	1.8	0.2	0.00067	0.00059	0.00063	0.00010	17,286
			98	12.6	11.3	1.3	2.0	1.8	0.2	0.00067	0.00059	0.00063	0.00010	17,137
			100	12.6	11.3	1.3	2.0	1.8	0.2	0.00067	0.00059	0.00063	0.00010	17,272
	COLUMN AVERAGE			12.6	11.3	1.3	2.0	1.8	0.2	0.00067	0.00059	0.00063	0.00010	17,215
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	99

Source: Paradise Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	95	25.0	22.5	2.4	4.0	3.6	0.4	0.00128	0.00111	0.00119	0.00020	18,173
			96	25.1	22.6	2.4	4.0	3.6	0.4	0.00128	0.00111	0.00119	0.00020	18,205
			97	25.1	22.6	2.4	4.0	3.6	0.4	0.00127	0.00110	0.00119	0.00020	18,321
			98	25.0	22.5	2.5	4.0	3.6	0.4	0.00128	0.00111	0.00119	0.00020	18,147
			100	25.0	22.6	2.5	4.0	3.6	0.4	0.00127	0.00110	0.00119	0.00020	18,268
	COLUMN AVERAGE			25.0	22.6	2.4	4.0	3.6	0.4	0.00128	0.00111	0.00119	0.00020	18,223
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	71
SEQUENCE 3	6.0	6.0	95	37.6	33.9	3.7	6.0	5.4	0.6	0.00185	0.00164	0.00175	0.00029	18,661
			96	37.6	33.9	3.7	6.0	5.4	0.6	0.00185	0.00165	0.00175	0.00029	18,617
			97	37.6	33.9	3.7	6.0	5.4	0.6	0.00185	0.00164	0.00175	0.00029	18,674
			98	37.6	33.9	3.7	6.0	5.4	0.6	0.00185	0.00165	0.00175	0.00029	18,617
			100	37.6	33.9	3.7	6.0	5.4	0.6	0.00185	0.00166	0.00175	0.00029	18,568
	COLUMN AVERAGE			37.6	33.9	3.7	6.0	5.4	0.6	0.00185	0.00165	0.00175	0.00029	18,627
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	42
SEQUENCE 4	6.0	8.0	95	50.2	45.3	4.9	8.0	7.2	0.8	0.00242	0.00217	0.00229	0.00038	18,990
			96	50.2	45.3	4.9	8.0	7.2	0.8	0.00241	0.00216	0.00229	0.00038	19,024
			97	50.3	45.4	4.9	8.0	7.2	0.8	0.00242	0.00216	0.00229	0.00038	19,062
			98	50.2	45.3	4.9	8.0	7.2	0.8	0.00243	0.00216	0.00229	0.00038	18,988
			100	50.2	45.3	4.9	8.0	7.2	0.8	0.00242	0.00216	0.00229	0.00038	19,022
	COLUMN AVERAGE			50.2	45.3	4.9	8.0	7.2	0.8	0.00242	0.00216	0.00229	0.00038	19,017
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	30

