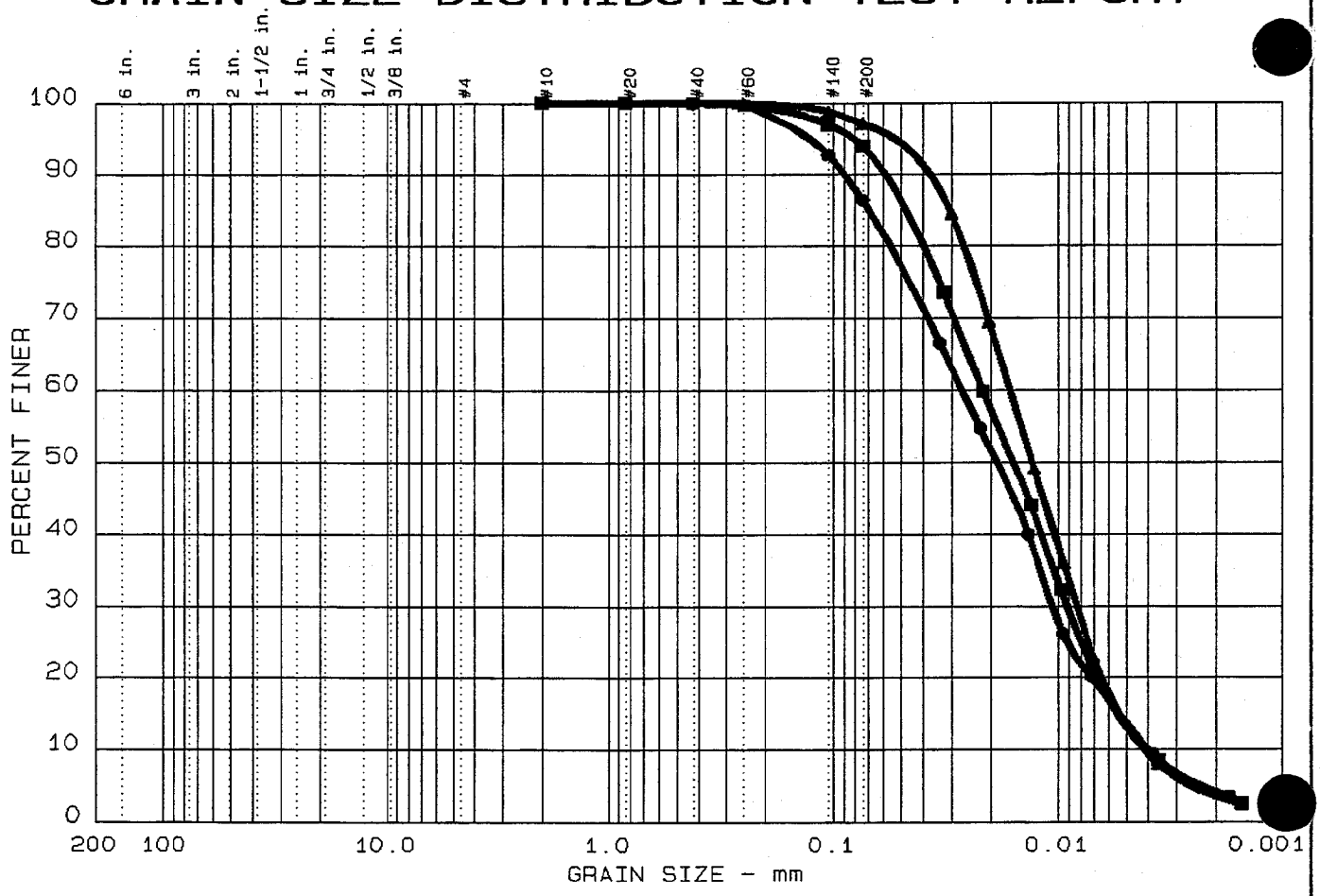
TVA - KINGSTON
PONDED FLY ASH (CELL I)

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 86.4 13.6	0.0 97.1 13.2	0.0 94.0 13.1
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	2.28	2.31	2.30
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, %	81.0 25.2		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	84.7 24.1		
			Result	Dry Density, pcf	Moisture Content, %
Consolidation	ASTM D2435	Compression Index C_c	0.05	76.9	25.1
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	8.3E-5	77.8	23.2
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ', degrees	0.14 26.1	77.8	23.1
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	0.36 19.6	77.8	23.1
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	0.82 39.1	74.1	24.8
California Bearing Ratio	ASTM D 1883	CBR, %	2	80.1	27.4
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	3,553	75.8	25.5
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	4,309	79.1	24.1
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	7,700		
pH of Soil	AASHTO T 289	pH	7.6		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	200		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	<10		

kif-fa1.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	12	0.0	0.0	13.6	72.8	13.6
▲	13	0.0	0.0	2.9	83.9	13.2
■	14	0.0	0.0	6.0	80.9	13.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP			0.02	0.011	0.0054	0.0040	1.07	6.8
▲	NL	NP			0.01	0.008	0.0054	0.0042	1.01	3.9
■	NL	NP			0.02	0.009	0.0055	0.0041	0.95	5.3

