JOHN SEVIER

Dry Fly Ash (Units 3-4)
Bottom Ash - From Pond

JOHN SEVIER

Dry Fly Ash (Units 3-4)

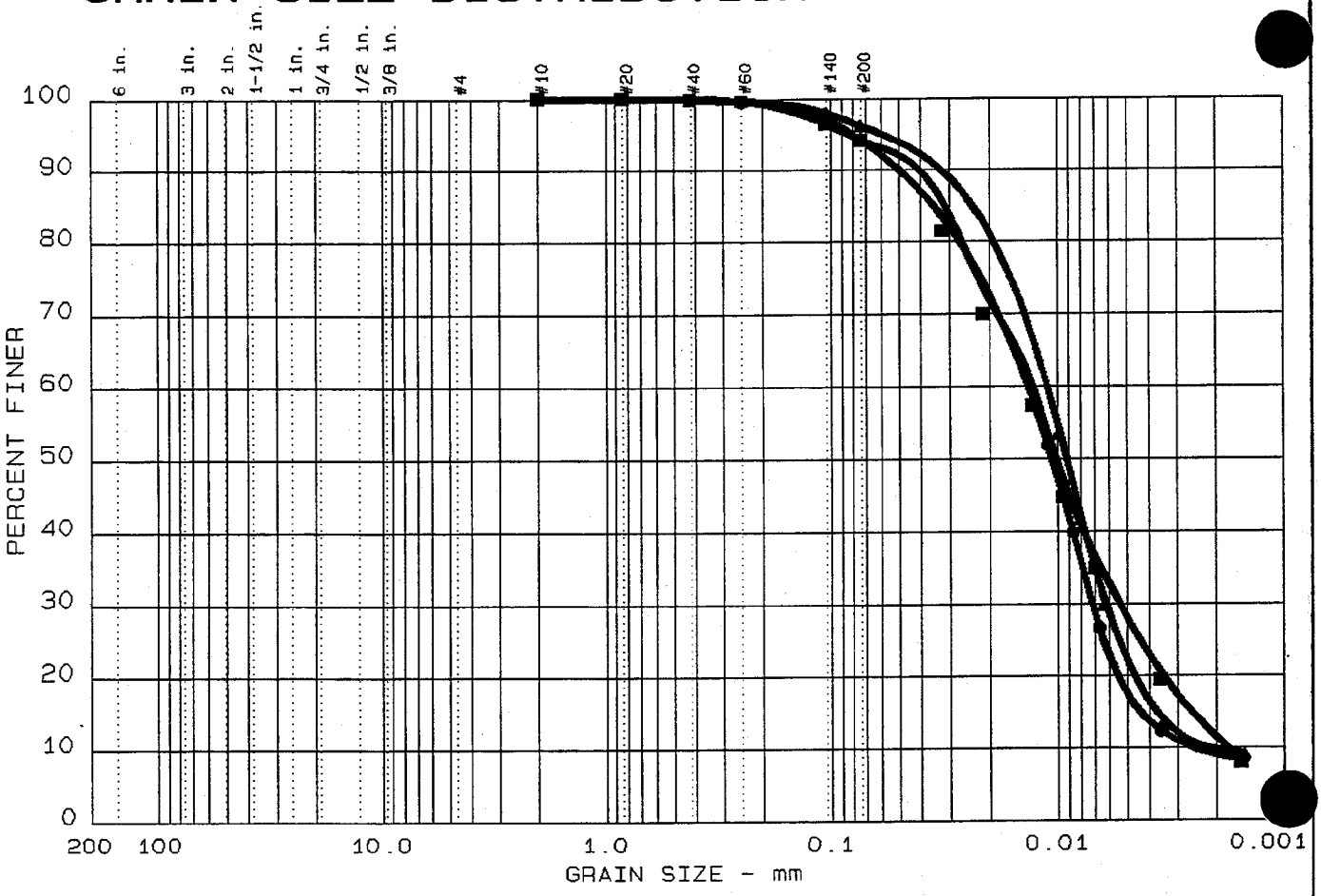
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus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

TVA - JOHN SEVIER
DRY FLY ASH (UNITS 3-4)

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 94.2 17.4	0.0 96.1 22.1	0.0 94.1 28.0
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	2.27	2.35	2.43
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, %	83.7 18.6		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	86.7 17.8		
			Result	Dry Density, pcf	Moisture Content, %
Consolidation	ASTM D2435	Compression Index C_c	0.05	81.4	22.0
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	5.5E-5	80.5	21.8
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ', degrees	0.22 22.4	80.5	21.8
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	0.26 17.7	80.5	21.8
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	1.11 33.6	80.0	21.9
California Bearing Ratio	ASTM D 1883	CBR, %	1	79.7	22.0
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	4,813	79.8	21.5
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	6,095	80.8	17.8
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	440		
pH of Soil	AASHTO T 289	pH	4.1		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	4910		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	<10		

jsf-fa.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	12	0.0	0.0	5.8	76.8	17.4
▲	13	0.0	0.0	3.9	74.0	22.1
■	14	0.0	0.0	5.9	66.1	28.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP			0.01	0.007	0.0044	0.0025	1.52	5.5
▲	NL	NP			0.01	0.006	0.0037	0.0022	1.60	5.1
■	NL	NP			0.01	0.005	0.0025	0.0018	1.29	7.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Units 3-4	ML	A-4 (0.0)
▲ Units 3-4	ML	A-4 (0.0)
■ Units 3-4	ML	A-4 (0.0)

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

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

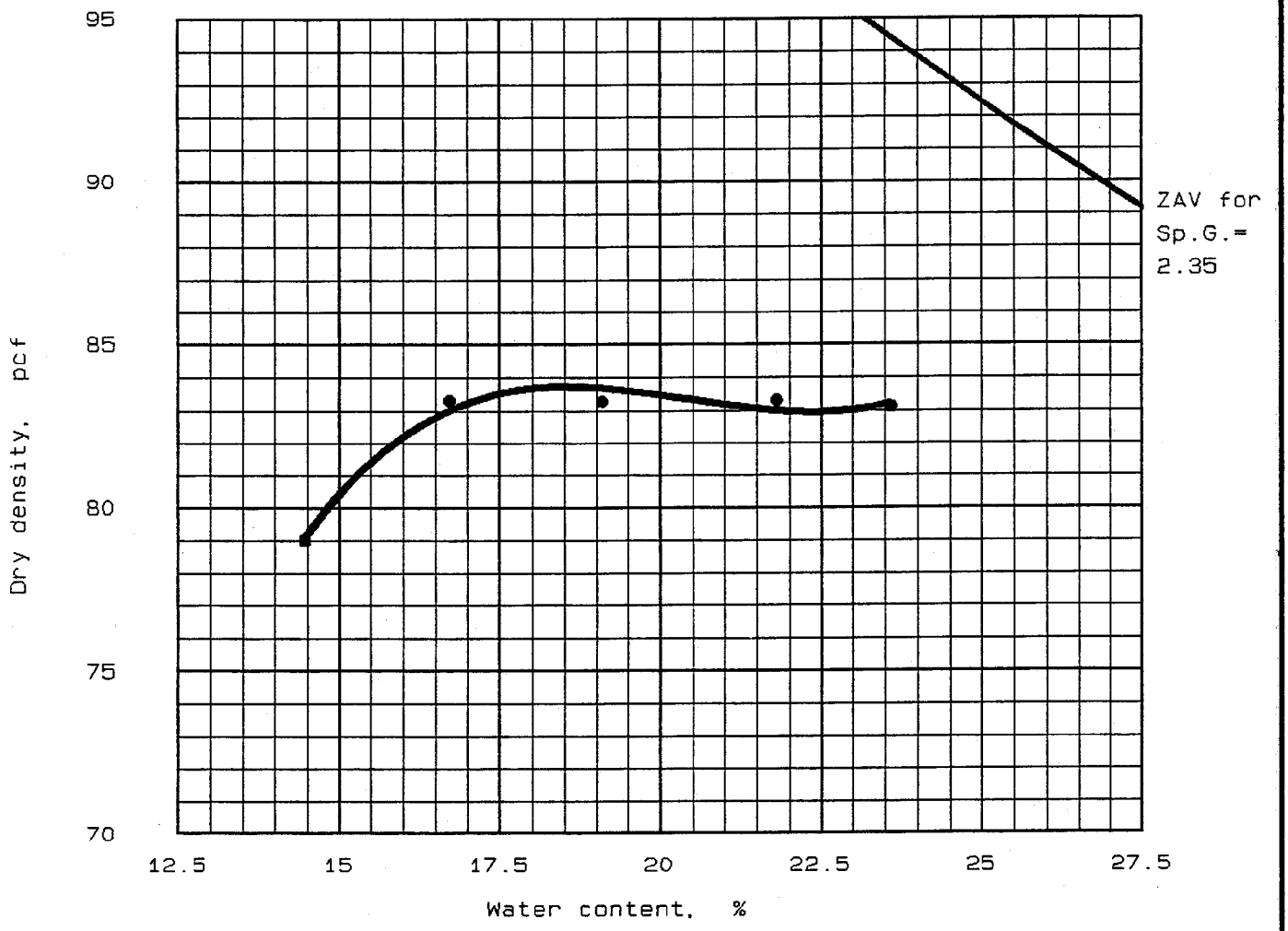
Remarks:

Tested by: JCE

Reviewed by: HS

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)	.09 %	2.35	NL	NP	0 %	94.8 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 18.6 % Maximum dry density = 83.7 pcf	

Project No.: 5810860101
Project: TVA - John Sevier
Location: Dry Fly Ash
Units 3-4
Date: July 25, 1995

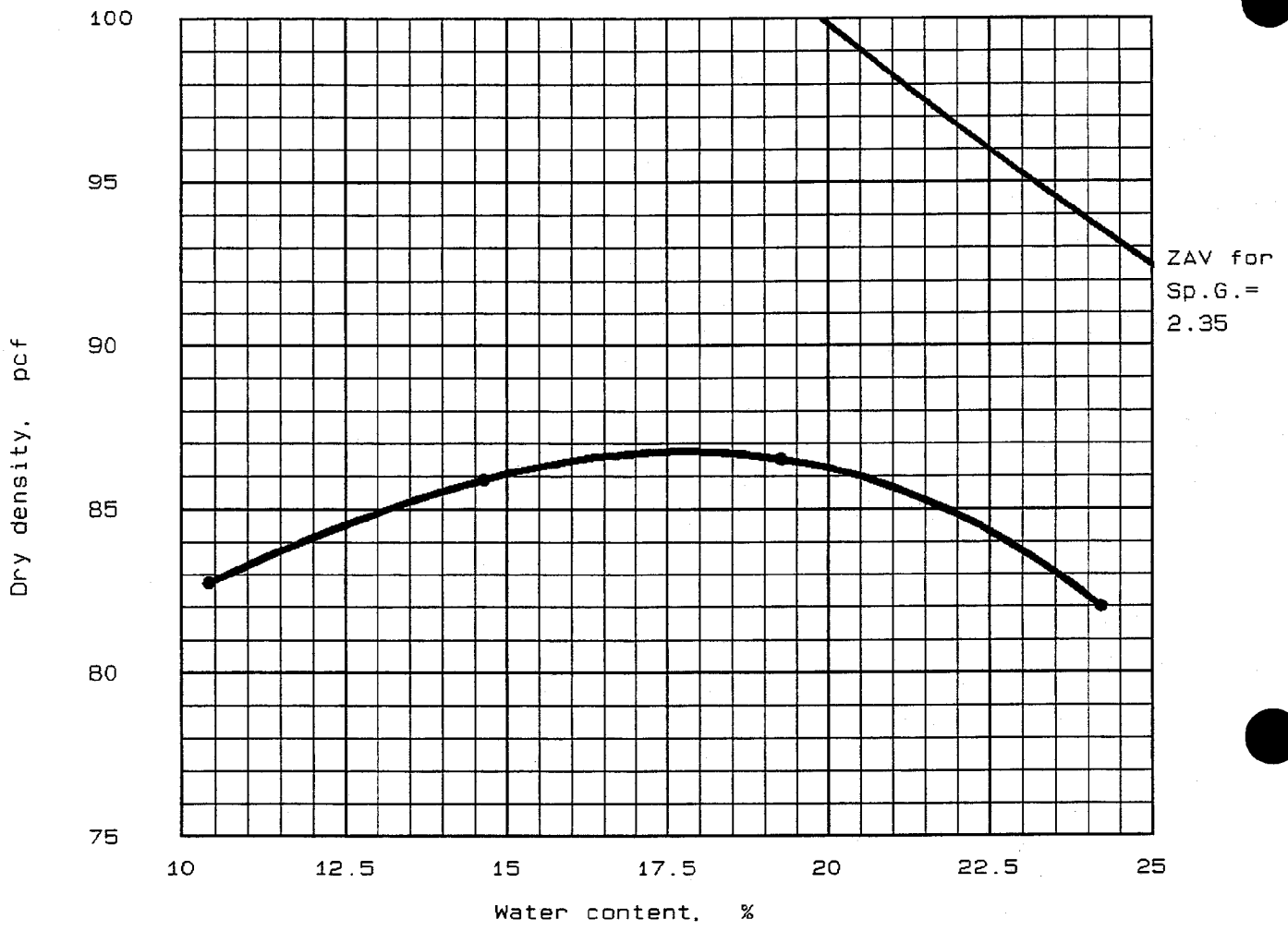
Remarks:
Tested by: CLG
Reviewed by: RLB

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						
	ML	A-4 (0.0)	.09 %	2.35	NL	NP	0 %	94.8 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 17.8 % Maximum dry density = 86.7 pcf	

Project No.: 5810860101
Project: TVA - John Sevier
Location: Dry Fly Ash
Units 3-4
Date: July 25, 1995

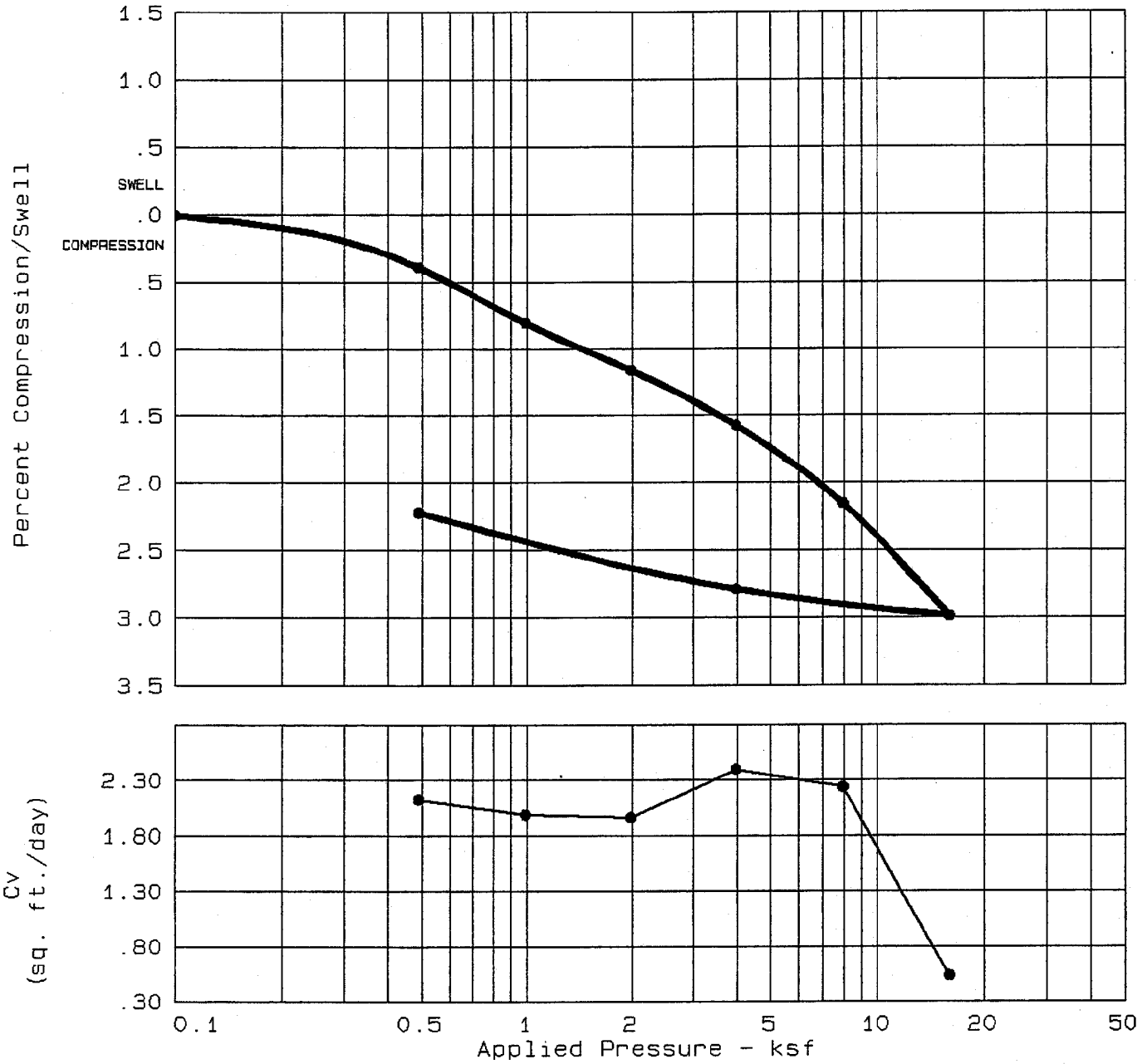
Remarks:
Tested by: CLG
Reviewed by: RLB