Source: Paradise Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	95	62.6	56.5	6.1	10.0	9.0	1.0	0.00296	0.00266	0.00281	0.00047	19,338
			96	62.6	56.5	6.2	10.0	9.0	1.0	0.00293	0.00267	0.00280	0.00046	19,388
			97	62.6	56.4	6.2	10.0	9.0	1.0	0.00295	0.00266	0.00280	0.00047	19,347
			98	62.6	56.5	6.1	10.0	9.0	1.0	0.00294	0.00267	0.00281	0.00047	19,342
			100	62.5	56.4	6.2	10.0	9.0	1.0	0.00294	0.00265	0.00279	0.00046	19,399
	COLUMN AVERAGE			62.6	56.5	6.2	10.0	9.0	1.0	0.00294	0.00266	0.00280	0.00046	19,363
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	28
SEQUENCE 6	4.0	2.0	95	13.0	11.3	1.7	2.1	1.8	0.3	0.00071	0.00063	0.00067	0.00011	16,158
			96	13.0	11.3	1.7	2.1	1.8	0.3	0.00072	0.00062	0.00067	0.00011	16,177
			97	13.0	11.3	1.7	2.1	1.8	0.3	0.00070	0.00063	0.00067	0.00011	16,261
			98	13.0	11.3	1.7	2.1	1.8	0.3	0.00071	0.00063	0.00067	0.00011	16,149
			100	13.0	11.3	1.7	2.1	1.8	0.3	0.00071	0.00063	0.00067	0.00011	16,153
	COLUMN AVERAGE			13.0	11.3	1.7	2.1	1.8	0.3	0.00071	0.00063	0.00067	0.00011	16,180
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	47
SEQUENCE 7	4.0	4.0	95	25.1	22.7	2.4	4.0	3.6	0.4	0.00134	0.00120	0.00127	0.00021	17,162
			96	25.0	22.6	2.4	4.0	3.6	0.4	0.00134	0.00119	0.00127	0.00021	17,149
			97	25.1	22.6	2.4	4.0	3.6	0.4	0.00134	0.00121	0.00127	0.00021	17,063
			98	25.1	22.6	2.4	4.0	3.6	0.4	0.00134	0.00119	0.00127	0.00021	17,157
			100	25.0	22.6	2.4	4.0	3.6	0.4	0.00134	0.00120	0.00127	0.00021	17,077
	COLUMN AVERAGE			25.0	22.6	2.4	4.0	3.6	0.4	0.00134	0.00120	0.00127	0.00021	17,122
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	47

Source: Paradise Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	95	37.6	33.9	3.7	6.0	5.4	0.6	0.00193	0.00178	0.00185	0.00031	17,597
			96	37.7	34.0	3.7	6.0	5.4	0.6	0.00194	0.00177	0.00186	0.00031	17,590
			97	37.7	34.0	3.7	6.0	5.4	0.6	0.00194	0.00177	0.00186	0.00031	17,615
			98	37.7	34.0	3.7	6.0	5.4	0.6	0.00194	0.00176	0.00185	0.00031	17,634
			100	37.7	34.0	3.7	6.0	5.4	0.6	0.00195	0.00177	0.00186	0.00031	17,583
	COLUMN AVERAGE			37.7	34.0	3.7	6.0	5.4	0.6	0.00194	0.00177	0.00185	0.00031	17,604
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	20
SEQUENCE 9	4.0	8.0	95	50.1	45.2	4.9	8.0	7.2	0.8	0.00251	0.00232	0.00242	0.00040	17,979
			96	50.1	45.2	4.9	8.0	7.2	0.8	0.00250	0.00233	0.00241	0.00040	17,990
			97	50.1	45.2	4.9	8.0	7.2	0.8	0.00252	0.00231	0.00242	0.00040	17,966
			98	50.0	45.2	4.8	8.0	7.2	0.8	0.00250	0.00233	0.00242	0.00040	18,000
			100	50.1	45.1	4.9	8.0	7.2	0.8	0.00251	0.00232	0.00242	0.00040	17,970
	COLUMN AVERAGE			50.1	45.2	4.9	8.0	7.2	0.8	0.00251	0.00232	0.00242	0.00040	17,981
	STANDARD DEV.			0.0	0.0	0.1	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	14
SEQUENCE 10	4.0	10.0	95	62.5	56.5	6.1	10.0	9.0	1.0	0.00308	0.00285	0.00297	0.00049	18,298
			96	62.7	56.5	6.2	10.0	9.0	1.0	0.00309	0.00284	0.00297	0.00049	18,315
			97	62.0	55.9	6.1	9.9	8.9	1.0	0.00305	0.00283	0.00294	0.00049	18,262
			98	62.6	56.6	6.0	10.0	9.0	1.0	0.00308	0.00284	0.00296	0.00049	18,379
			100	62.6	57.1	5.5	10.0	9.1	0.9	0.00310	0.00286	0.00298	0.00049	18,421
	COLUMN AVERAGE			62.5	56.5	6.0	10.0	9.0	1.0	0.00308	0.00284	0.00296	0.00049	18,335
	STANDARD DEV.			0.3	0.4	0.3	0.0	0.1	0.0	0.00002	0.00001	0.00001	0.00000	64