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

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

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

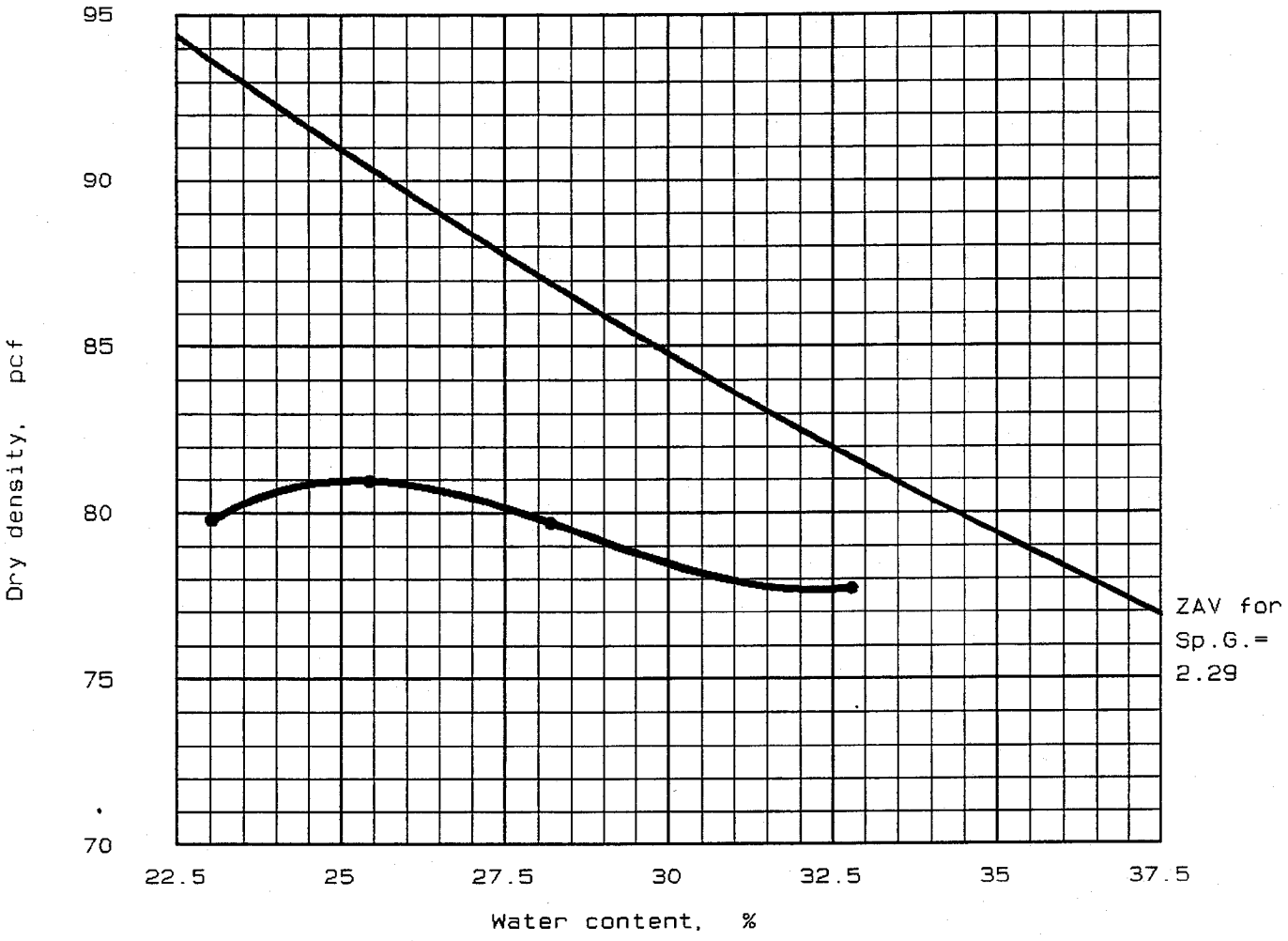
Remarks:

Tested by: JCR

Reviewed by: HJ

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)	31.1 %	2.29	NL	NP	0 %	92.5 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 25.2 % Maximum dry density = 81.0 pcf	

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

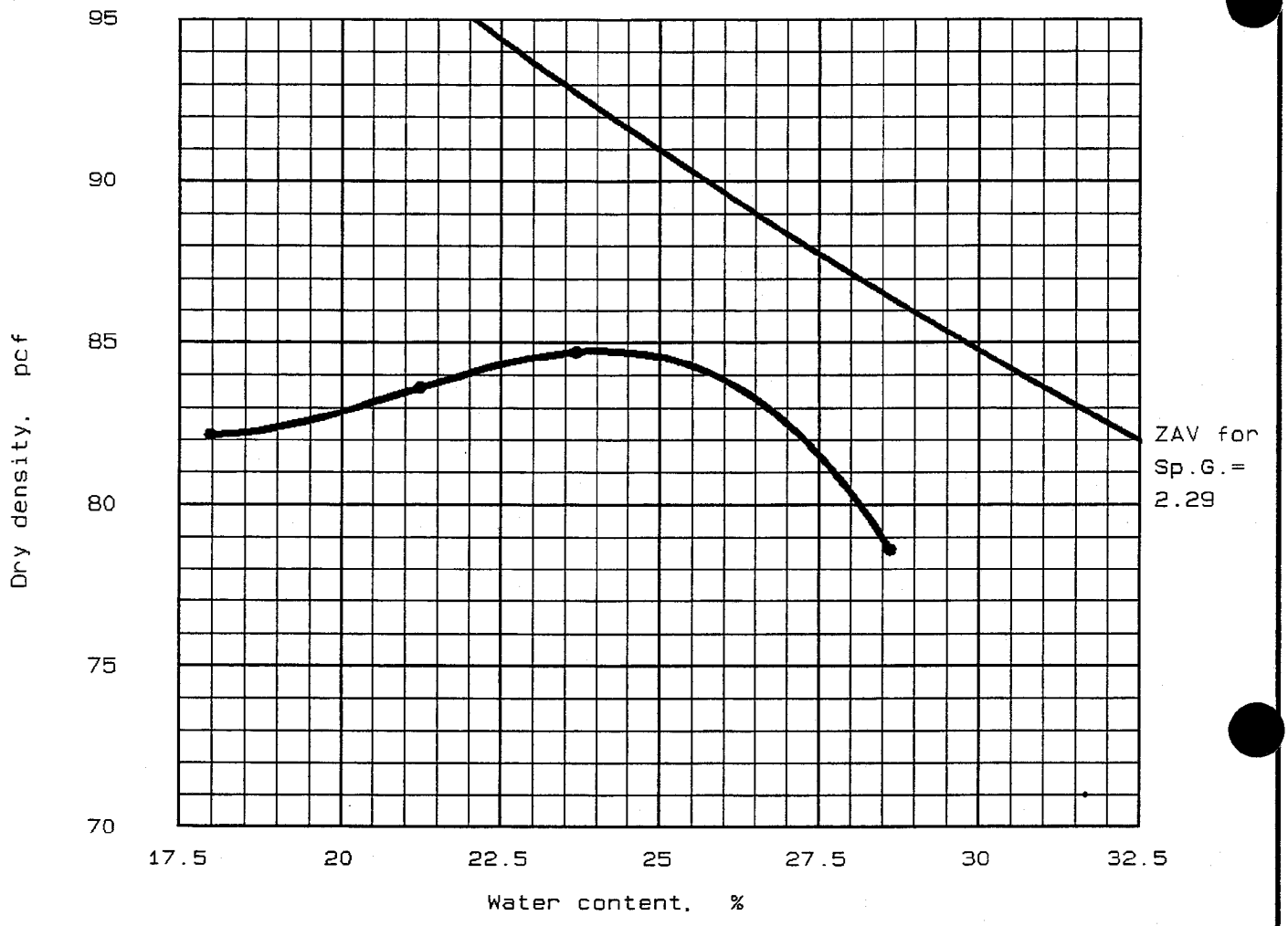
Remarks:
Tested by: JCR
Reviewed by: RLB

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						
	ML	A-4(0.0)	31.1 %	2.29	NL	NP	0 %	92.5 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 24.1 % Maximum dry density = 84.7 pcf	