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_o
67.5 %	22.0	81.4	NL	NP	2.270	7.33	0.05	0.7404

TEST RESULTS

Compression Index = 0.05

Project No.: 581-0860101
Project: TVA - John Sevier
Location: Dry Fly Ash
Units 3-4
Date: July 24, 1995

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

MATERIAL DESCRIPTION

Class: USCS: ML

Remarks:

Tested by: AAK

Reviewed by: HG

Fig. No. _____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - John Sevier*	Test Date	*06/16/95*
Material (Source)	*Dry Fly Ash (Units 3-4)*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*21.8*
Wet Unit Weight, pcf:	*98.1*
Dry Unit Weight, pcf:	*80.5*
Compaction, %:	*96.2*
Hydraulic Conductivity, cm/sec. @20 °C:	***5.5E-05***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - John Sevier	Test Date	06/16/95
Material (Source)	Dry Fly Ash (Units 3-4)	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	797.82
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, %	21.8
		Wet Soil + Tare, grams	971.75	Wet Unit Wt, pcf	98.1
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	80.5

Chamber Pressure, psi	39
Back Pressure, psi	25
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
				1148	0.0	20.0	127.87	107.87	5.6E-05	21	5.5E-05
				1135	0.0	20.0	127.87	107.87	5.6E-05	21	5.5E-05
				1283	0.0	22.5	127.87	105.37	5.7E-05	21	5.6E-05

No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	83.7	96.2	Vertical

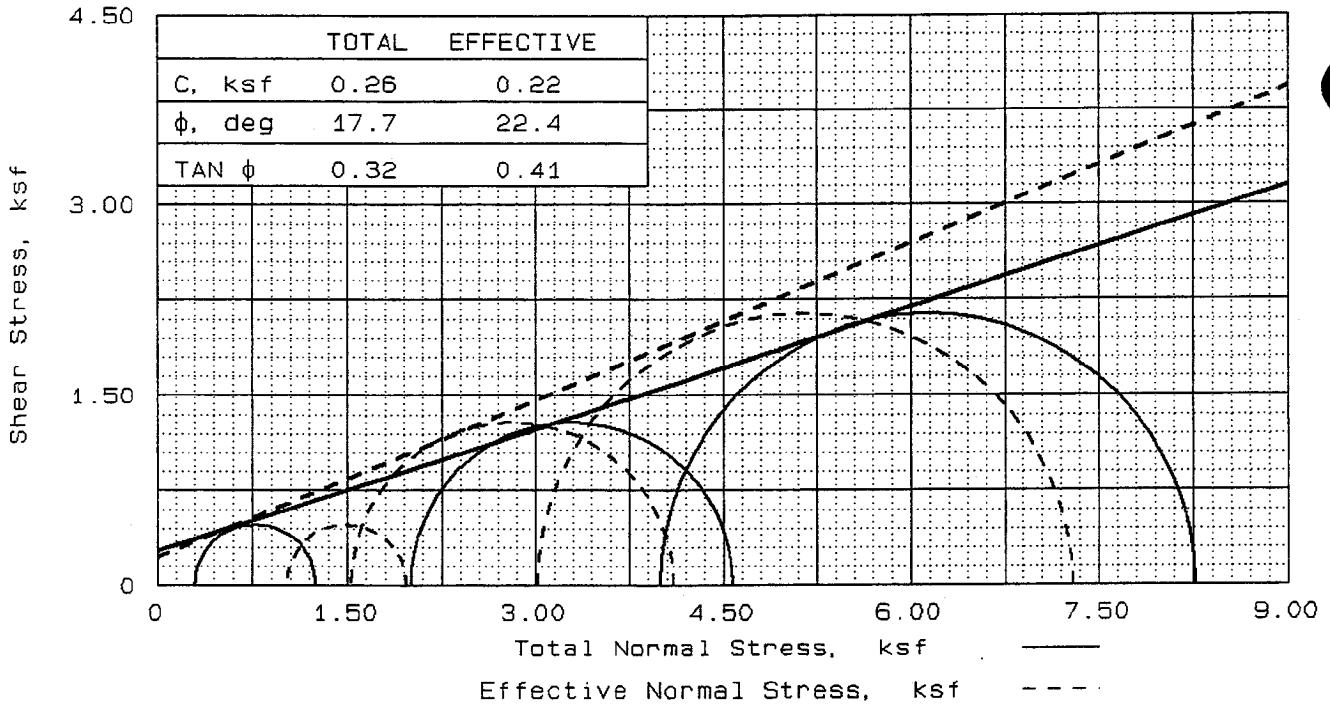
Avg. k at 20 °C 5.5E-05 cm/sec

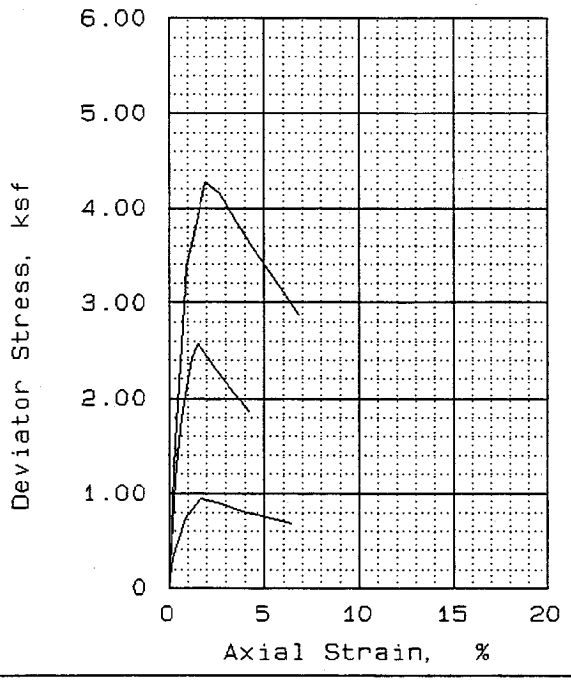
a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

H_0 = initial head in cm
H_f = final head in cm
t = time in seconds

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

TVA-00012022





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	21.8	21.9	21.6
	DRY DENSITY, pcf	80.5	80.4	80.7
	SATURATION, %	62.3	62.3	62.2
	VOID RATIO	0.822	0.825	0.818
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	33.7	34.6	32.9
	DRY DENSITY, pcf	81.8	80.9	82.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.793	0.814	0.773
	DIAMETER, in	2.81	2.83	2.80
	HEIGHT, in	5.99	5.98	5.99
BACK PRESSURE, ksf		3.56	4.23	3.56
CELL PRESSURE, ksf		5.56	4.54	7.56
FAILURE STRESS, ksf		2.57	0.95	4.27
PORE PRESSURE, ksf		4.03	3.51	4.54
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		4.10	1.97	7.29
$\bar{\sigma}_3$ FAILURE, ksf		1.53	1.02	3.02

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

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.35
REMARKS: Tested by: HG

Reviewed by: RLB

FIG. NO.

CLIENT:

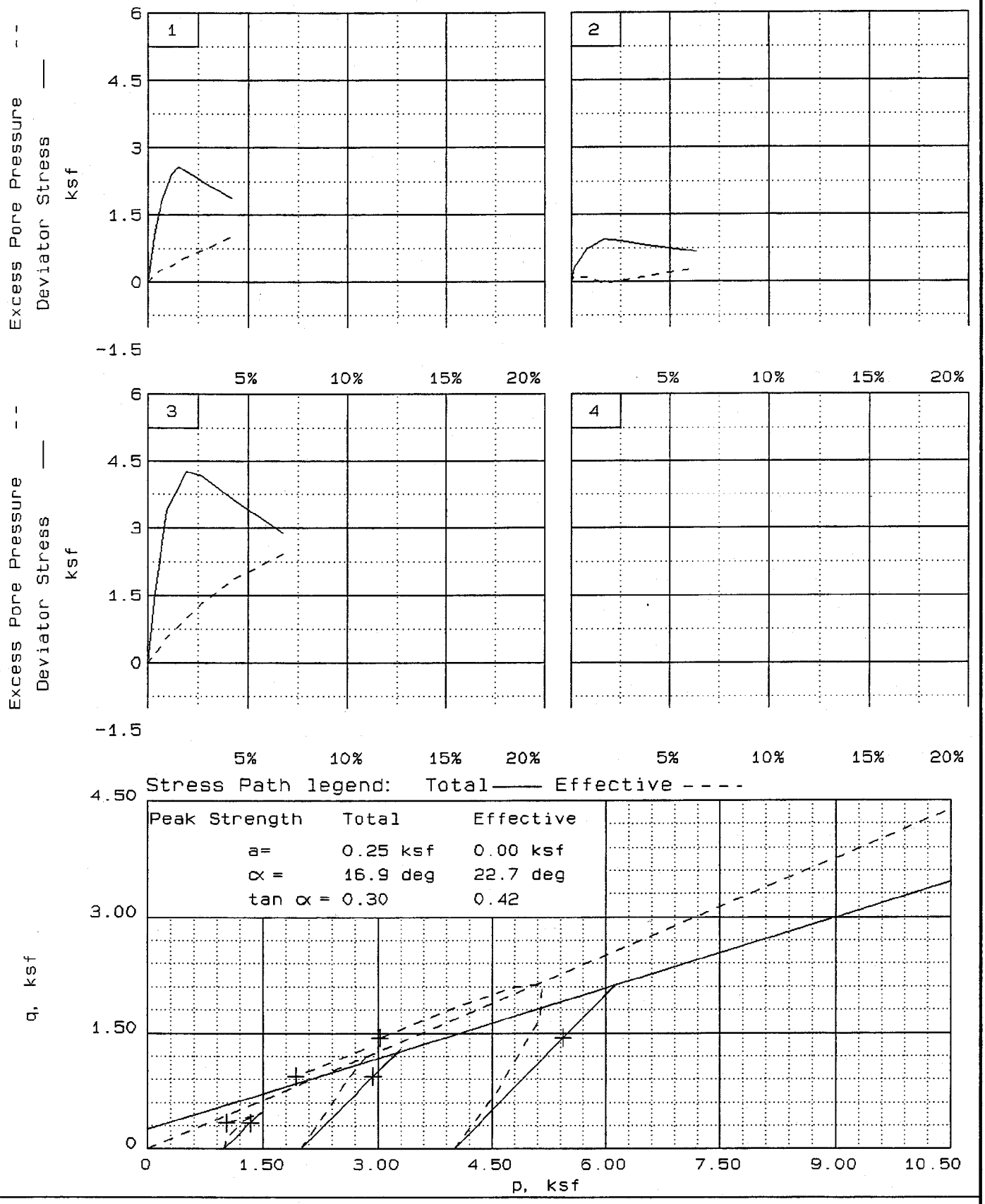
PROJECT: TVA - John Sevier

SAMPLE LOCATION: Dry Fly Ash
Units 3-4

PROJ. NO.: 5810860101 DATE: August 24, 1995

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.

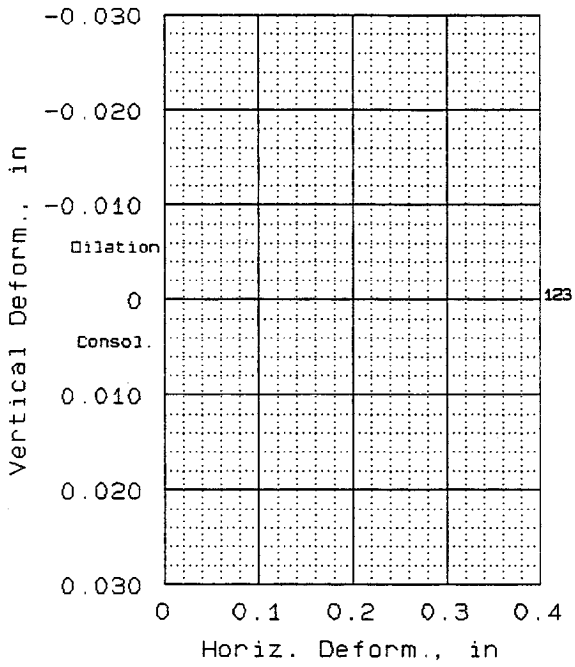


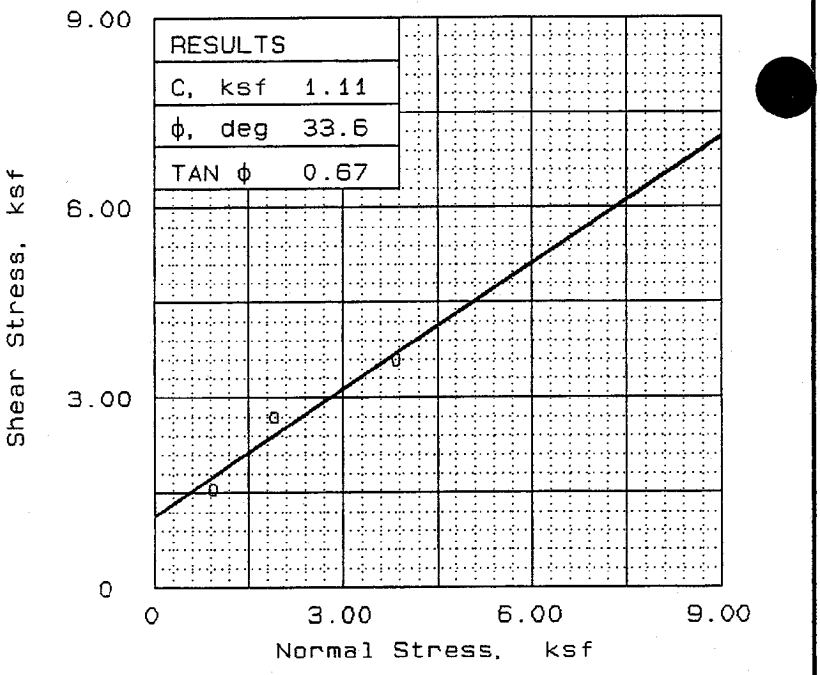
Client:

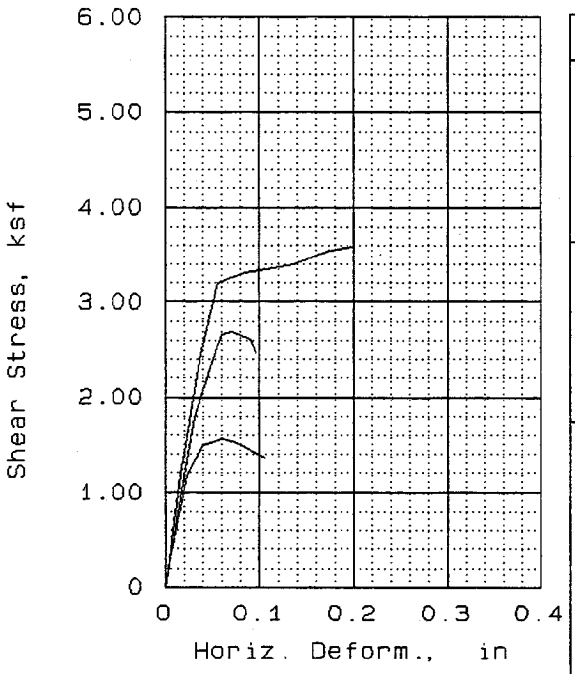
Project: TVA - John Sevier

Location: Dry Fly Ash Units 3-4

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







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	21.8	22.0	22.0
	DRY DENSITY, pcf	80.0	80.8	79.3
	SATURATION, %	61.3	63.5	60.8
	VOID RATIO	0.835	0.815	0.851
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	21.8	22.0	22.0
	DRY DENSITY, pcf	80.0	80.8	79.3
	SATURATION, %	61.3	63.5	60.8
	VOID RATIO	0.835	0.815	0.851
	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		1.56	2.69	3.59
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= 2.35

REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: TVA - John Sevier

SAMPLE LOCATION: Dry Fly Ash
Units 3-4

PROJ. NO.: 5810860101 DATE: August 28, 1995

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

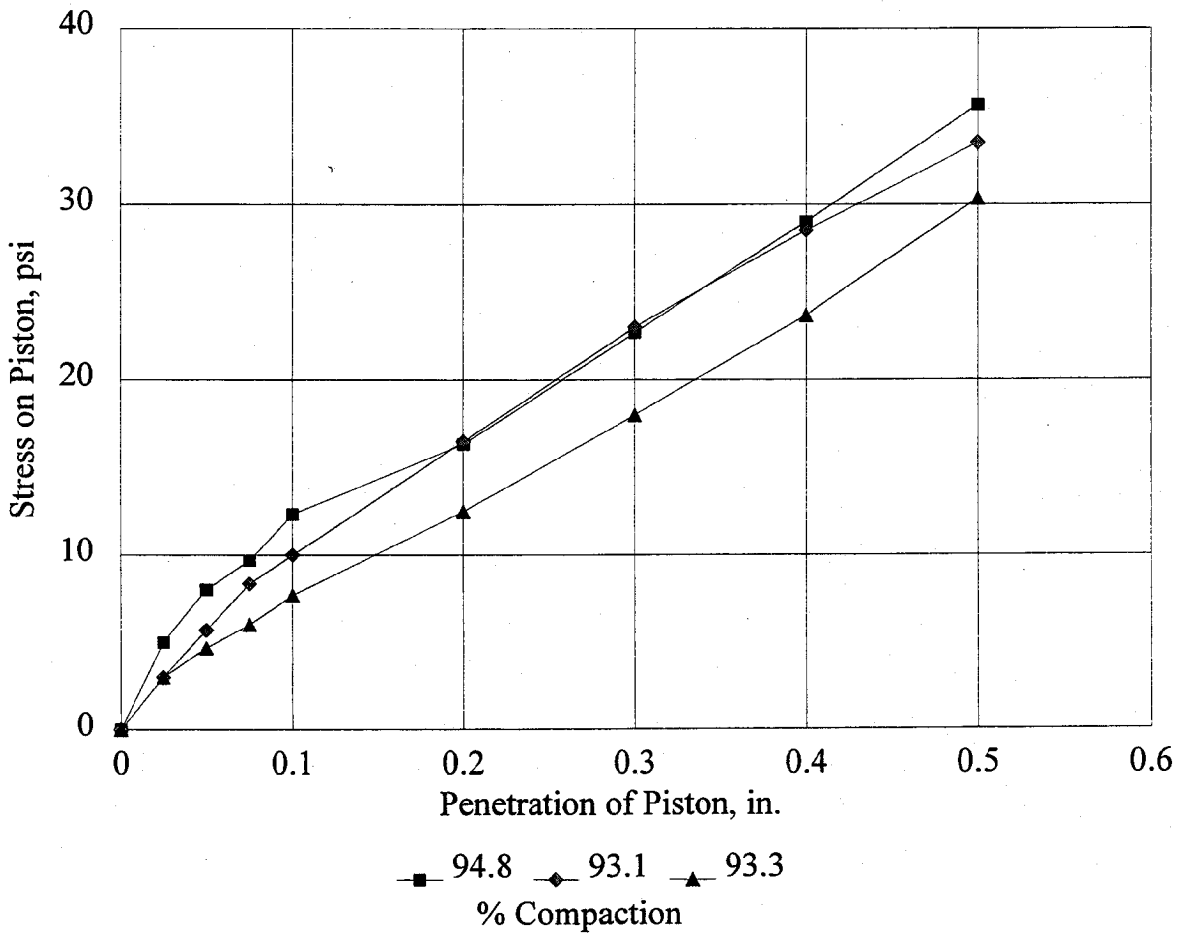
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - John Sevier	**Test Date**	07/24/95
Material (Source)	Dry Fly Ash (Units 3-4)	**Reviewed By**	RLB
		Review Date	08/16/95

Compaction, %	94.8	93.1	93.3
Before Soak Dry Density, pcf	80.6	79.1	79.3
Before Soak Moisture Content,	21.9	22.7	21.3
After Soak Dry Density, pcf	76.7	75.6	75.1
After Soak Moisture Content, %	33.4	34.0	34.3
CBR @ 0.1 in.	1.2	1.0	0.8
CBR @ 0.2 in.	1.1	1.1	0.8



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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash (Units 3-4)
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	6.06
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.06
	INITIAL AREA, A_0 , in^2	6.30
	INITIAL VOLUME A_0L_0 , in^3	38.17
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	972.45
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	972.45
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	18.6
	MAX. DRY DENSITY, pcf	83.7
	95 % MAX. DRY DENSITY, pcf	79.5
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	21.5
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	21.5
	COMPACTION DRY DENSITY, γ_d pcf	79.8
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	21.6
	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*	07-31-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Boudreau 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* John Sevier
2. *MATERIAL DESCRIPTION:* Dry Fly Ash (Units 3-4)
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 07-31-1995
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	
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	11.6	1.2	2.0	1.8	0.2	0.00163	0.00174	0.00169	0.00028	6,624
			2	12.8	11.6	1.2	2.0	1.8	0.2	0.00165	0.00171	0.00168	0.00028	6,668
			3	12.7	11.6	1.2	2.0	1.8	0.2	0.00164	0.00171	0.00168	0.00028	6,626
			4	12.8	11.6	1.2	2.0	1.8	0.2	0.00165	0.00171	0.00168	0.00028	6,646
			5	12.8	11.6	1.2	2.0	1.8	0.2	0.00163	0.00172	0.00168	0.00028	6,668
	COLUMN AVERAGE			12.8	11.6	1.2	2.0	1.8	0.2	0.00164	0.00172	0.00168	0.00028	6,646
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	22

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.3	23.0	2.3	4.0	3.6	0.4	0.00338	0.00354	0.00346	0.00057	6,385
			2	25.3	22.9	2.3	4.0	3.6	0.4	0.00338	0.00358	0.00348	0.00057	6,335
			3	25.3	23.0	2.3	4.0	3.6	0.4	0.00339	0.00355	0.00347	0.00057	6,366
			4	25.3	22.9	2.3	4.0	3.6	0.4	0.00339	0.00354	0.00347	0.00057	6,355
			5	25.3	23.0	2.3	4.0	3.6	0.4	0.00338	0.00354	0.00346	0.00057	6,385
	COLUMN AVERAGE			25.3	23.0	2.3	4.0	3.6	0.4	0.00338	0.00355	0.00347	0.00057	6,365
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	21
SEQUENCE 3	6.0	6.0	1	38.0	34.4	3.6	6.0	5.5	0.6	0.00530	0.00559	0.00544	0.00090	6,074
			2	38.0	34.4	3.6	6.0	5.5	0.6	0.00533	0.00556	0.00544	0.00090	6,078
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00533	0.00559	0.00546	0.00090	6,055
			4	38.0	34.4	3.6	6.0	5.5	0.6	0.00534	0.00558	0.00546	0.00090	6,062
			5	38.1	34.5	3.6	6.0	5.5	0.6	0.00534	0.00558	0.00546	0.00090	6,069
	COLUMN AVERAGE			38.0	34.4	3.6	6.0	5.5	0.6	0.00533	0.00558	0.00545	0.00090	6,067
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	9
SEQUENCE 4	6.0	8.0	1	50.6	45.7	4.9	8.0	7.2	0.8	0.00735	0.00763	0.00749	0.00124	5,862
			2	50.4	45.5	4.9	8.0	7.2	0.8	0.00735	0.00763	0.00749	0.00124	5,840
			3	50.5	45.6	4.9	8.0	7.2	0.8	0.00732	0.00763	0.00747	0.00123	5,861
			4	50.4	45.5	4.9	8.0	7.2	0.8	0.00732	0.00763	0.00747	0.00123	5,850
			5	50.4	45.5	4.9	8.0	7.2	0.8	0.00735	0.00765	0.00750	0.00124	5,832
	COLUMN AVERAGE			50.4	45.6	4.9	8.0	7.2	0.8	0.00734	0.00763	0.00748	0.00124	5,849
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	13

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.2	57.1	6.1	10.0	9.1	1.0	0.00922	0.00952	0.00937	0.00155	5,860
			2	63.3	57.2	6.1	10.0	9.1	1.0	0.00924	0.00954	0.00939	0.00155	5,850
			3	63.3	57.2	6.1	10.0	9.1	1.0	0.00921	0.00955	0.00938	0.00155	5,863
			4	63.3	57.2	6.0	10.0	9.1	1.0	0.00922	0.00957	0.00939	0.00155	5,850
			5	63.3	57.3	6.0	10.0	9.1	1.0	0.00924	0.00954	0.00939	0.00155	5,864
	COLUMN AVERAGE			63.3	57.2	6.1	10.0	9.1	1.0	0.00923	0.00954	0.00938	0.00155	5,857
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	7
SEQUENCE 6	4.0	2.0	1	13.0	11.6	1.3	2.1	1.8	0.2	0.00184	0.00189	0.00186	0.00031	5,988
			2	13.3	12.0	1.3	2.1	1.9	0.2	0.00188	0.00195	0.00192	0.00032	6,012
			3	13.3	12.0	1.3	2.1	1.9	0.2	0.00191	0.00196	0.00194	0.00032	5,933
			4	13.3	11.8	1.5	2.1	1.9	0.2	0.00185	0.00193	0.00189	0.00031	6,011
			5	13.2	11.6	1.6	2.1	1.8	0.3	0.00185	0.00189	0.00187	0.00031	5,980
	COLUMN AVERAGE			13.2	11.8	1.4	2.1	1.9	0.2	0.00187	0.00192	0.00189	0.00031	5,985
	STANDARD DEV.			0.1	0.2	0.1	0.0	0.0	0.0	0.00003	0.00004	0.00003	0.00001	32
SEQUENCE 7	4.0	4.0	1	24.9	22.9	2.0	4.0	3.6	0.3	0.00435	0.00453	0.00444	0.00073	4,959
			2	24.9	22.9	2.0	3.9	3.6	0.3	0.00436	0.00454	0.00445	0.00073	4,945
			3	24.7	22.7	2.0	3.9	3.6	0.3	0.00435	0.00452	0.00444	0.00073	4,910
			4	24.9	22.9	2.0	4.0	3.6	0.3	0.00438	0.00453	0.00445	0.00074	4,937
			5	24.7	22.7	2.0	3.9	3.6	0.3	0.00437	0.00454	0.00445	0.00074	4,886
	COLUMN AVERAGE			24.8	22.8	2.0	3.9	3.6	0.3	0.00436	0.00453	0.00445	0.00073	4,927
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	29

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.1	34.5	3.5	6.0	5.5	0.6	0.00691	0.00714	0.00702	0.00116	4,723
			2	38.0	34.5	3.5	6.0	5.5	0.6	0.00690	0.00714	0.00702	0.00116	4,716
			3	37.9	34.5	3.5	6.0	5.5	0.5	0.00690	0.00714	0.00702	0.00116	4,719
			4	38.1	34.5	3.6	6.0	5.5	0.6	0.00691	0.00712	0.00702	0.00116	4,725
			5	38.2	34.6	3.5	6.1	5.5	0.6	0.00694	0.00715	0.00704	0.00116	4,724
	COLUMN AVERAGE			38.0	34.5	3.5	6.0	5.5	0.6	0.00691	0.00714	0.00702	0.00116	4,721
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	4
SEQUENCE 9	4.0	8.0	1	50.6	45.8	4.8	8.0	7.3	0.8	0.00891	0.00922	0.00907	0.00150	4,847
			2	50.6	45.8	4.8	8.0	7.3	0.8	0.00891	0.00924	0.00907	0.00150	4,845
			3	50.6	45.8	4.8	8.0	7.3	0.8	0.00892	0.00920	0.00906	0.00150	4,853
			4	50.6	45.8	4.8	8.0	7.3	0.8	0.00892	0.00922	0.00907	0.00150	4,850
			5	50.6	45.8	4.8	8.0	7.3	0.8	0.00894	0.00923	0.00908	0.00150	4,840
	COLUMN AVERAGE			50.6	45.8	4.8	8.0	7.3	0.8	0.00892	0.00922	0.00907	0.00150	4,847
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5
SEQUENCE 10	4.0	10.0	1	63.2	57.1	6.1	10.0	9.1	1.0	0.01068	0.01103	0.01086	0.00179	5,049
			2	63.2	57.1	6.1	10.0	9.1	1.0	0.01067	0.01100	0.01084	0.00179	5,060
			3	63.2	57.1	6.1	10.0	9.1	1.0	0.01070	0.01105	0.01088	0.00180	5,044
			4	63.2	57.1	6.1	10.0	9.1	1.0	0.01069	0.01100	0.01084	0.00179	5,058
			5	63.4	57.3	6.1	10.1	9.1	1.0	0.01069	0.01103	0.01086	0.00179	5,067
	COLUMN AVERAGE			63.2	57.1	6.1	10.0	9.1	1.0	0.01069	0.01102	0.01085	0.00179	5,056
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	9

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.7	11.7	2.0	2.2	1.8	0.3	0.00231	0.00237	0.00234	0.00039	4,791
			2	13.6	11.6	2.0	2.2	1.8	0.3	0.00230	0.00235	0.00233	0.00038	4,794
			3	13.5	11.5	2.0	2.1	1.8	0.3	0.00228	0.00237	0.00232	0.00038	4,756
			4	13.5	11.5	2.0	2.1	1.8	0.3	0.00227	0.00236	0.00232	0.00038	4,773
			5	13.6	11.5	2.0	2.2	1.8	0.3	0.00229	0.00235	0.00232	0.00038	4,784
	COLUMN AVERAGE			13.6	11.6	2.0	2.2	1.8	0.3	0.00229	0.00236	0.00232	0.00038	4,779
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	15
SEQUENCE 12	2.0	4.0	1	25.3	22.9	2.4	4.0	3.6	0.4	0.00545	0.00562	0.00553	0.00091	3,975
			2	25.3	23.0	2.3	4.0	3.6	0.4	0.00545	0.00561	0.00553	0.00091	3,994
			3	25.3	22.9	2.4	4.0	3.6	0.4	0.00545	0.00562	0.00553	0.00091	3,980
			4	25.3	22.9	2.4	4.0	3.6	0.4	0.00543	0.00562	0.00552	0.00091	3,986
			5	25.3	22.9	2.4	4.0	3.6	0.4	0.00545	0.00562	0.00553	0.00091	3,974
	COLUMN AVERAGE			25.3	22.9	2.4	4.0	3.6	0.4	0.00545	0.00562	0.00553	0.00091	3,982
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8
SEQUENCE 13	2.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00832	0.00858	0.00845	0.00140	3,903
			2	37.9	34.3	3.6	6.0	5.4	0.6	0.00833	0.00859	0.00846	0.00140	3,889
			3	37.8	34.2	3.6	6.0	5.4	0.6	0.00831	0.00858	0.00844	0.00139	3,886
			4	37.7	34.0	3.6	6.0	5.4	0.6	0.00831	0.00858	0.00844	0.00139	3,873
			5	37.6	34.0	3.6	6.0	5.4	0.6	0.00832	0.00858	0.00845	0.00139	3,864
	COLUMN AVERAGE			37.8	34.2	3.6	6.0	5.4	0.6	0.00832	0.00858	0.00845	0.00140	3,883
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	15

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.6	45.8	4.8	8.0	7.3	0.8	0.01038	0.01072	0.01055	0.00174	4,169
			2	50.6	45.8	4.8	8.0	7.3	0.8	0.01039	0.01070	0.01054	0.00174	4,175
			3	50.5	45.7	4.8	8.0	7.3	0.8	0.01040	0.01068	0.01054	0.00174	4,170
			4	50.6	45.8	4.8	8.0	7.3	0.8	0.01038	0.01070	0.01054	0.00174	4,178
			5	50.7	45.9	4.8	8.0	7.3	0.8	0.01038	0.01071	0.01054	0.00174	4,181
	COLUMN AVERAGE			50.6	45.8	4.8	8.0	7.3	0.8	0.01039	0.01070	0.01054	0.00174	4,175
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	5
SEQUENCE 15	2.0	10.0	1	63.0	56.9	6.1	10.0	9.0	1.0	0.01230	0.01267	0.01249	0.00206	4,376
			2	63.0	56.9	6.0	10.0	9.0	1.0	0.01231	0.01268	0.01249	0.00206	4,378
			3	63.0	57.0	6.1	10.0	9.0	1.0	0.01231	0.01269	0.01250	0.00206	4,378
			4	62.9	56.8	6.1	10.0	9.0	1.0	0.01229	0.01269	0.01249	0.00206	4,370
			5	62.8	56.8	6.1	10.0	9.0	1.0	0.01233	0.01265	0.01249	0.00206	4,367
	COLUMN AVERAGE			62.9	56.9	6.1	10.0	9.0	1.0	0.01231	0.01268	0.01249	0.00206	4,374
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	5