Source: Paradise Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	95	13.3	11.6	1.6	2.1	1.9	0.3	0.00081	0.00076	0.00078	0.00013	14,287
			96	12.9	11.3	1.6	2.1	1.8	0.3	0.00078	0.00074	0.00076	0.00013	14,227
			97	13.4	11.8	1.6	2.1	1.9	0.3	0.00081	0.00078	0.00080	0.00013	14,240
			98	13.6	12.0	1.6	2.2	1.9	0.3	0.00083	0.00078	0.00081	0.00013	14,278
			100	13.6	11.8	1.8	2.2	1.9	0.3	0.00082	0.00076	0.00079	0.00013	14,285
	COLUMN AVERAGE			13.3	11.7	1.7	2.1	1.9	0.3	0.00081	0.00077	0.00079	0.00013	14,263
	STANDARD DEV.			0.3	0.3	0.1	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	28
SEQUENCE 12	2.0	4.0	95	24.9	22.6	2.3	4.0	3.6	0.4	0.00149	0.00138	0.00144	0.00024	15,094
			96	24.9	22.6	2.3	4.0	3.6	0.4	0.00149	0.00138	0.00144	0.00024	15,124
			97	25.2	22.9	2.3	4.0	3.7	0.4	0.00153	0.00140	0.00147	0.00024	15,024
			98	24.8	22.6	2.2	4.0	3.6	0.4	0.00149	0.00138	0.00144	0.00024	15,108
			100	24.9	22.7	2.2	4.0	3.6	0.3	0.00150	0.00138	0.00144	0.00024	15,177
	COLUMN AVERAGE			24.9	22.7	2.3	4.0	3.6	0.4	0.00150	0.00138	0.00144	0.00024	15,106
	STANDARD DEV.			0.2	0.2	0.1	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	55
SEQUENCE 13	2.0	6.0	95	37.6	34.0	3.6	6.0	5.4	0.6	0.00214	0.00201	0.00208	0.00034	15,741
			96	37.6	34.0	3.5	6.0	5.4	0.6	0.00215	0.00202	0.00209	0.00035	15,683
			97	37.8	34.2	3.6	6.0	5.5	0.6	0.00216	0.00201	0.00209	0.00035	15,756
			98	37.6	34.1	3.5	6.0	5.4	0.6	0.00216	0.00201	0.00209	0.00035	15,726
			100	37.5	33.9	3.5	6.0	5.4	0.6	0.00216	0.00201	0.00208	0.00035	15,663
	COLUMN AVERAGE			37.6	34.1	3.5	6.0	5.4	0.6	0.00215	0.00201	0.00208	0.00035	15,714
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	39

Source: Paradise Description: Gypsum 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	95	50.0	45.2	4.8	8.0	7.2	0.8	0.00277	0.00258	0.00267	0.00044	16,247
			96	50.0	45.2	4.8	8.0	7.2	0.8	0.00277	0.00259	0.00268	0.00044	16,198
			97	50.0	45.2	4.8	8.0	7.2	0.8	0.00277	0.00259	0.00268	0.00044	16,213
			98	50.0	45.1	4.8	8.0	7.2	0.8	0.00276	0.00260	0.00268	0.00044	16,191
			100	50.0	45.1	4.9	8.0	7.2	0.8	0.00275	0.00259	0.00267	0.00044	16,230
	COLUMN AVERAGE			50.0	45.2	4.8	8.0	7.2	0.8	0.00277	0.00259	0.00268	0.00044	16,216
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	23
SEQUENCE 15	2.0	10.0	95	62.8	56.7	6.1	10.0	9.0	1.0	0.00338	0.00318	0.00328	0.00054	16,628
			96	62.7	56.6	6.1	10.0	9.0	1.0	0.00337	0.00318	0.00327	0.00054	16,634
			97	62.7	56.6	6.1	10.0	9.0	1.0	0.00338	0.00318	0.00328	0.00054	16,587
			98	62.8	56.7	6.1	10.0	9.0	1.0	0.00338	0.00317	0.00327	0.00054	16,670
			100	62.7	56.6	6.1	10.0	9.0	1.0	0.00338	0.00318	0.00328	0.00054	16,599
	COLUMN AVERAGE			62.8	56.7	6.1	10.0	9.0	1.0	0.00338	0.00318	0.00328	0.00054	16,624
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	33