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

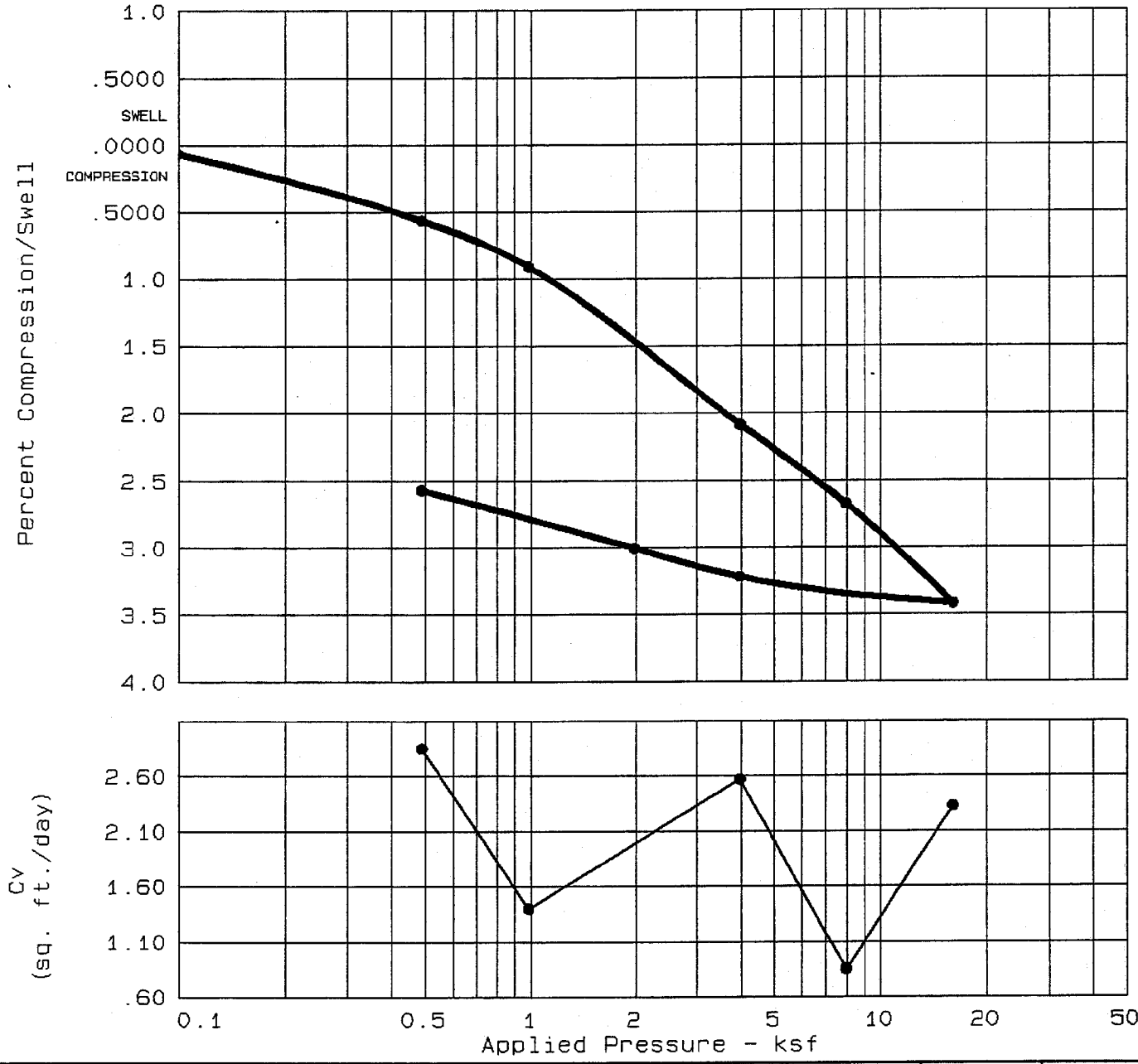
Remarks:
Tested by: JCR
Reviewed by: RLB

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
66.9 %	25.1	76.9	NL	NP	2.295	8.00	0.05	0.8604

TEST RESULTS

Compression Index = 0.05

MATERIAL DESCRIPTION

Class: USCS: ML

Project No.: 5810860101
Project: TVA - Kingston
Location: Ponded Fly Ash
Cell I
Date: 6/29/95

Remarks:

Tested by: AGK
Reviewed by: HJ

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No. _____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - Kingston*	Test Date	*06/12/95*
Material (Source)	*Ponded Fly Ash (Cell I)*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*23.2*
Wet Unit Weight, pcf:	*95.8*
Dry Unit Weight, pcf:	*77.8*
Compaction, %:	*96.0*
Hydraulic Conductivity, cm/sec. @20 °C:	***8.3E-05***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - Kingston	Test Date	06/12/95
Material (Source)	Ponded Fly Ash (Cell I)	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	770.60
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, %	23.2
		Wet Soil + Tare, grams	949.40	Wet Unit Wt, pcf	95.8
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	77.8

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
				862	0.0	22.0	125.08	103.08	8.4E-05	21	8.3E-05
				861	0.0	22.0	125.08	103.08	8.4E-05	21	8.3E-05
				865	0.0	22.0	125.08	103.08	8.4E-05	21	8.2E-05