SUBMITTED BY, DATE

RJ Bordhem 9/5/95

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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash (Units 3-4)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-31-1995

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

K1 =	2,965
K2 =	-0.08694
K5 =	0.43636
R^2 =	0.90

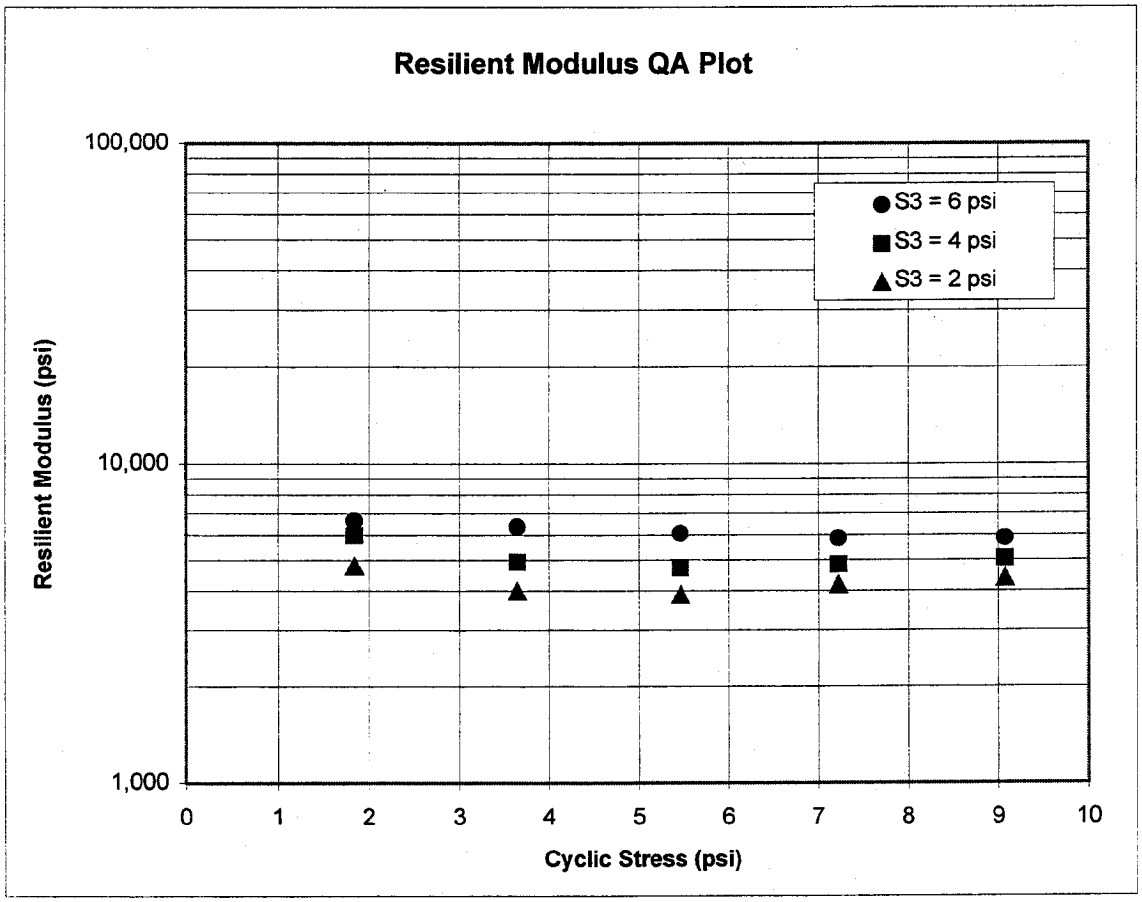
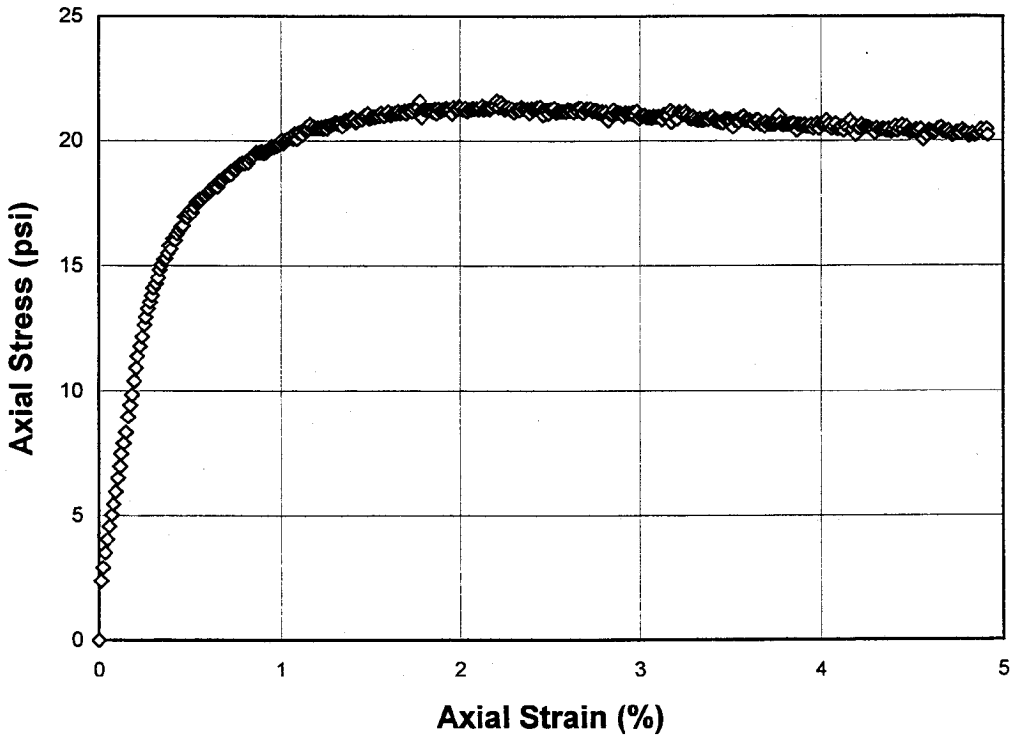


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash (Units 3-4)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-31-1995



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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash (Units 3-4)
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	2.86
	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	6.09
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0, inch	6.09
	INITIAL AREA, A_0, in^2	6.30
	INITIAL VOLUME A_0L_0, in^3	38.34
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	958.80
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	958.80
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	17.8
	MAX. DRY DENSITY, pcf	86.7
	95 % MAX. DRY DENSITY, pcf	82.4
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	17.8
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	17.8
	COMPACTION DRY DENSITY, γ_d pcf	80.8
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	26.9
	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*	07-31-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Boudreau 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* John Sevier
2. *MATERIAL DESCRIPTION:* Dry Fly Ash (Units 3-4)
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 07-31-1995
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	
UNIT	psi	psi	---	lbs	lbs	lbs	psi	psi	psi	in.	in.	in.	in/in	psi
PRECISION	___._	___._	_	____._	___._	___._	___._	___._	__._	_._____	_._____	_._____	_._____	____.
SEQUENCE 1	6.0	2.0	1	12.5	11.4	1.2	2.0	1.8	0.2	0.00134	0.00135	0.00135	0.00022	8,154
			2	12.5	11.4	1.2	2.0	1.8	0.2	0.00136	0.00135	0.00136	0.00022	8,111
			3	12.6	11.5	1.2	2.0	1.8	0.2	0.00135	0.00136	0.00135	0.00022	8,192
			4	12.8	11.6	1.2	2.0	1.8	0.2	0.00137	0.00137	0.00137	0.00022	8,187
			5	12.5	11.4	1.1	2.0	1.8	0.2	0.00134	0.00134	0.00134	0.00022	8,179
	COLUMN AVERAGE			12.6	11.4	1.2	2.0	1.8	0.2	0.00135	0.00135	0.00135	0.00022	8,164
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	33

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.3	23.0	2.3	4.0	3.7	0.4	0.00278	0.00277	0.00277	0.00046	8,008
			2	25.3	23.0	2.3	4.0	3.7	0.4	0.00278	0.00276	0.00277	0.00046	8,036
			3	25.3	23.1	2.3	4.0	3.7	0.4	0.00280	0.00276	0.00278	0.00046	8,016
			4	25.3	23.0	2.3	4.0	3.7	0.4	0.00280	0.00278	0.00279	0.00046	7,970
			5	25.3	23.0	2.2	4.0	3.7	0.4	0.00278	0.00278	0.00278	0.00046	8,012
	COLUMN AVERAGE			25.3	23.0	2.3	4.0	3.7	0.4	0.00279	0.00277	0.00278	0.00046	8,008
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	24
SEQUENCE 3	6.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00444	0.00441	0.00443	0.00073	7,492
			2	37.8	34.2	3.6	6.0	5.4	0.6	0.00446	0.00445	0.00445	0.00073	7,430
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00445	0.00441	0.00443	0.00073	7,491
			4	38.0	34.4	3.6	6.0	5.5	0.6	0.00445	0.00444	0.00444	0.00073	7,474
			5	38.0	34.4	3.6	6.0	5.5	0.6	0.00447	0.00443	0.00445	0.00073	7,472
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.5	0.6	0.00445	0.00443	0.00444	0.00073	7,472
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	25
SEQUENCE 4	6.0	8.0	1	50.6	45.8	4.9	8.0	7.3	0.8	0.00615	0.00614	0.00614	0.00101	7,201
			2	50.7	45.8	4.9	8.0	7.3	0.8	0.00614	0.00612	0.00613	0.00101	7,223
			3	50.7	45.8	4.9	8.0	7.3	0.8	0.00616	0.00612	0.00614	0.00101	7,212
			4	50.6	45.8	4.9	8.0	7.3	0.8	0.00615	0.00612	0.00614	0.00101	7,208
			5	50.7	45.9	4.8	8.1	7.3	0.8	0.00617	0.00614	0.00615	0.00101	7,207
	COLUMN AVERAGE			50.7	45.8	4.9	8.0	7.3	0.8	0.00615	0.00613	0.00614	0.00101	7,210
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.3	57.2	6.1	10.0	9.1	1.0	0.00770	0.00771	0.00770	0.00127	7,171
			2	63.3	57.2	6.1	10.1	9.1	1.0	0.00771	0.00771	0.00771	0.00127	7,173
			3	63.2	57.1	6.1	10.0	9.1	1.0	0.00770	0.00771	0.00771	0.00127	7,164
			4	63.4	57.2	6.1	10.1	9.1	1.0	0.00771	0.00771	0.00771	0.00127	7,176
			5	63.3	57.2	6.1	10.0	9.1	1.0	0.00771	0.00771	0.00771	0.00127	7,167
	COLUMN AVERAGE			63.3	57.2	6.1	10.0	9.1	1.0	0.00771	0.00771	0.00771	0.00127	7,170
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00000	0.00000	5
SEQUENCE 6	4.0	2.0	1	13.3	11.7	1.6	2.1	1.9	0.3	0.00143	0.00157	0.00150	0.00025	7,530
			2	13.4	11.7	1.7	2.1	1.9	0.3	0.00143	0.00157	0.00150	0.00025	7,564
			3	13.3	11.6	1.7	2.1	1.8	0.3	0.00142	0.00156	0.00149	0.00025	7,515
			4	13.1	11.5	1.6	2.1	1.8	0.3	0.00143	0.00157	0.00150	0.00025	7,389
			5	13.2	11.6	1.7	2.1	1.8	0.3	0.00143	0.00157	0.00150	0.00025	7,449
	COLUMN AVERAGE			13.2	11.6	1.6	2.1	1.8	0.3	0.00143	0.00157	0.00150	0.00025	7,489
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	70
SEQUENCE 7	4.0	4.0	1	25.0	22.8	2.3	4.0	3.6	0.4	0.00348	0.00351	0.00349	0.00057	6,297
			2	25.1	22.7	2.3	4.0	3.6	0.4	0.00350	0.00351	0.00351	0.00058	6,267
			3	25.1	22.8	2.3	4.0	3.6	0.4	0.00349	0.00353	0.00351	0.00058	6,287
			4	25.1	22.8	2.3	4.0	3.6	0.4	0.00350	0.00351	0.00350	0.00058	6,276
			5	25.1	22.8	2.3	4.0	3.6	0.4	0.00350	0.00352	0.00351	0.00058	6,266
	COLUMN AVERAGE			25.1	22.8	2.3	4.0	3.6	0.4	0.00349	0.00352	0.00350	0.00058	6,279
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	13

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	37.9	34.4	3.6	6.0	5.5	0.6	0.00564	0.00561	0.00563	0.00092	5,905
			2	37.9	34.4	3.5	6.0	5.5	0.6	0.00565	0.00562	0.00563	0.00093	5,899
			3	37.8	34.2	3.6	6.0	5.4	0.6	0.00564	0.00562	0.00563	0.00092	5,879
			4	37.9	34.4	3.6	6.0	5.5	0.6	0.00564	0.00561	0.00563	0.00092	5,907
			5	38.1	34.6	3.6	6.1	5.5	0.6	0.00565	0.00563	0.00564	0.00093	5,923
	COLUMN AVERAGE			37.9	34.4	3.6	6.0	5.5	0.6	0.00565	0.00562	0.00563	0.00093	5,902
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16
SEQUENCE 9	4.0	8.0	1	50.8	45.9	4.9	8.1	7.3	0.8	0.00739	0.00735	0.00737	0.00121	6,020
			2	50.8	46.0	4.8	8.1	7.3	0.8	0.00737	0.00735	0.00736	0.00121	6,038
			3	50.8	45.9	4.9	8.1	7.3	0.8	0.00737	0.00736	0.00736	0.00121	6,023
			4	50.7	45.9	4.9	8.1	7.3	0.8	0.00737	0.00737	0.00737	0.00121	6,014
			5	50.8	45.9	4.9	8.1	7.3	0.8	0.00738	0.00738	0.00738	0.00121	6,009
	COLUMN AVERAGE			50.8	45.9	4.9	8.1	7.3	0.8	0.00738	0.00736	0.00737	0.00121	6,021
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	11
SEQUENCE 10	4.0	10.0	1	63.2	57.1	6.1	10.0	9.1	1.0	0.00879	0.00879	0.00879	0.00144	6,278
			2	63.2	57.1	6.1	10.0	9.1	1.0	0.00878	0.00877	0.00877	0.00144	6,294
			3	63.3	57.3	6.1	10.1	9.1	1.0	0.00879	0.00879	0.00879	0.00144	6,297
			4	63.2	57.2	6.1	10.0	9.1	1.0	0.00880	0.00877	0.00878	0.00144	6,290
			5	63.3	57.2	6.1	10.0	9.1	1.0	0.00879	0.00880	0.00880	0.00144	6,285
	COLUMN AVERAGE			63.3	57.2	6.1	10.0	9.1	1.0	0.00879	0.00878	0.00879	0.00144	6,289
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	8

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 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	0.00170	0.00184	0.00177	0.00029	6,188
			2	13.6	11.5	2.1	2.2	1.8	0.3	0.00169	0.00185	0.00177	0.00029	6,272
			3	13.4	11.3	2.1	2.1	1.8	0.3	0.00169	0.00185	0.00177	0.00029	6,196
			4	13.4	11.4	2.1	2.1	1.8	0.3	0.00170	0.00186	0.00178	0.00029	6,189
			5	13.4	11.3	2.0	2.1	1.8	0.3	0.00171	0.00184	0.00177	0.00029	6,177
	COLUMN AVERAGE			13.4	11.4	2.1	2.1	1.8	0.3	0.00170	0.00185	0.00177	0.00029	6,204
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	38
SEQUENCE 12	2.0	4.0	1	25.1	22.7	2.4	4.0	3.6	0.4	0.00421	0.00428	0.00425	0.00070	5,175
			2	24.9	22.5	2.3	3.9	3.6	0.4	0.00420	0.00427	0.00424	0.00070	5,140
			3	24.8	22.5	2.3	3.9	3.6	0.4	0.00421	0.00428	0.00425	0.00070	5,115
			4	24.9	22.6	2.3	4.0	3.6	0.4	0.00422	0.00426	0.00424	0.00070	5,159
			5	25.0	22.6	2.3	4.0	3.6	0.4	0.00421	0.00427	0.00424	0.00070	5,160
	COLUMN AVERAGE			24.9	22.6	2.3	4.0	3.6	0.4	0.00421	0.00427	0.00424	0.00070	5,150
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	23
SEQUENCE 13	2.0	6.0	1	37.8	34.2	3.6	6.0	5.4	0.6	0.00664	0.00666	0.00665	0.00109	4,971
			2	37.8	34.2	3.6	6.0	5.4	0.6	0.00666	0.00663	0.00664	0.00109	4,972
			3	37.9	34.4	3.5	6.0	5.5	0.6	0.00664	0.00667	0.00666	0.00109	4,987
			4	37.8	34.2	3.6	6.0	5.4	0.6	0.00665	0.00663	0.00664	0.00109	4,983
			5	37.9	34.3	3.6	6.0	5.4	0.6	0.00665	0.00664	0.00665	0.00109	4,985
	COLUMN AVERAGE			37.8	34.3	3.6	6.0	5.4	0.6	0.00665	0.00665	0.00665	0.00109	4,980
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	8