SUBMITTED BY, DATE

Richard S. Bowman 10/18/95

LABORATORY MANAGER

FIGURE 1 - Logarithmic Plot of Resilient Modulus (M_R) vs Cyclic Stress (S_C)

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995

$$M_R = K1\,(S_C)^{K2}(1+S_3)^{K5}$$

K1 =	10,977
K2 =	0.08137
K5 =	0.20492
R^2 =	0.99

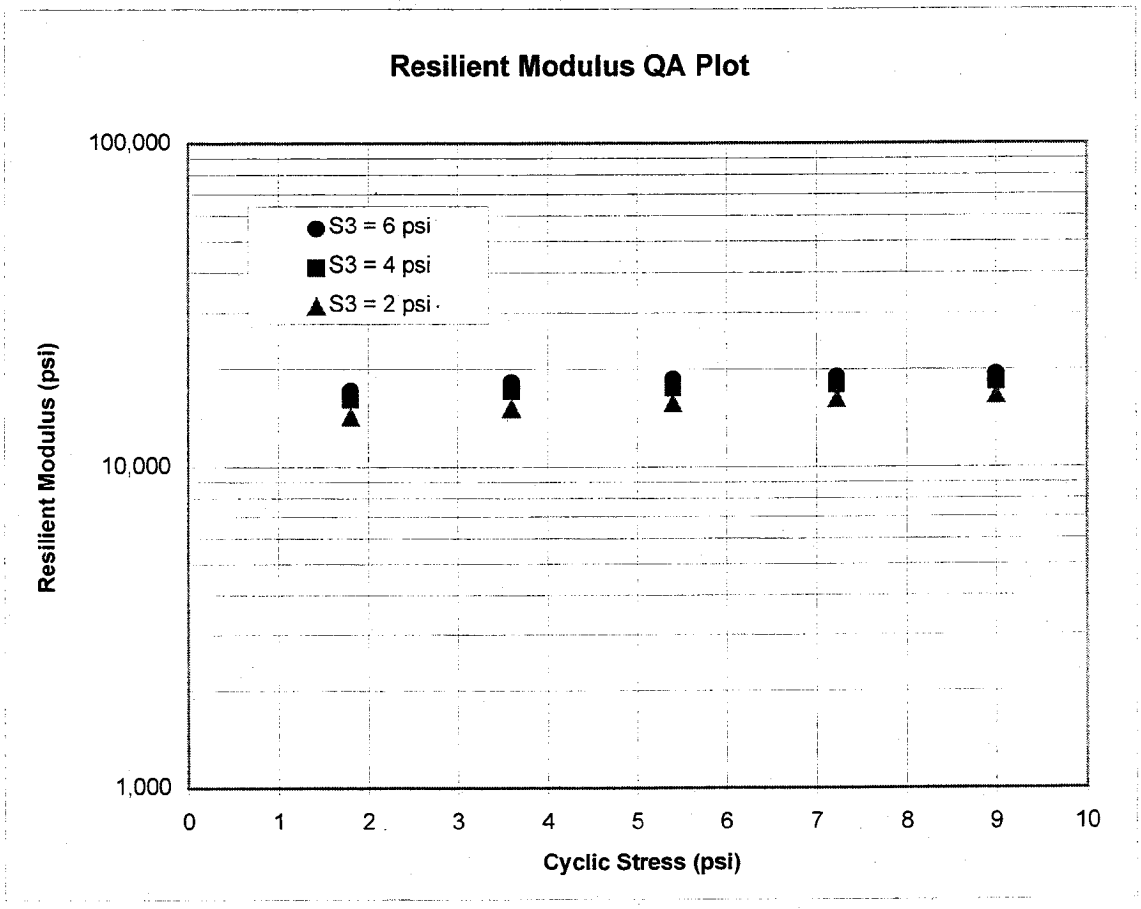


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Paradise
2.	*MATERIAL DESCRIPTION:*	Gypsum
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	10-05-1995