No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	81.0	96.0	Vertical

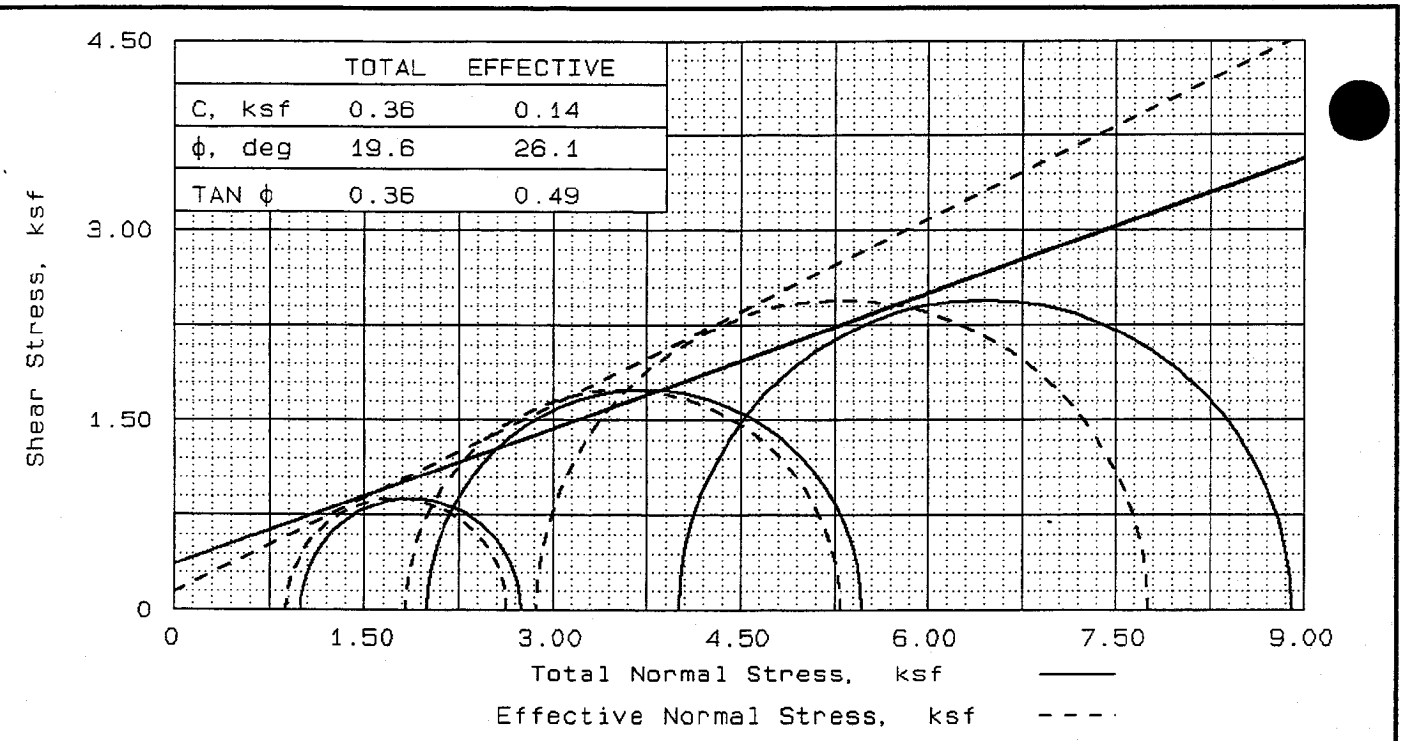
Avg. k at 20 °C 8.3E-05 cm/sec

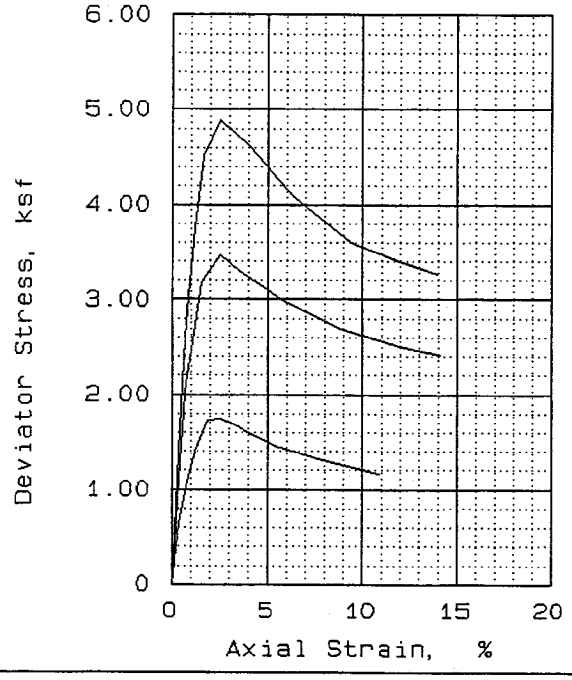
a = area of burette in cm²
L = length of sample in cm
A = area of sample in cm²

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-00012204





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	22.9	23.2	23.3
	DRY DENSITY, pcf	77.9	77.8	77.6
	SATURATION, %	62.9	63.4	63.3
	VOID RATIO	0.835	0.838	0.842
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	36.1	35.5	35.3
	DRY DENSITY, pcf	78.3	78.9	79.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.826	0.813	0.807
	DIAMETER, in	2.83	2.82	2.81
	HEIGHT, in	5.98	5.97	5.97
BACK PRESSURE, ksf		4.39	3.57	3.61
CELL PRESSURE, ksf		5.39	5.57	7.62
FAILURE STRESS, ksf		1.75	3.47	4.89
PORE PRESSURE, ksf		4.51	3.74	4.75
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		2.63	5.30	7.75
$\bar{\sigma}_3$ FAILURE, ksf		0.88	1.83	2.87

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

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.28
REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