Source: John Sevier Description: Dry Fly Ash (Units 3-4) 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.5	45.6	4.9	8.0	7.2	0.8	0.00846	0.00842	0.00844	0.00139	5,226
			2	50.6	45.7	4.8	8.0	7.3	0.8	0.00846	0.00844	0.00845	0.00139	5,226
			3	50.5	45.6	4.8	8.0	7.2	0.8	0.00844	0.00842	0.00843	0.00139	5,228
			4	50.4	45.6	4.8	8.0	7.2	0.8	0.00845	0.00842	0.00844	0.00139	5,221
			5	50.5	45.7	4.8	8.0	7.3	0.8	0.00846	0.00842	0.00844	0.00139	5,236
	COLUMN AVERAGE			50.5	45.7	4.8	8.0	7.2	0.8	0.00845	0.00843	0.00844	0.00139	5,228
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5
SEQUENCE 15	2.0	10.0	1	63.0	57.0	6.1	10.0	9.0	1.0	0.00983	0.00984	0.00983	0.00162	5,600
			2	63.1	57.1	6.0	10.0	9.1	1.0	0.00984	0.00983	0.00984	0.00162	5,609
			3	63.2	57.1	6.1	10.0	9.1	1.0	0.00982	0.00983	0.00982	0.00161	5,621
			4	63.1	57.0	6.1	10.0	9.1	1.0	0.00983	0.00982	0.00983	0.00161	5,606
			5	63.2	57.1	6.1	10.0	9.1	1.0	0.00984	0.00982	0.00983	0.00162	5,617
	COLUMN AVERAGE			63.1	57.1	6.1	10.0	9.1	1.0	0.00983	0.00983	0.00983	0.00161	5,611
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	8

SUBMITTED BY, DATE

R S Boudreau 9/5/95

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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash (Units 3-4)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-31-1995

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

K1 =	4,033
K2 =	-0.09489
K5 =	0.39276
R^2 =	0.88

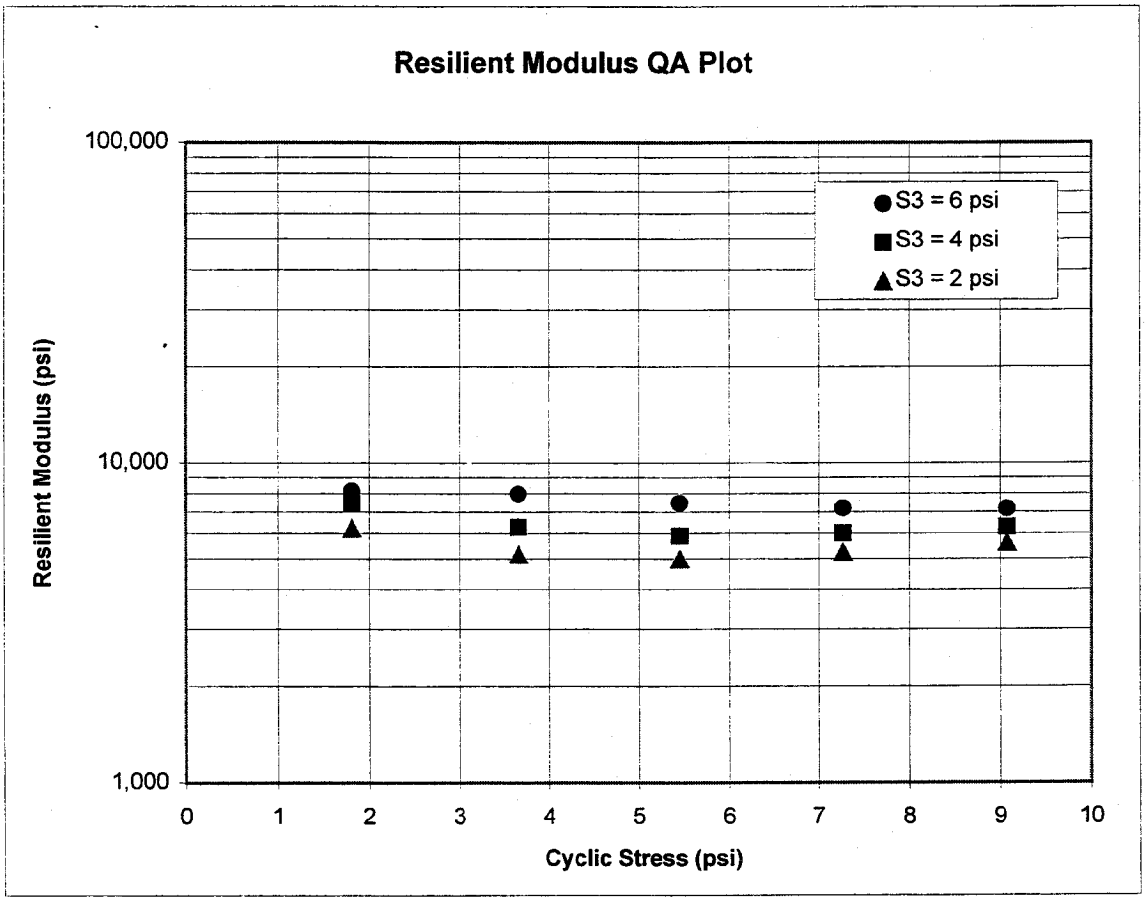
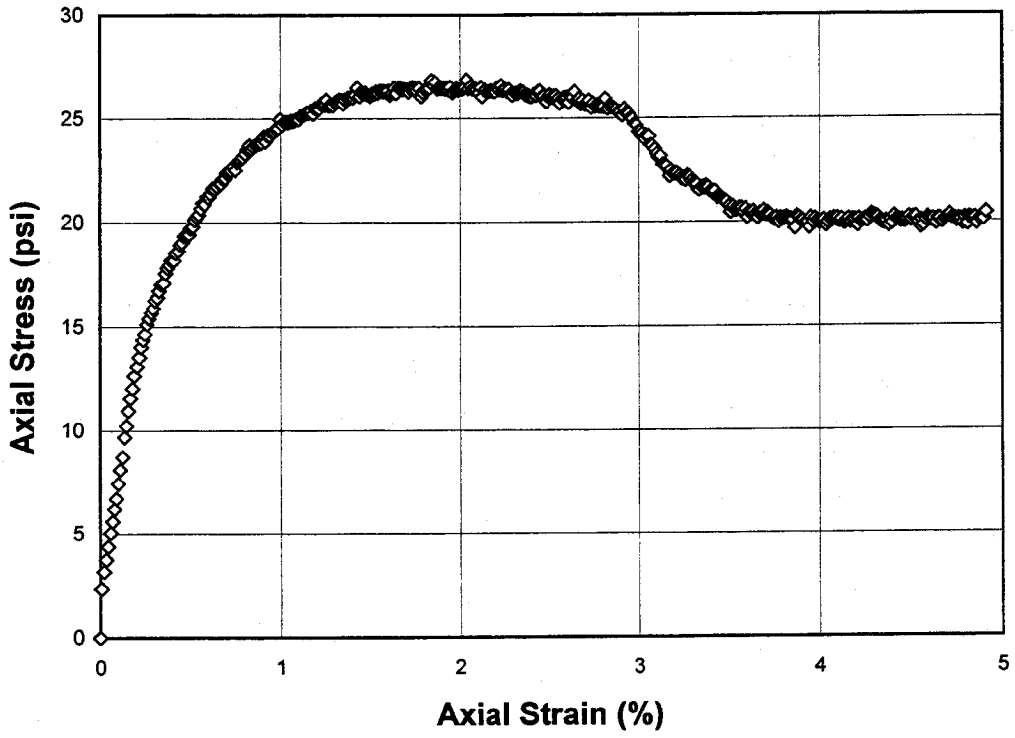


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Dry Fly Ash (Units 3-4)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-31-1995

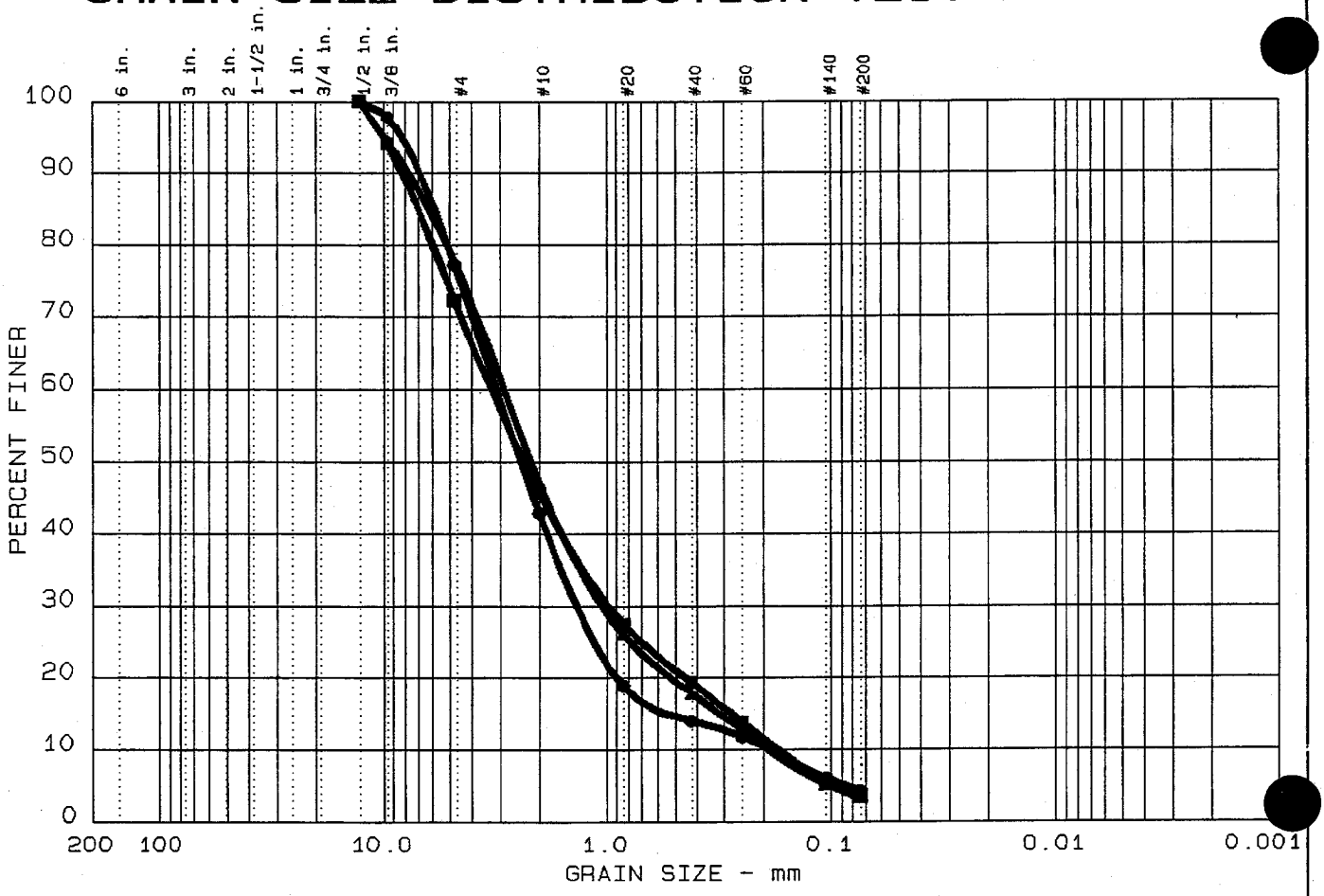


TVA - JOHN SEVIER
BOTTOM ASH - FROM POND

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	22.8 4.3	22.2 3.3	27.8 3.7
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	2.25	2.24	2.22
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	SP A-1-a	SW A-1-a	SW A-1-a
			Composite Sample		
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %	78.9 30.3		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	96.2 21.9		
Relative Density	ASTM D 4254 ASTM D 4253	Minimum Dry Density, pcf Maximum Dry Density (Dry Method), pcf	55.7 73.9		
			Result	**Dry Density, pcf**	**Moisture Content, %**
Hydraulic Conductivity	ASTM D 2434	Hydraulic Conductivity, cm/sec	2.6E-2	65.0	0.0
Angle of Repose	LAW TP6	Angle of Repose, degrees	27.4	55.7	0.0
California Bearing Ratio	ASTM D 1883	CBR, %	40	71.0	29.6
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	6,949	76.1	25.6
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	6,352	92.2	18.9
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	5,200		
pH of Soil	AASHTO T 289	pH	6.8		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	285		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	<10		

jsf-ba.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	22.8	72.9	4.3	
▲	16	0.0	22.2	74.5	3.3	
■	17	0.0	27.8	68.5	3.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	NL	NP	5.86	3.10	2.41	1.365	0.5495	0.1862	3.22	16.7
▲	NL	NP	6.17	2.87	2.18	1.042	0.3148	0.1897	2.00	15.1
■	NL	NP	6.92	3.27	2.34	0.977	0.2754	0.1718	1.70	19.1

	MATERIAL DESCRIPTION	USCS	AASHTO
●		SP	A-1-a
▲		SW	A-1-a
■		SW	A-1-a

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

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

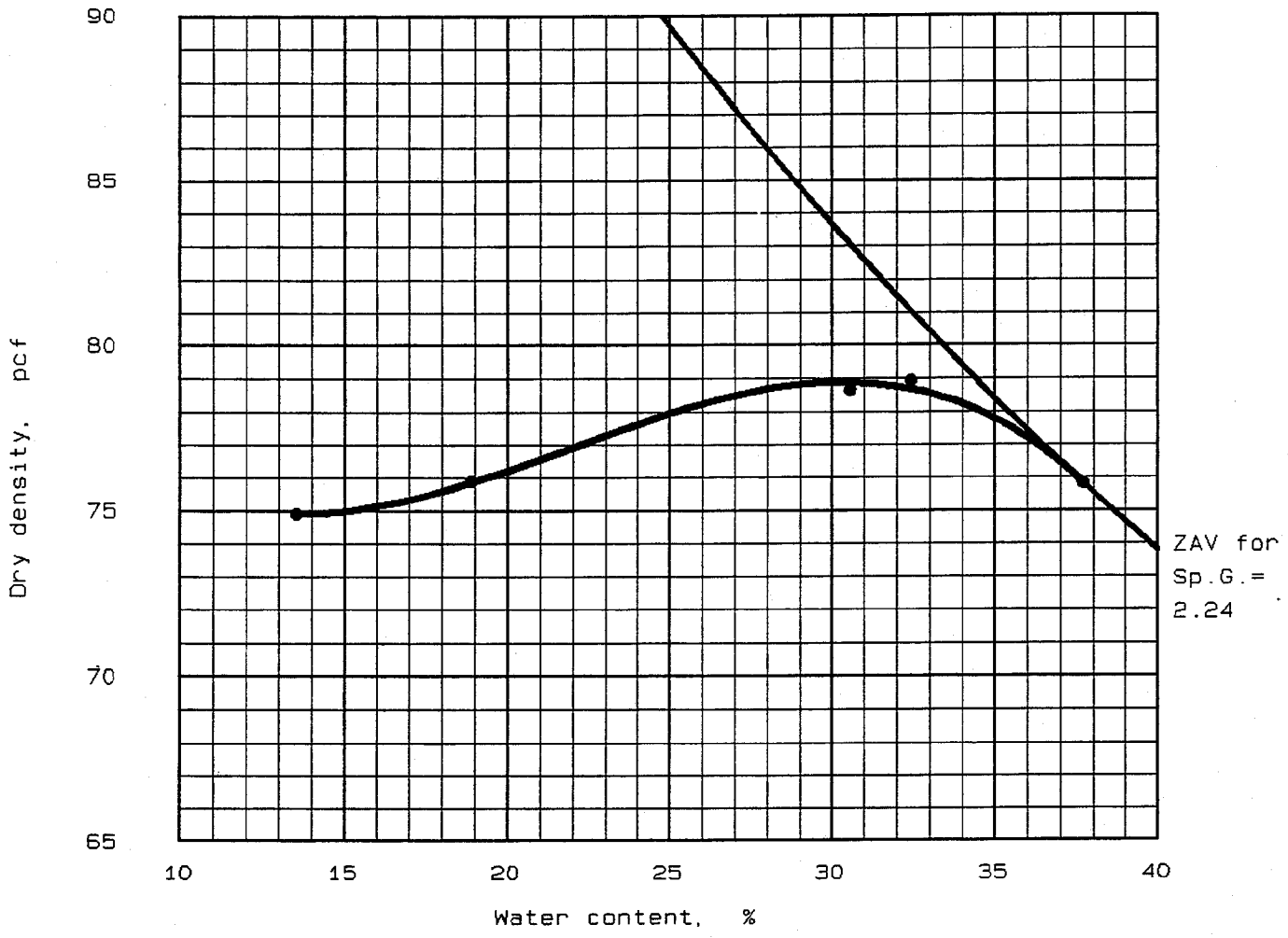
Remarks:

Tested by: JCR

Reviewed by: HS

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						
	SW (SP)	A-1-a	28.2 %	2.24	NL	NP	24.3 %	3.77 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 30.3 % Maximum dry density = 78.9 pcf	

Project No.: 5810860101
Project: TVA - John Sevier
Location: Bottom Ash

Date: July 25, 1995

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

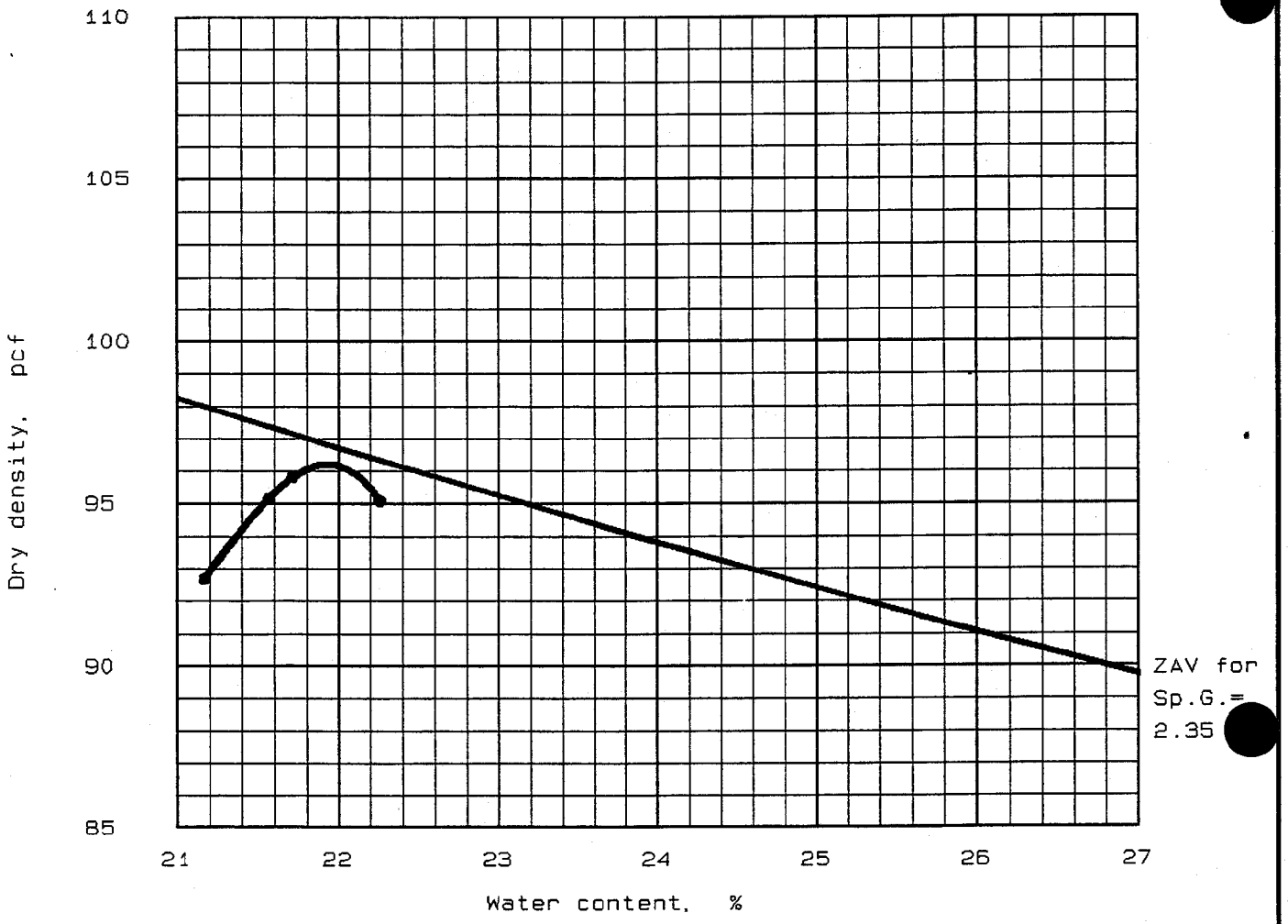
Remarks:

Tested by: CCG

Reviewed by: HS/RLB

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						
	SW (SP)	A-1-a	28.2 %	2.24	NL	NP	24.3 %	3.77 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 21.9 % Maximum dry density = 96.2 pcf	

Project No.: 5810860101
Project: TVA - John Sevier
Location: Bottom Ash

Date: July 25, 1995

Remarks:

Tested by: CLG

Reviewed by: PLB

MOISTURE-DENSITY RELATIONSHIP

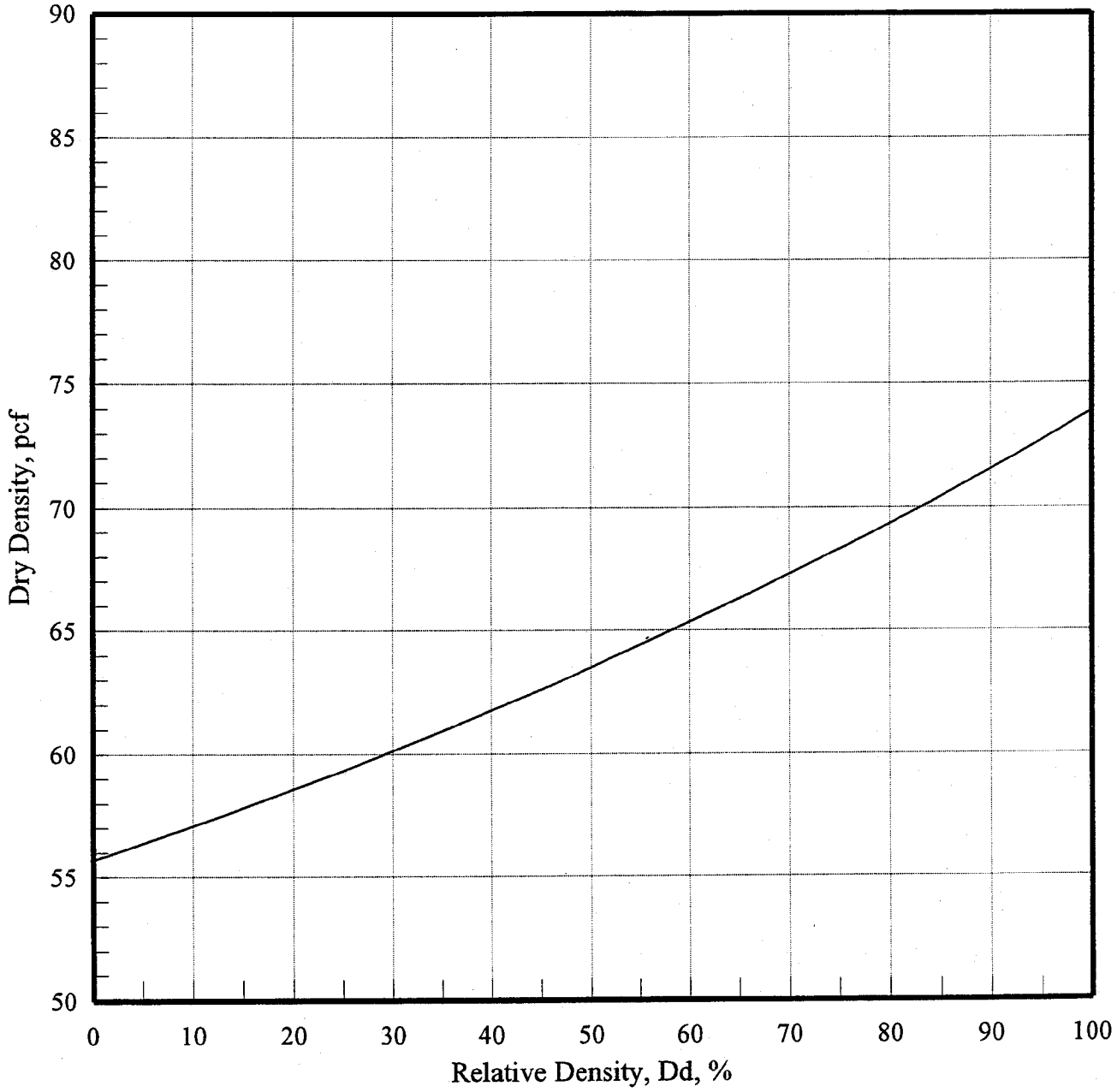
LAW ENGINEERING, INC.

Figure No. _____

Relative Density Test

TVA - John Sevier, Bottom Ash

Law Project No. 5810860101



HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*JCR*
Project Name	*TVA - John Sevier*	Test Date	*08/17/95*
Material	*Bottom Ash*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D2434-68 Constant Head Permeability

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*0.0*
Wet Unit Weight, pcf:	*65.0*
Dry Unit Weight, pcf:	*65.0*
Compaction, %:	*82.4*
Hydraulic Conductivity, cm/sec. @20° C:	***2.6E-02***

PERMEABILITY TEST - Constant Head
(ASTM D2434 - 68)

LAW ENGINEERING

Project No. 5810860101
Project Name TVA - John Sevier
Material Bottom Ash

Tested By JCR
Test Date 08/17/95
Reviewed By RLB
Review Date 09/06/95

Sample Data

Length, in		Diameter, in		Pan No.	
Location 1	5.798	Location 1	2.858	Wet Soil + Pan, grams	636.43
Location 2	5.703	Location 2	2.875	Dry Soil+Pan, grams	636.43
Location3	5.820	Location 3	2.868	Pan Weight, grams	0.00
Average	5.774	Average	2.867	Moisture Content, %	0.0
		Sample wet weight, grams	636.43	Wet Unit Wt, pcf	65.0
		Membrane, Cap weight, grams	0.00	Dry Unit Wt, pcf	65.0

Time (sec)	Q (cm^3)	H (cm)	k (cm/sec)	Temp ° C	k (cm/sec at 20° C)	i (cm/cm)
600	250.00	5.08	2.9E-02	20.0	2.9E-02	0.35
1200	450.00	5.08	2.6E-02	20.0	2.6E-02	0.35

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
2	Remolded	78.9	82.4	Vertical

L = length of sample in cm
A = area of sample in cm^2
H = constant head in cm
t = time in seconds

A = 41.65 cm^2
L = 14.665 cm

Avg. k at 20° C 2.6E-02 cm/sec

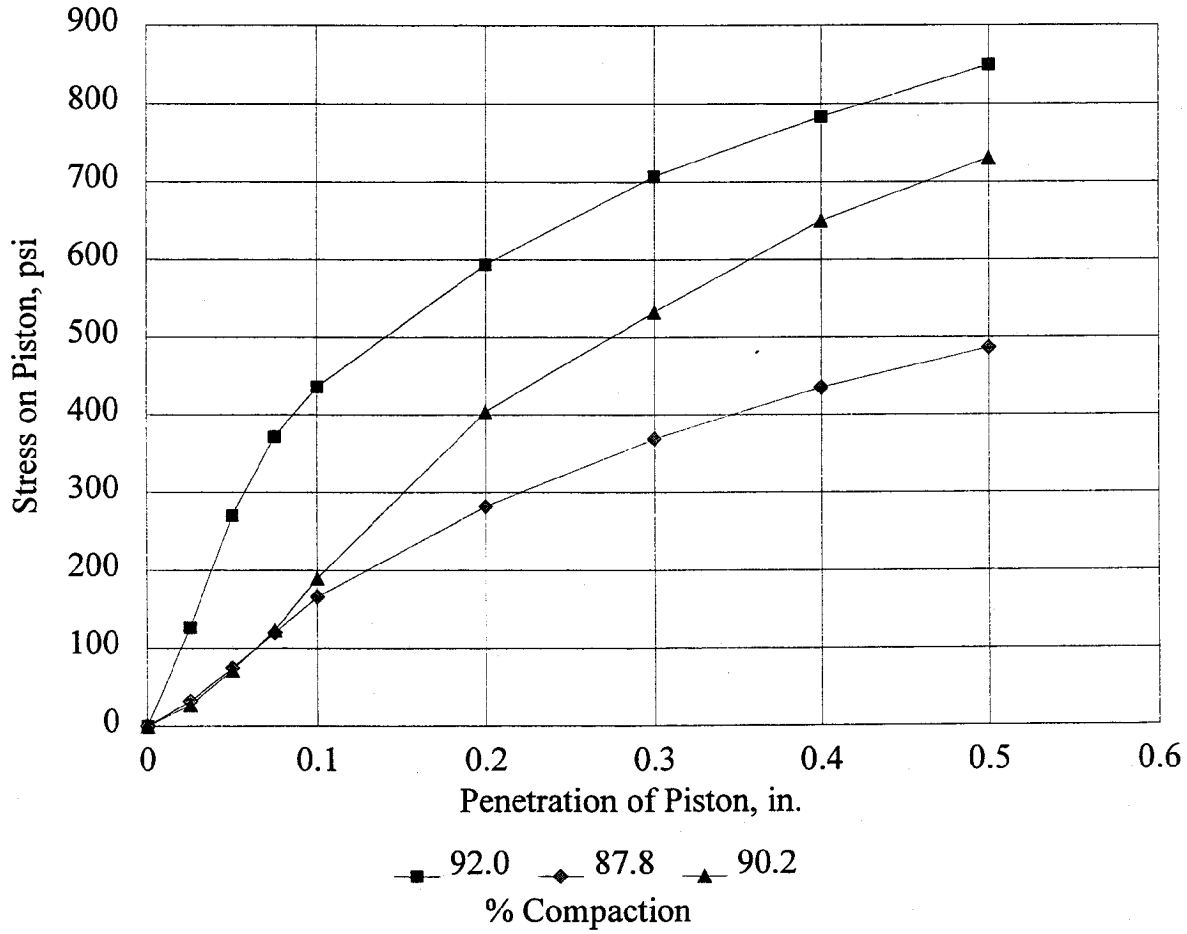
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - John Sevier	**Test Date**	08/25/95
Material (Source)	Bottom Ash	**Reviewed By**	RLB
		Review Date	08/30/95

Compaction, %	92.0	87.8	90.2
Before Soak Dry Density, pcf	72.6	69.3	71.1
Before Soak Moisture Content,	29.5	28.5	30.9
After Soak Dry Density, pcf	72.7	69.4	71.2
After Soak Moisture Content, %	29.8	31.4	29.8
CBR @ 0.1 in.	43.6	16.6	19.0
CBR @ 0.2 in.	39.6	18.8	26.9



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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
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	2.86
	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	6.02
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.02
	INITIAL AREA, A_0 , in^2	6.31
	INITIAL VOLUME $A_0 L_0$, in^3	37.94
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	952.40
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED , grams	952.40
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	30.3
	MAX. DRY DENSITY, pcf	78.9
	95 % MAX. DRY DENSITY, pcf	75.0
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	25.6
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	25.6
	COMPACTION DRY DENSITY, γ_d pcf	76.1
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	42.0
	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*	08-18-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

R J Burcham 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* John Sevier
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-18-1995
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	11.6	1.3	2.0	1.8	0.2	0.00105	0.00105	0.00105	0.00017	10,550
			2	12.8	11.6	1.2	2.0	1.8	0.2	0.00104	0.00104	0.00104	0.00017	10,633
			3	12.8	11.5	1.3	2.0	1.8	0.2	0.00105	0.00104	0.00104	0.00017	10,534
			4	12.8	11.6	1.2	2.0	1.8	0.2	0.00105	0.00105	0.00105	0.00017	10,557
			5	12.9	11.6	1.3	2.0	1.8	0.2	0.00106	0.00105	0.00106	0.00018	10,491
	COLUMN AVERAGE			12.8	11.6	1.3	2.0	1.8	0.2	0.00105	0.00105	0.00105	0.00017	10,553
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	51

Source: John Sevier Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.4	23.1	2.4	4.0	3.7	0.4	0.00199	0.00198	0.00198	0.00033	11,096
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00199	0.00196	0.00197	0.00033	11,035
			3	25.2	22.9	2.3	4.0	3.6	0.4	0.00197	0.00197	0.00197	0.00033	11,085
			4	25.2	22.8	2.3	4.0	3.6	0.4	0.00199	0.00197	0.00198	0.00033	11,018
			5	25.1	22.8	2.4	4.0	3.6	0.4	0.00197	0.00196	0.00197	0.00033	11,046
	COLUMN AVERAGE			25.2	22.9	2.3	4.0	3.6	0.4	0.00198	0.00197	0.00197	0.00033	11,056
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	34
SEQUENCE 3	6.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00292	0.00292	0.00292	0.00049	11,207
			2	37.8	34.3	3.5	6.0	5.4	0.6	0.00294	0.00291	0.00292	0.00049	11,188
			3	37.7	34.2	3.6	6.0	5.4	0.6	0.00292	0.00291	0.00291	0.00048	11,204
			4	37.8	34.2	3.6	6.0	5.4	0.6	0.00292	0.00292	0.00292	0.00049	11,186
			5	37.7	34.1	3.6	6.0	5.4	0.6	0.00294	0.00292	0.00293	0.00049	11,110
	COLUMN AVERAGE			37.8	34.2	3.6	6.0	5.4	0.6	0.00293	0.00292	0.00292	0.00049	11,179
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	40
SEQUENCE 4	6.0	8.0	1	50.7	45.9	4.9	8.0	7.3	0.8	0.00395	0.00390	0.00393	0.00065	11,154
			2	50.9	46.0	4.9	8.1	7.3	0.8	0.00394	0.00392	0.00393	0.00065	11,173
			3	50.6	45.8	4.8	8.0	7.3	0.8	0.00395	0.00392	0.00394	0.00065	11,103
			4	50.7	45.9	4.8	8.0	7.3	0.8	0.00394	0.00391	0.00393	0.00065	11,154
			5	50.9	46.0	4.9	8.1	7.3	0.8	0.00395	0.00394	0.00395	0.00066	11,134
	COLUMN AVERAGE			50.8	45.9	4.9	8.1	7.3	0.8	0.00395	0.00392	0.00393	0.00065	11,144
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	26

Source: John Sevier Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.5	57.4	6.1	10.1	9.1	1.0	0.00495	0.00492	0.00493	0.00082	11,107
			2	63.5	57.4	6.1	10.1	9.1	1.0	0.00493	0.00491	0.00492	0.00082	11,137
			3	63.4	57.3	6.1	10.1	9.1	1.0	0.00495	0.00492	0.00494	0.00082	11,075
			4	63.5	57.4	6.1	10.1	9.1	1.0	0.00494	0.00492	0.00493	0.00082	11,110
			5	63.4	57.2	6.1	10.1	9.1	1.0	0.00495	0.00491	0.00493	0.00082	11,082
	COLUMN AVERAGE			63.5	57.3	6.1	10.1	9.1	1.0	0.00494	0.00492	0.00493	0.00082	11,102
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	25
SEQUENCE 6	4.0	2.0	1	13.1	11.5	1.6	2.1	1.8	0.3	0.00143	0.00138	0.00140	0.00023	7,811
			2	13.1	11.4	1.7	2.1	1.8	0.3	0.00144	0.00138	0.00141	0.00023	7,746
			3	13.0	11.4	1.6	2.1	1.8	0.3	0.00143	0.00137	0.00140	0.00023	7,760
			4	13.0	11.4	1.6	2.1	1.8	0.3	0.00144	0.00139	0.00142	0.00024	7,690
			5	13.0	11.4	1.6	2.1	1.8	0.3	0.00143	0.00138	0.00140	0.00023	7,724
	COLUMN AVERAGE			13.0	11.4	1.6	2.1	1.8	0.3	0.00143	0.00138	0.00141	0.00023	7,746
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	45
SEQUENCE 7	4.0	4.0	1	25.2	22.9	2.3	4.0	3.6	0.4	0.00286	0.00281	0.00283	0.00047	7,712
			2	25.2	22.9	2.3	4.0	3.6	0.4	0.00285	0.00280	0.00282	0.00047	7,753
			3	25.5	23.2	2.3	4.0	3.7	0.4	0.00285	0.00282	0.00284	0.00047	7,809
			4	25.3	23.0	2.3	4.0	3.6	0.4	0.00284	0.00281	0.00282	0.00047	7,775
			5	25.1	22.8	2.3	4.0	3.6	0.4	0.00284	0.00281	0.00282	0.00047	7,714
	COLUMN AVERAGE			25.3	23.0	2.3	4.0	3.6	0.4	0.00285	0.00281	0.00283	0.00047	7,753
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	41

Source: John Sevier Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	38.0	34.4	3.6	6.0	5.5	0.6	0.00410	0.00404	0.00407	0.00068	8,072
			2	38.0	34.4	3.6	6.0	5.5	0.6	0.00406	0.00404	0.00405	0.00067	8,112
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00408	0.00405	0.00406	0.00068	8,078
			4	38.0	34.5	3.5	6.0	5.5	0.6	0.00407	0.00404	0.00406	0.00067	8,117
			5	38.1	34.5	3.6	6.0	5.5	0.6	0.00407	0.00404	0.00405	0.00067	8,123
	COLUMN AVERAGE			38.0	34.4	3.6	6.0	5.5	0.6	0.00408	0.00404	0.00406	0.00067	8,100
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	23
SEQUENCE 9	4.0	8.0	1	51.0	46.1	4.8	8.1	7.3	0.8	0.00527	0.00524	0.00526	0.00087	8,376
			2	50.8	45.9	4.9	8.1	7.3	0.8	0.00526	0.00522	0.00524	0.00087	8,369
			3	50.9	46.1	4.9	8.1	7.3	0.8	0.00527	0.00523	0.00525	0.00087	8,377
			4	51.0	46.1	4.9	8.1	7.3	0.8	0.00527	0.00523	0.00525	0.00087	8,381
			5	51.0	46.1	4.9	8.1	7.3	0.8	0.00527	0.00524	0.00525	0.00087	8,379
	COLUMN AVERAGE			50.9	46.1	4.9	8.1	7.3	0.8	0.00527	0.00523	0.00525	0.00087	8,376
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5
SEQUENCE 10	4.0	10.0	1	63.4	57.3	6.1	10.1	9.1	1.0	0.00645	0.00638	0.00641	0.00107	8,533
			2	63.4	57.3	6.1	10.1	9.1	1.0	0.00645	0.00638	0.00642	0.00107	8,526
			3	63.4	57.4	6.0	10.1	9.1	1.0	0.00643	0.00641	0.00642	0.00107	8,532
			4	63.3	57.2	6.1	10.0	9.1	1.0	0.00644	0.00639	0.00642	0.00107	8,506
			5	63.4	57.3	6.1	10.1	9.1	1.0	0.00644	0.00639	0.00642	0.00107	8,523
	COLUMN AVERAGE			63.4	57.3	6.1	10.1	9.1	1.0	0.00644	0.00639	0.00642	0.00107	8,524
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	11

Source: John Sevier Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.7	11.6	2.0	2.2	1.8	0.3	0.00220	0.00210	0.00215	0.00036	5,169
			2	13.8	11.7	2.0	2.2	1.9	0.3	0.00221	0.00212	0.00217	0.00036	5,157
			3	13.5	11.5	2.0	2.1	1.8	0.3	0.00220	0.00210	0.00215	0.00036	5,105
			4	13.7	11.7	2.0	2.2	1.9	0.3	0.00222	0.00212	0.00217	0.00036	5,136
			5	13.5	11.5	2.0	2.1	1.8	0.3	0.00219	0.00210	0.00215	0.00036	5,093
	COLUMN AVERAGE			13.6	11.6	2.0	2.2	1.8	0.3	0.00221	0.00211	0.00216	0.00036	5,132
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	32
SEQUENCE 12	2.0	4.0	1	25.4	23.1	2.3	4.0	3.7	0.4	0.00421	0.00414	0.00418	0.00069	5,282
			2	25.4	23.0	2.3	4.0	3.7	0.4	0.00421	0.00413	0.00417	0.00069	5,271
			3	25.6	23.3	2.3	4.1	3.7	0.4	0.00422	0.00415	0.00419	0.00070	5,307
			4	25.5	23.2	2.3	4.0	3.7	0.4	0.00421	0.00414	0.00418	0.00069	5,298
			5	25.3	23.0	2.3	4.0	3.7	0.4	0.00423	0.00414	0.00419	0.00070	5,254
	COLUMN AVERAGE			25.5	23.1	2.3	4.0	3.7	0.4	0.00422	0.00414	0.00418	0.00069	5,282
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	21
SEQUENCE 13	2.0	6.0	1	37.9	34.4	3.6	6.0	5.5	0.6	0.00577	0.00568	0.00572	0.00095	5,735
			2	38.0	34.4	3.6	6.0	5.5	0.6	0.00576	0.00571	0.00573	0.00095	5,724
			3	38.0	34.4	3.6	6.0	5.5	0.6	0.00577	0.00570	0.00574	0.00095	5,721
			4	37.9	34.3	3.6	6.0	5.4	0.6	0.00575	0.00572	0.00574	0.00095	5,714
			5	37.9	34.3	3.6	6.0	5.4	0.6	0.00577	0.00571	0.00574	0.00095	5,705
	COLUMN AVERAGE			37.9	34.4	3.6	6.0	5.4	0.6	0.00576	0.00570	0.00573	0.00095	5,720
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	11

Source: John Sevier Description: Bottom Ash 95% Standard Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.4	45.5	4.8	8.0	7.2	0.8	0.00716	0.00713	0.00715	0.00119	6,081
			2	50.5	45.7	4.8	8.0	7.2	0.8	0.00717	0.00712	0.00714	0.00119	6,105
			3	50.4	45.5	4.8	8.0	7.2	0.8	0.00716	0.00714	0.00715	0.00119	6,081
			4	50.7	45.9	4.8	8.0	7.3	0.8	0.00717	0.00715	0.00716	0.00119	6,121
			5	50.6	45.8	4.8	8.0	7.3	0.8	0.00716	0.00713	0.00714	0.00119	6,115
	COLUMN AVERAGE			50.5	45.7	4.8	8.0	7.2	0.8	0.00717	0.00713	0.00715	0.00119	6,101
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	19
SEQUENCE 15	2.0	10.0	1	63.2	57.1	6.1	10.0	9.1	1.0	0.00840	0.00835	0.00837	0.00139	6,512
			2	63.4	57.3	6.1	10.1	9.1	1.0	0.00840	0.00838	0.00839	0.00139	6,514
			3	63.3	57.2	6.1	10.0	9.1	1.0	0.00839	0.00837	0.00838	0.00139	6,515
			4	63.4	57.3	6.1	10.1	9.1	1.0	0.00843	0.00839	0.00841	0.00140	6,503
			5	63.5	57.3	6.1	10.1	9.1	1.0	0.00841	0.00839	0.00840	0.00140	6,516
	COLUMN AVERAGE			63.4	57.2	6.1	10.0	9.1	1.0	0.00840	0.00838	0.00839	0.00139	6,512
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	5

SUBMITTED BY, DATE

RS Burdeen 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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-18-1995

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

K1 =	2,156
K2 =	0.08085
K5 =	0.76340
R^2 =	0.98

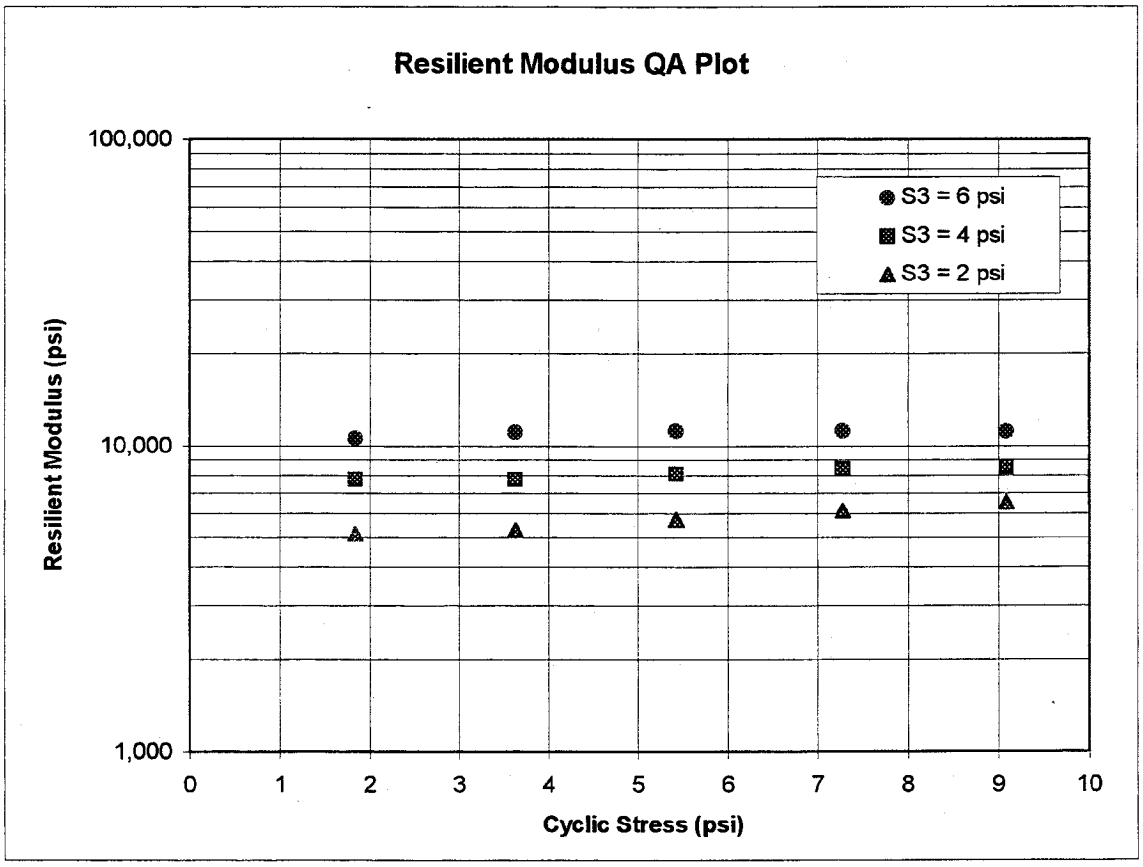
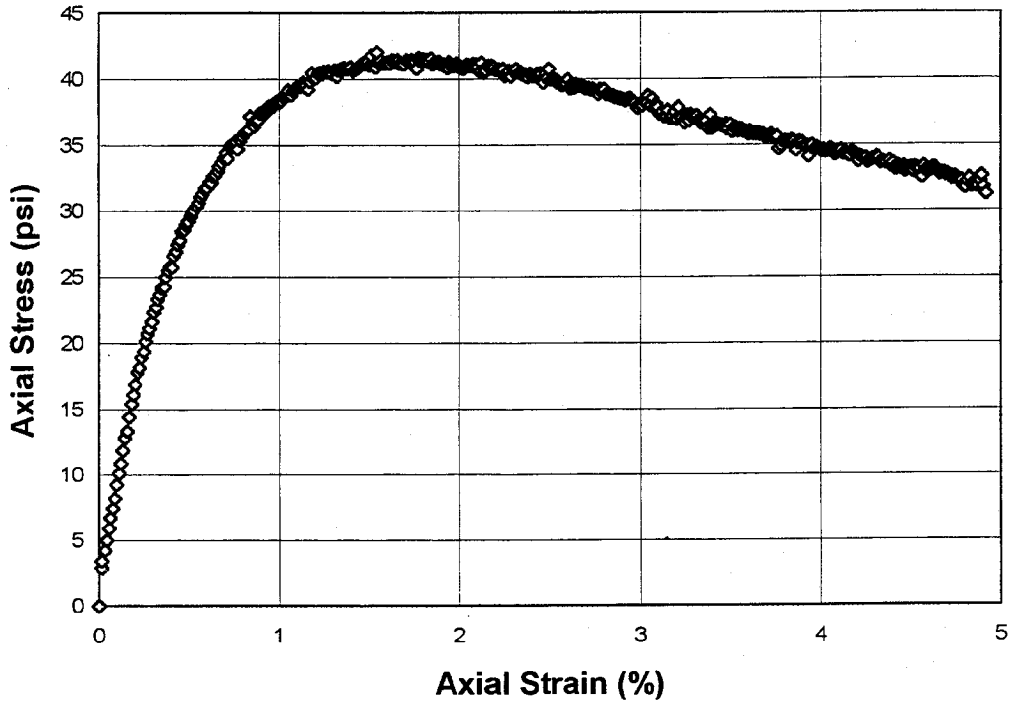