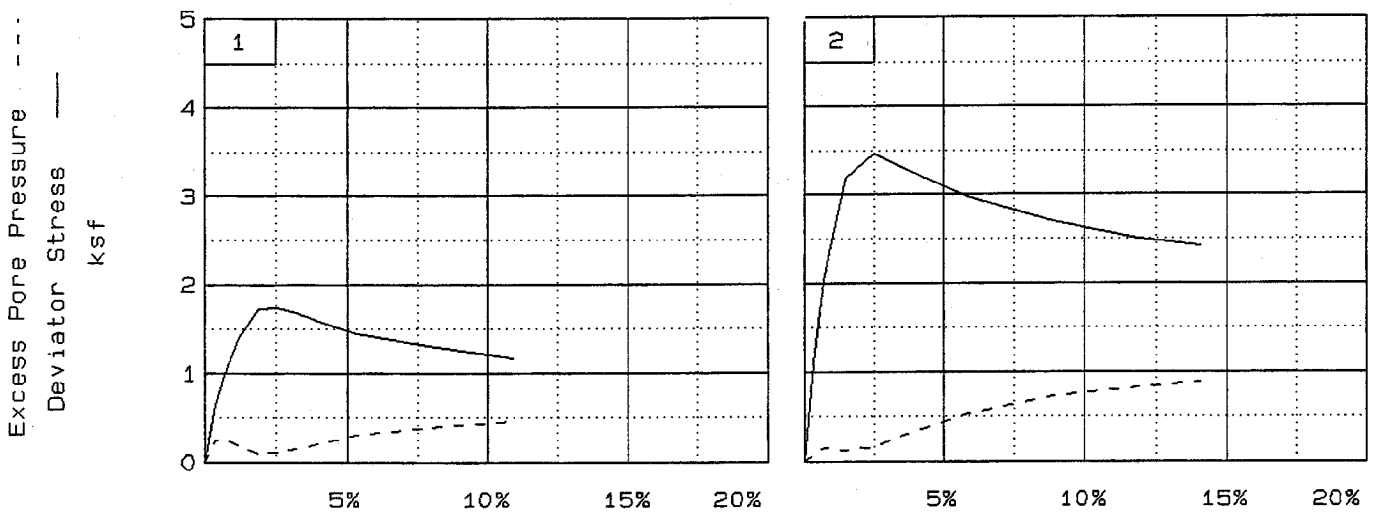
PROJECT: TVA - Kingston

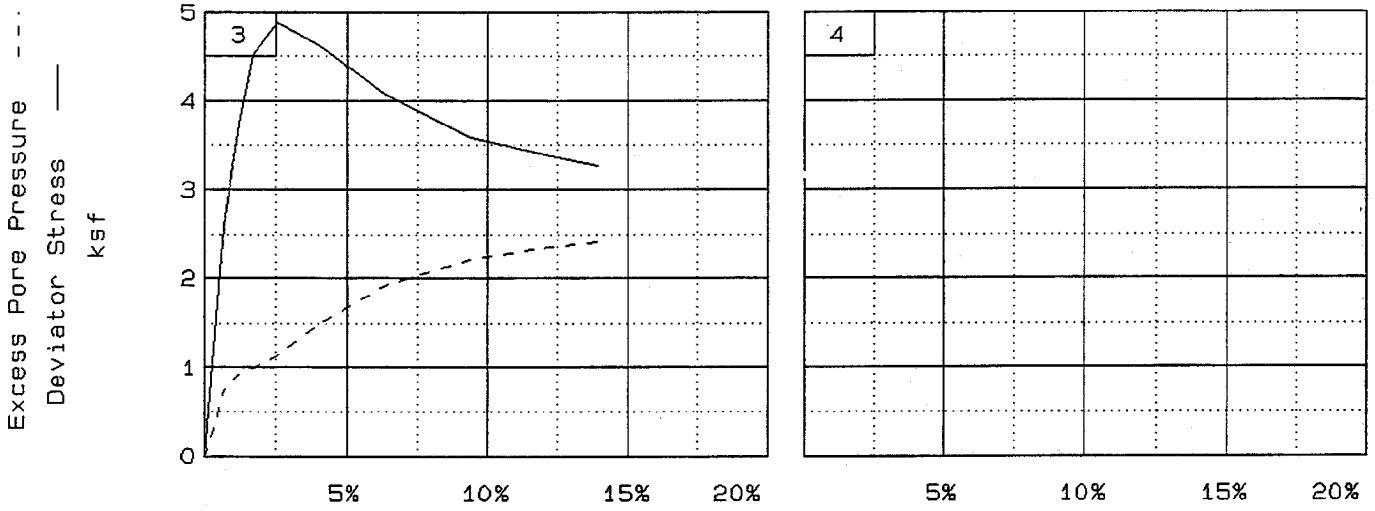
SAMPLE LOCATION: Ponded Fly Ash
Cell I

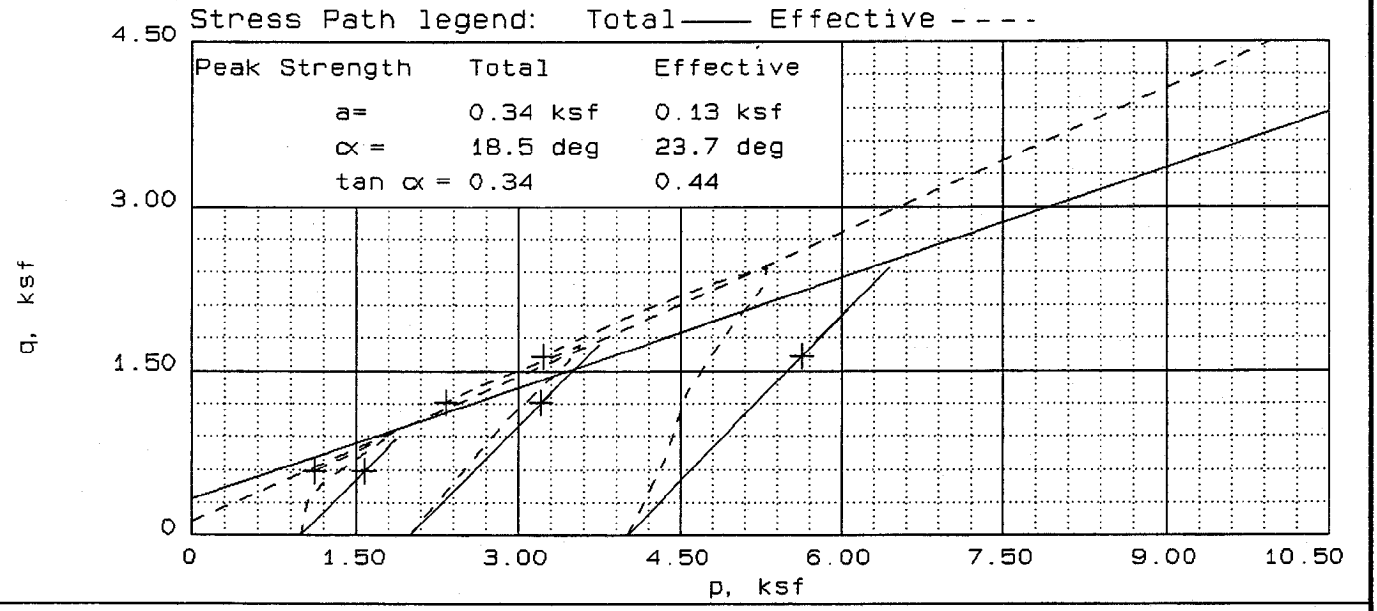
PROJ. NO.: 5810860101 DATE: August 23, 1995

TRIAXIAL COMPRESSION TEST

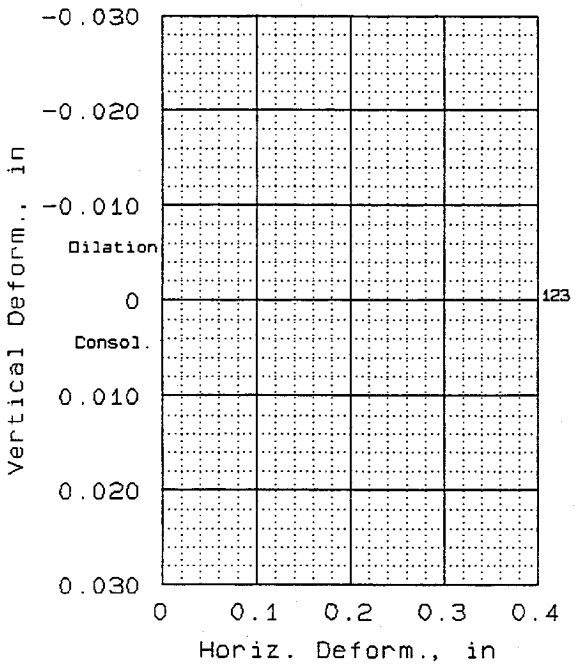
LAW ENGINEERING, INC.