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-18-1995



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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
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	2.85
	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	6.08
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_o , inch	6.08
	INITIAL AREA, A_o , in^2	6.30
	INITIAL VOLUME $A_o L_o$, in^3	38.27
7.	*SOIL SPECIMEN WEIGHT:*	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1102.60
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED , grams	1102.60
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	21.9
	MAX. DRY DENSITY, pcf	96.2
	95 % MAX. DRY DENSITY, pcf	91.4
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	18.9
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	18.9
	COMPACTION DRY DENSITY, γ_d pcf	92.2
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	66.5
	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*	08-18-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RS Buchanan 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* John Sevier
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-18-1995
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	1.3	2.0	1.8	0.2	0.00112	0.00116	0.00114	0.00019	9,656
			2	12.9	11.7	1.2	2.0	1.9	0.2	0.00113	0.00116	0.00115	0.00019	9,822
			3	12.6	11.4	1.3	2.0	1.8	0.2	0.00113	0.00116	0.00115	0.00019	9,554
			4	12.5	11.3	1.3	2.0	1.8	0.2	0.00110	0.00116	0.00113	0.00019	9,646
			5	12.6	11.3	1.3	2.0	1.8	0.2	0.00112	0.00117	0.00114	0.00019	9,566
	COLUMN AVERAGE			12.7	11.4	1.3	2.0	1.8	0.2	0.00112	0.00116	0.00114	0.00019	9,649
	STANDARD DEV.			0.1	0.2	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	107

Source: John Sevier Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 2	6.0	4.0	1	25.0	22.7	2.3	4.0	3.6	0.4	0.00207	0.00227	0.00217	0.00036	10,126
			2	25.1	22.8	2.3	4.0	3.6	0.4	0.00208	0.00227	0.00217	0.00036	10,143
			3	25.1	22.9	2.2	4.0	3.6	0.3	0.00206	0.00227	0.00216	0.00036	10,214
			4	25.1	22.8	2.3	4.0	3.6	0.4	0.00208	0.00228	0.00218	0.00036	10,087
			5	25.1	22.7	2.4	4.0	3.6	0.4	0.00208	0.00227	0.00217	0.00036	10,103
	COLUMN AVERAGE			25.1	22.8	2.3	4.0	3.6	0.4	0.00207	0.00227	0.00217	0.00036	10,135
	STANDARD DEV.			0.0	0.1	0.1	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	49
SEQUENCE 3	6.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00316	0.00344	0.00330	0.00054	10,026
			2	37.8	34.3	3.6	6.0	5.4	0.6	0.00318	0.00345	0.00331	0.00054	9,990
			3	37.8	34.2	3.6	6.0	5.4	0.6	0.00317	0.00344	0.00331	0.00054	9,995
			4	37.6	34.1	3.5	6.0	5.4	0.6	0.00316	0.00343	0.00330	0.00054	9,992
			5	37.8	34.3	3.5	6.0	5.4	0.6	0.00317	0.00343	0.00330	0.00054	10,017
	COLUMN AVERAGE			37.8	34.2	3.5	6.0	5.4	0.6	0.00317	0.00344	0.00330	0.00054	10,004
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16
SEQUENCE 4	6.0	8.0	1	50.6	45.8	4.8	8.0	7.3	0.8	0.00432	0.00467	0.00450	0.00074	9,822
			2	50.6	45.8	4.8	8.0	7.3	0.8	0.00434	0.00466	0.00450	0.00074	9,831
			3	50.6	45.9	4.8	8.0	7.3	0.8	0.00431	0.00467	0.00449	0.00074	9,853
			4	50.6	45.7	4.8	8.0	7.3	0.8	0.00434	0.00466	0.00450	0.00074	9,802
			5	50.7	46.0	4.8	8.1	7.3	0.8	0.00433	0.00470	0.00451	0.00074	9,828
	COLUMN AVERAGE			50.6	45.8	4.8	8.0	7.3	0.8	0.00433	0.00467	0.00450	0.00074	9,827
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	18

Source: John Sevier Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 5	6.0	10.0	1	63.2	57.1	6.1	10.0	9.1	1.0	0.00543	0.00582	0.00563	0.00093	9,794
			2	63.2	57.1	6.1	10.0	9.1	1.0	0.00543	0.00581	0.00562	0.00092	9,809
			3	63.1	57.0	6.1	10.0	9.1	1.0	0.00542	0.00582	0.00562	0.00092	9,792
			4	63.1	57.1	6.1	10.0	9.1	1.0	0.00543	0.00582	0.00563	0.00093	9,787
			5	63.2	57.1	6.1	10.0	9.1	1.0	0.00544	0.00583	0.00564	0.00093	9,784
	COLUMN AVERAGE			63.2	57.1	6.1	10.0	9.1	1.0	0.00543	0.00582	0.00563	0.00093	9,793
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	10
SEQUENCE 6	4.0	2.0	1	13.2	11.5	1.7	2.1	1.8	0.3	0.00155	0.00166	0.00161	0.00026	6,920
			2	13.2	11.5	1.7	2.1	1.8	0.3	0.00155	0.00166	0.00160	0.00026	6,920
			3	13.3	11.6	1.7	2.1	1.8	0.3	0.00154	0.00168	0.00161	0.00026	6,964
			4	13.0	11.3	1.7	2.1	1.8	0.3	0.00154	0.00166	0.00160	0.00026	6,855
			5	13.2	11.5	1.7	2.1	1.8	0.3	0.00155	0.00167	0.00161	0.00026	6,893
	COLUMN AVERAGE			13.2	11.5	1.7	2.1	1.8	0.3	0.00154	0.00167	0.00160	0.00026	6,910
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	40
SEQUENCE 7	4.0	4.0	1	25.4	23.1	2.3	4.0	3.7	0.4	0.00322	0.00349	0.00335	0.00055	6,661
			2	25.3	23.0	2.3	4.0	3.7	0.4	0.00319	0.00348	0.00334	0.00055	6,655
			3	25.5	23.1	2.3	4.0	3.7	0.4	0.00322	0.00350	0.00336	0.00055	6,643
			4	25.5	23.2	2.3	4.1	3.7	0.4	0.00322	0.00349	0.00336	0.00055	6,673
			5	25.5	23.2	2.3	4.1	3.7	0.4	0.00323	0.00349	0.00336	0.00055	6,667
	COLUMN AVERAGE			25.5	23.1	2.3	4.0	3.7	0.4	0.00322	0.00349	0.00335	0.00055	6,660
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	12

Source: John Sevier Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 8	4.0	6.0	1	37.9	34.3	3.5	6.0	5.5	0.6	0.00460	0.00495	0.00477	0.00079	6,943
			2	37.9	34.4	3.5	6.0	5.5	0.6	0.00461	0.00495	0.00478	0.00079	6,941
			3	37.9	34.3	3.5	6.0	5.5	0.6	0.00461	0.00495	0.00478	0.00079	6,930
			4	37.7	34.2	3.5	6.0	5.4	0.6	0.00458	0.00494	0.00476	0.00078	6,944
			5	37.9	34.4	3.5	6.0	5.5	0.6	0.00460	0.00497	0.00478	0.00079	6,939
	COLUMN AVERAGE			37.9	34.3	3.5	6.0	5.5	0.6	0.00460	0.00495	0.00477	0.00079	6,939
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	6
SEQUENCE 9	4.0	8.0	1	50.7	45.9	4.8	8.1	7.3	0.8	0.00580	0.00621	0.00600	0.00099	7,381
			2	50.7	45.9	4.8	8.0	7.3	0.8	0.00579	0.00620	0.00600	0.00099	7,382
			3	50.8	46.0	4.8	8.1	7.3	0.8	0.00579	0.00619	0.00599	0.00099	7,400
			4	50.6	45.9	4.8	8.0	7.3	0.8	0.00580	0.00619	0.00599	0.00099	7,384
			5	50.6	45.9	4.8	8.0	7.3	0.8	0.00577	0.00620	0.00599	0.00099	7,392
	COLUMN AVERAGE			50.7	45.9	4.8	8.0	7.3	0.8	0.00579	0.00620	0.00599	0.00099	7,388
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8
SEQUENCE 10	4.0	10.0	1	63.2	57.2	6.0	10.0	9.1	1.0	0.00685	0.00729	0.00707	0.00116	7,809
			2	63.2	57.2	6.0	10.0	9.1	1.0	0.00685	0.00728	0.00706	0.00116	7,812
			3	63.2	57.1	6.1	10.0	9.1	1.0	0.00683	0.00731	0.00707	0.00116	7,796
			4	63.5	57.4	6.1	10.1	9.1	1.0	0.00687	0.00729	0.00708	0.00116	7,821
			5	63.2	57.2	6.1	10.0	9.1	1.0	0.00688	0.00730	0.00709	0.00117	7,785
	COLUMN AVERAGE			63.3	57.2	6.1	10.0	9.1	1.0	0.00685	0.00729	0.00707	0.00116	7,805
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	14

Source: John Sevier Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 11	2.0	2.0	1	13.5	11.4	2.0	2.1	1.8	0.3	0.00223	0.00242	0.00233	0.00038	4,741
			2	13.3	11.3	2.0	2.1	1.8	0.3	0.00222	0.00242	0.00232	0.00038	4,696
			3	13.3	11.3	2.0	2.1	1.8	0.3	0.00222	0.00242	0.00232	0.00038	4,686
			4	13.3	11.3	2.0	2.1	1.8	0.3	0.00223	0.00244	0.00233	0.00038	4,678
			5	13.4	11.4	2.0	2.1	1.8	0.3	0.00222	0.00241	0.00232	0.00038	4,729
	COLUMN AVERAGE			13.4	11.3	2.0	2.1	1.8	0.3	0.00223	0.00242	0.00232	0.00038	4,706
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	28
SEQUENCE 12	2.0	4.0	1	24.9	22.6	2.3	4.0	3.6	0.4	0.00451	0.00483	0.00467	0.00077	4,674
			2	25.0	22.7	2.3	4.0	3.6	0.4	0.00451	0.00484	0.00467	0.00077	4,678
			3	24.8	22.4	2.4	3.9	3.6	0.4	0.00450	0.00484	0.00467	0.00077	4,632
			4	24.8	22.4	2.4	3.9	3.6	0.4	0.00449	0.00483	0.00466	0.00077	4,634
			5	24.7	22.4	2.3	3.9	3.6	0.4	0.00451	0.00482	0.00467	0.00077	4,630
	COLUMN AVERAGE			24.8	22.5	2.4	3.9	3.6	0.4	0.00450	0.00483	0.00467	0.00077	4,650
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	24
SEQUENCE 13	2.0	6.0	1	38.0	34.5	3.5	6.0	5.5	0.6	0.00607	0.00643	0.00625	0.00103	5,327
			2	38.0	34.4	3.5	6.0	5.5	0.6	0.00605	0.00642	0.00623	0.00103	5,335
			3	37.9	34.3	3.5	6.0	5.5	0.6	0.00604	0.00642	0.00623	0.00103	5,316
			4	38.1	34.5	3.6	6.0	5.5	0.6	0.00607	0.00642	0.00624	0.00103	5,335
			5	37.9	34.3	3.5	6.0	5.5	0.6	0.00605	0.00642	0.00624	0.00103	5,311
	COLUMN AVERAGE			38.0	34.4	3.5	6.0	5.5	0.6	0.00606	0.00642	0.00624	0.00103	5,325
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	11

Source: John Sevier Description: Bottom Ash 95% Modified Dry Density at Optimum Moisture Content

SEQUENCE 14	2.0	8.0	1	50.9	46.1	4.7	8.1	7.3	0.8	0.00721	0.00765	0.00743	0.00122	5,990
			2	50.7	46.0	4.8	8.1	7.3	0.8	0.00718	0.00765	0.00741	0.00122	5,983
			3	50.7	45.9	4.8	8.0	7.3	0.8	0.00722	0.00758	0.00740	0.00122	5,984
			4	50.5	45.7	4.8	8.0	7.3	0.8	0.00720	0.00762	0.00741	0.00122	5,952
			5	50.5	45.7	4.8	8.0	7.3	0.8	0.00720	0.00765	0.00742	0.00122	5,945
	COLUMN AVERAGE			50.6	45.9	4.8	8.0	7.3	0.8	0.00720	0.00763	0.00742	0.00122	5,971
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00002	0.00003	0.00001	0.00000	21
SEQUENCE 15	2.0	10.0	1	63.0	57.0	6.1	10.0	9.0	1.0	0.00814	0.00852	0.00833	0.00137	6,597
			2	63.1	57.1	6.0	10.0	9.1	1.0	0.00815	0.00856	0.00835	0.00137	6,593
			3	63.1	57.0	6.0	10.0	9.1	1.0	0.00814	0.00855	0.00834	0.00137	6,598
			4	63.1	57.1	6.0	10.0	9.1	1.0	0.00812	0.00853	0.00833	0.00137	6,619
			5	63.1	57.1	6.0	10.0	9.1	1.0	0.00813	0.00854	0.00834	0.00137	6,604
	COLUMN AVERAGE			63.1	57.0	6.0	10.0	9.1	1.0	0.00813	0.00854	0.00834	0.00137	6,602
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	10

SUBMITTED BY, DATE

RS Boudreau 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:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-18-1995

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

K1 =	2,108
K2 =	0.09702
K5 =	0.69867
R^2 =	0.91

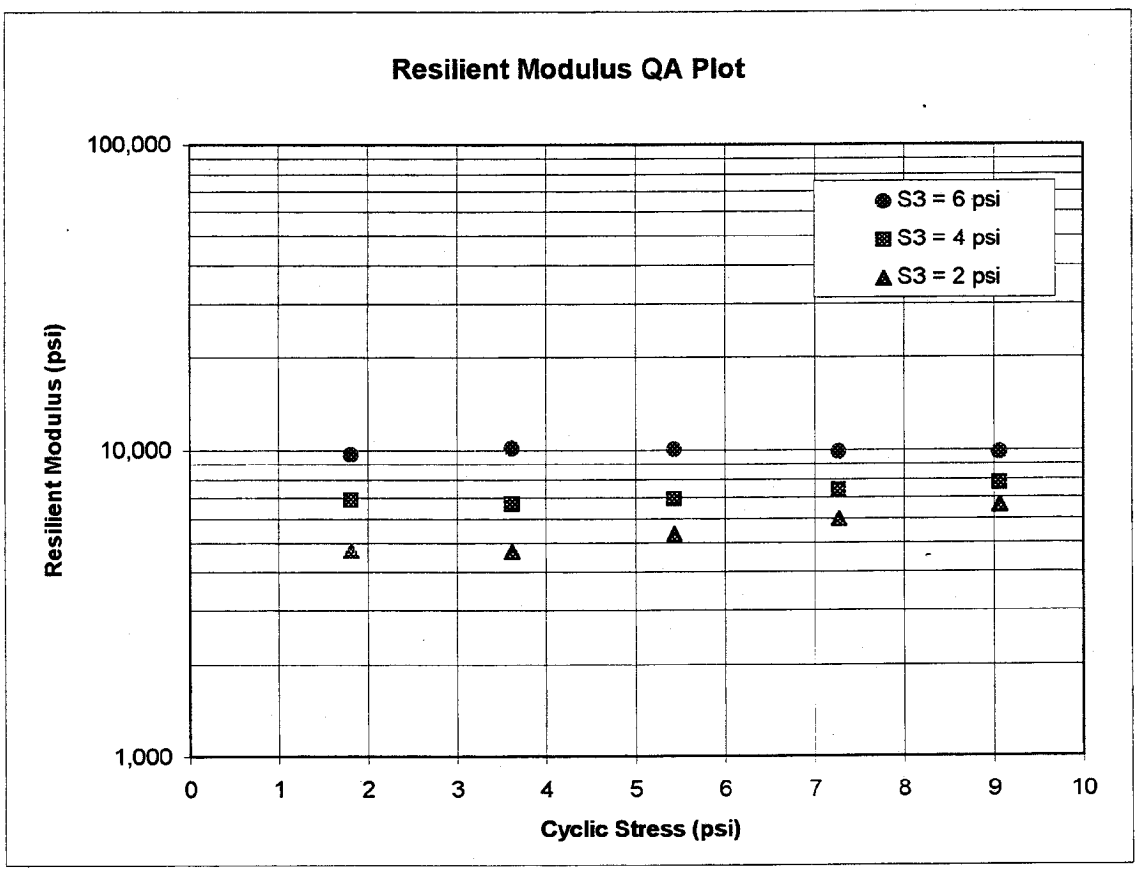


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	John Sevier
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-18-1995