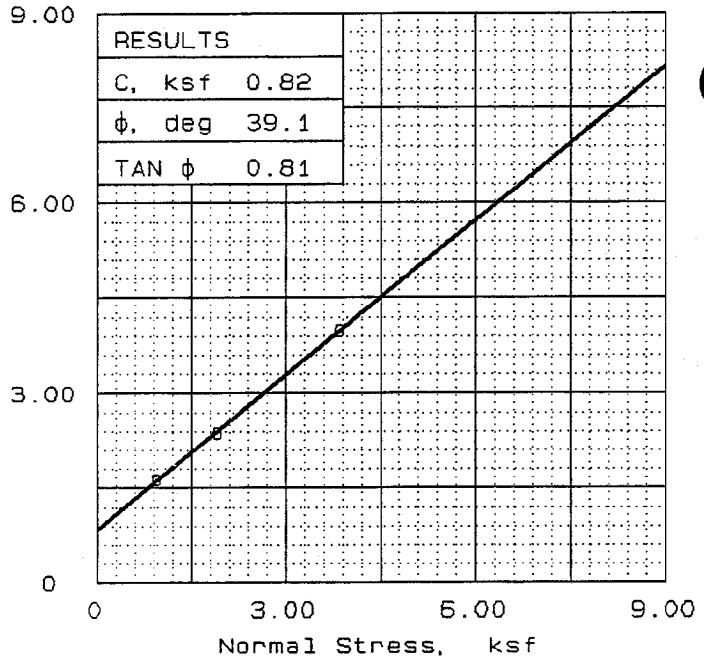


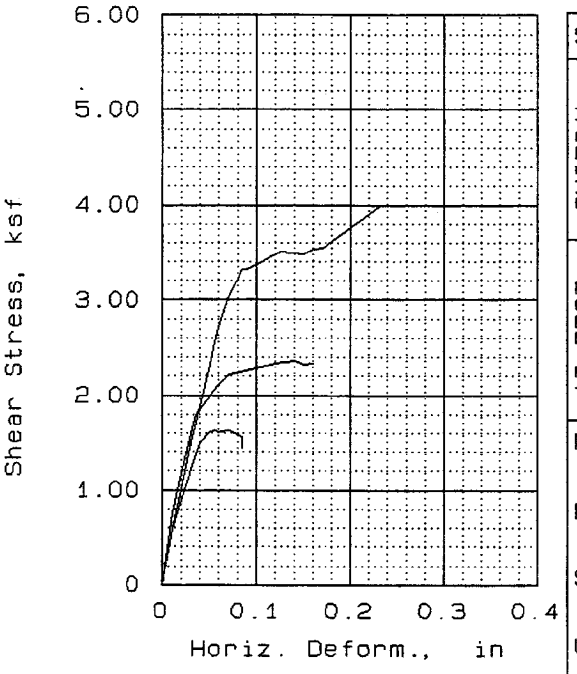




Client:
Project: TVA - Kingston
Location: Ponded Fly Ash Cell I
File: 8601G Project No.: 5810860101 Page 2/2 Fig. No. ____







SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	24.7	24.8	24.8
	DRY DENSITY, pcf	73.7	73.3	75.4
	SATURATION, %	60.2	59.8	63.3
	VOID RATIO	0.940	0.949	0.896
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	24.7	24.8	24.8
	DRY DENSITY, pcf	73.7	73.3	75.4
	SATURATION, %	60.2	59.8	63.3
	VOID RATIO	0.940	0.949	0.896
	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		1.63	2.37	3.99
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= 2.29

REMARKS: Tested by: HJ

Reviewed by: RWB

FIG. NO.

CLIENT:

PROJECT: TVA - Kingston

SAMPLE LOCATION: Ponded Fly Ash Cell I

PROJ. NO.: 5810860101 DATE: August 30, 1995

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

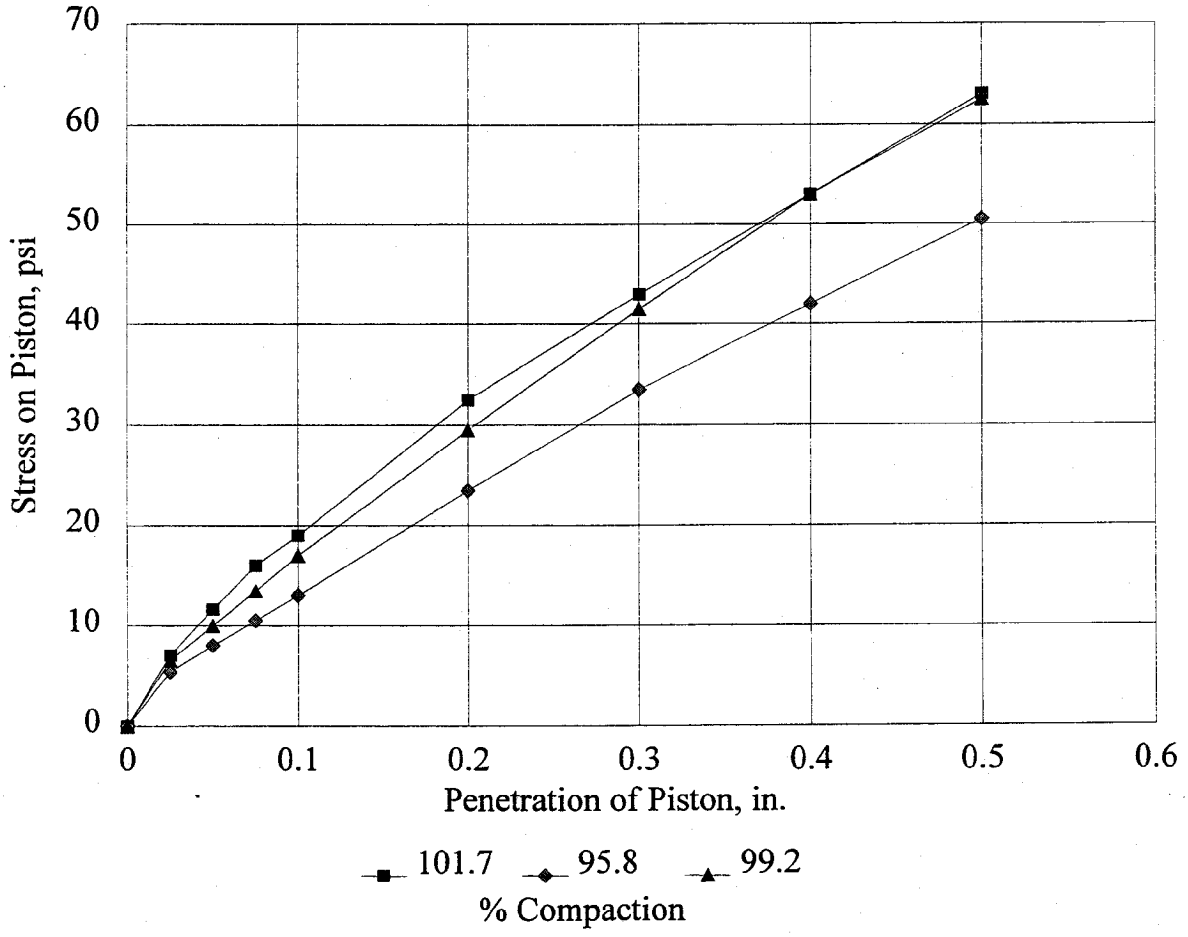
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Kingston	**Test Date**	07/31/95
Material (Source)	Ponded Fly Ash (Cell 1)	**Reviewed By**	RLB
		Review Date	08/30/95

Compaction, %	101.7	95.8	99.2
Before Soak Dry Density, pcf	82.4	77.6	80.4
Before Soak Moisture Content,	26.5	30.1	25.7
After Soak Dry Density, pcf	79.4	77.4	78.2
After Soak Moisture Content, %	32.2	32.3	33.8
CBR @ 0.1 in.	1.9	1.3	1.7
CBR @ 0.2 in.	2.2	1.6	2.0



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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell I)
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	6.09
	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	38.39
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	959.94
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	959.94
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	25.2
	MAX. DRY DENSITY, pcf	81.0
	95 % MAX. DRY DENSITY, pcf	77.0
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	25.5
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	25.5
	COMPACTION DRY DENSITY, γ_d pcf	75.8
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	22.1
	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*	06-29-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Bonham 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Kingston
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (Cell I)
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 06-29-1995
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	12.9	11.6	1.3	2.0	1.8	0.2	0.00286	0.00289	0.00288	0.00047	3,894
			2	12.8	11.5	1.3	2.0	1.8	0.2	0.00286	0.00288	0.00287	0.00047	3,886
			3	12.9	11.6	1.3	2.0	1.8	0.2	0.00287	0.00290	0.00288	0.00047	3,891
			4	12.8	11.5	1.3	2.0	1.8	0.2	0.00287	0.00292	0.00289	0.00047	3,859
			5	12.9	11.6	1.3	2.0	1.8	0.2	0.00285	0.00292	0.00289	0.00047	3,890
	COLUMN AVERAGE			12.9	11.6	1.3	2.0	1.8	0.2	0.00286	0.00290	0.00288	0.00047	3,884
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	14

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

SEQUENCE 2	6.0	4.0	1	25.4	23.0	2.4	4.0	3.7	0.4	0.00482	0.00491	0.00486	0.00080	4,578
			2	25.4	23.0	2.4	4.0	3.7	0.4	0.00484	0.00492	0.00488	0.00080	4,560
			3	25.5	23.1	2.4	4.0	3.7	0.4	0.00486	0.00491	0.00488	0.00080	4,566
			4	25.5	23.1	2.4	4.0	3.7	0.4	0.00484	0.00491	0.00487	0.00080	4,577
			5	25.4	23.1	2.4	4.0	3.7	0.4	0.00486	0.00492	0.00489	0.00080	4,557
	COLUMN AVERAGE			25.4	23.0	2.4	4.0	3.7	0.4	0.00485	0.00491	0.00488	0.00080	4,568
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	9
SEQUENCE 3	6.0	6.0	1	37.9	34.3	3.6	6.0	5.4	0.6	0.00687	0.00696	0.00692	0.00114	4,799
			2	37.8	34.2	3.6	6.0	5.4	0.6	0.00690	0.00698	0.00694	0.00114	4,771
			3	37.9	34.3	3.6	6.0	5.4	0.6	0.00689	0.00701	0.00695	0.00114	4,770
			4	37.9	34.3	3.6	6.0	5.4	0.6	0.00689	0.00701	0.00695	0.00114	4,773
			5	37.8	34.2	3.6	6.0	5.4	0.6	0.00687	0.00697	0.00692	0.00114	4,783
	COLUMN AVERAGE			37.9	34.3	3.6	6.0	5.4	0.6	0.00689	0.00699	0.00694	0.00114	4,779
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	12
SEQUENCE 4	6.0	8.0	1	50.8	45.9	4.9	8.1	7.3	0.8	0.00919	0.00934	0.00927	0.00152	4,795
			2	50.8	45.9	4.9	8.1	7.3	0.8	0.00918	0.00935	0.00927	0.00152	4,797
			3	50.8	45.9	4.9	8.1	7.3	0.8	0.00915	0.00933	0.00924	0.00152	4,804
			4	50.8	45.9	4.9	8.1	7.3	0.8	0.00915	0.00932	0.00923	0.00152	4,808
			5	50.8	45.9	4.9	8.1	7.3	0.8	0.00916	0.00932	0.00924	0.00152	4,804
	COLUMN AVERAGE			50.8	45.9	4.9	8.1	7.3	0.8	0.00917	0.00933	0.00925	0.00152	4,802
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	5

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

SEQUENCE 5	6.0	10.0	1	63.6	57.8	5.8	10.1	9.2	0.9	0.01133	0.01151	0.01142	0.00187	4,897
			2	63.6	57.5	6.1	10.1	9.1	1.0	0.01132	0.01150	0.01141	0.00187	4,878
			3	63.3	57.4	5.9	10.1	9.1	0.9	0.01126	0.01143	0.01135	0.00186	4,894
			4	63.3	57.3	6.1	10.1	9.1	1.0	0.01128	0.01145	0.01136	0.00186	4,875
			5	63.3	57.2	6.1	10.1	9.1	1.0	0.01129	0.01146	0.01137	0.00187	4,866
	COLUMN AVERAGE			63.4	57.4	6.0	10.1	9.1	1.0	0.01130	0.01147	0.01138	0.00187	4,882
	STANDARD DEV.			0.2	0.2	0.1	0.0	0.0	0.0	0.00003	0.00004	0.00003	0.00001	13
SEQUENCE 6	4.0	2.0	1	13.2	11.6	1.6	2.1	1.8	0.3	0.00285	0.00292	0.00289	0.00047	3,877
			2	13.2	11.5	1.6	2.1	1.8	0.3	0.00285	0.00292	0.00289	0.00047	3,860
			3	13.2	11.6	1.6	2.1	1.8	0.3	0.00284	0.00291	0.00288	0.00047	3,905
			4	13.2	11.6	1.6	2.1	1.8	0.3	0.00283	0.00293	0.00288	0.00047	3,878
			5	13.2	11.6	1.6	2.1	1.8	0.3	0.00286	0.00292	0.00289	0.00047	3,880
	COLUMN AVERAGE			13.2	11.6	1.6	2.1	1.8	0.3	0.00285	0.00292	0.00289	0.00047	3,880
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16
SEQUENCE 7	4.0	4.0	1	25.0	22.6	2.4	4.0	3.6	0.4	0.00587	0.00597	0.00592	0.00097	3,690
			2	25.0	22.6	2.4	4.0	3.6	0.4	0.00589	0.00595	0.00592	0.00097	3,699
			3	25.0	22.7	2.4	4.0	3.6	0.4	0.00586	0.00596	0.00591	0.00097	3,709
			4	25.1	22.7	2.4	4.0	3.6	0.4	0.00587	0.00596	0.00592	0.00097	3,711
			5	25.0	22.7	2.4	4.0	3.6	0.4	0.00587	0.00596	0.00592	0.00097	3,706
	COLUMN AVERAGE			25.0	22.6	2.4	4.0	3.6	0.4	0.00587	0.00596	0.00592	0.00097	3,703
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	9

Source: Kingston Description: Ponded Fly Ash (Cell I) 95% Standard 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	0.00872	0.00884	0.00878	0.00144	3,775
			2	37.8	34.2	3.6	6.0	5.4	0.6	0.00872	0.00884	0.00878	0.00144	3,773
			3	37.8	34.3	3.6	6.0	5.4	0.6	0.00875	0.00884	0.00880	0.00144	3,768
			4	37.8	34.3	3.6	6.0	5.4	0.6	0.00874	0.00885	0.00879	0.00144	3,769
			5	37.9	34.3	3.6	6.0	5.4	0.6	0.00873	0.00882	0.00878	0.00144	3,780
	COLUMN AVERAGE			37.8	34.3	3.6	6.0	5.4	0.6	0.00873	0.00884	0.00878	0.00144	3,773
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	5
SEQUENCE 9	4.0	8.0	1	50.8	46.0	4.8	8.1	7.3	0.8	0.01107	0.01121	0.01114	0.00183	3,993
			2	50.8	45.9	4.8	8.1	7.3	0.8	0.01107	0.01121	0.01114	0.00183	3,991
			3	50.8	46.0	4.8	8.1	7.3	0.8	0.01107	0.01123	0.01115	0.00183	3,990
			4	50.8	46.0	4.8	8.1	7.3	0.8	0.01108	0.01124	0.01116	0.00183	3,989
			5	50.8	45.9	4.8	8.1	7.3	0.8	0.01109	0.01123	0.01116	0.00183	3,982
	COLUMN AVERAGE			50.8	46.0	4.8	8.1	7.3	0.8	0.01108	0.01122	0.01115	0.00183	3,989
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	4
SEQUENCE 10	4.0	10.0	1	63.6	57.5	6.1	10.1	9.1	1.0	0.01324	0.01341	0.01332	0.00219	4,175
			2	63.5	57.4	6.1	10.1	9.1	1.0	0.01325	0.01344	0.01334	0.00219	4,161
			3	63.5	57.4	6.1	10.1	9.1	1.0	0.01325	0.01341	0.01333	0.00219	4,164
			4	63.5	57.4	6.1	10.1	9.1	1.0	0.01321	0.01340	0.01331	0.00218	4,171
			5	63.4	57.3	6.1	10.1	9.1	1.0	0.01323	0.01339	0.01331	0.00218	4,166
	COLUMN AVERAGE			63.5	57.4	6.1	10.1	9.1	1.0	0.01324	0.01341	0.01332	0.00219	4,168
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	5

Source: Kingston Description: Ponded Fly Ash (Cell I) 95% Standard 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	0.00340	0.00345	0.00342	0.00056	3,201
			2	13.4	11.3	2.1	2.1	1.8	0.3	0.00340	0.00343	0.00341	0.00056	3,213
			3	13.4	11.4	2.1	2.1	1.8	0.3	0.00339	0.00344	0.00341	0.00056	3,216
			4	13.4	11.4	2.0	2.1	1.8	0.3	0.00339	0.00345	0.00342	0.00056	3,219
			5	13.4	11.4	2.1	2.1	1.8	0.3	0.00338	0.00342	0.00340	0.00056	3,233
	COLUMN AVERAGE			13.4	11.4	2.1	2.1	1.8	0.3	0.00339	0.00344	0.00341	0.00056	3,216
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	12
SEQUENCE 12	2.0	4.0	1	25.1	22.7	2.4	4.0	3.6	0.4	0.00732	0.00742	0.00737	0.00121	2,978
			2	24.9	22.6	2.3	4.0	3.6	0.4	0.00732	0.00745	0.00738	0.00121	2,961
			3	25.1	22.7	2.4	4.0	3.6	0.4	0.00732	0.00740	0.00736	0.00121	2,986
			4	25.1	22.8	2.4	4.0	3.6	0.4	0.00735	0.00745	0.00740	0.00121	2,976
			5	25.0	22.7	2.3	4.0	3.6	0.4	0.00733	0.00742	0.00737	0.00121	2,978
	COLUMN AVERAGE			25.0	22.7	2.3	4.0	3.6	0.4	0.00733	0.00743	0.00738	0.00121	2,976
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	9
SEQUENCE 13	2.0	6.0	1	37.6	34.0	3.6	6.0	5.4	0.6	0.01059	0.01080	0.01069	0.00175	3,074
			2	37.6	34.0	3.6	6.0	5.4	0.6	0.01059	0.01073	0.01066	0.00175	3,086
			3	37.6	34.0	3.6	6.0	5.4	0.6	0.01062	0.01072	0.01067	0.00175	3,084
			4	37.5	33.9	3.6	6.0	5.4	0.6	0.01059	0.01077	0.01068	0.00175	3,073
			5	37.6	34.0	3.6	6.0	5.4	0.6	0.01059	0.01074	0.01067	0.00175	3,081
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.01060	0.01075	0.01067	0.00175	3,080
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00003	0.00001	0.00000	6

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

SEQUENCE 14	2.0	8.0	1	50.2	45.4	4.8	8.0	7.2	0.8	0.01312	0.01328	0.01320	0.00217	3,325
			2	50.1	45.3	4.8	8.0	7.2	0.8	0.01316	0.01328	0.01322	0.00217	3,316
			3	50.2	45.4	4.8	8.0	7.2	0.8	0.01310	0.01327	0.01318	0.00216	3,331
			4	50.1	45.4	4.8	8.0	7.2	0.8	0.01314	0.01331	0.01322	0.00217	3,319
			5	50.2	45.4	4.8	8.0	7.2	0.8	0.01311	0.01327	0.01319	0.00216	3,332
	COLUMN AVERAGE			50.2	45.4	4.8	8.0	7.2	0.8	0.01313	0.01328	0.01320	0.00217	3,325
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	7
SEQUENCE 15	2.0	10.0	1	62.7	56.8	6.0	10.0	9.0	0.9	0.01575	0.01591	0.01583	0.00260	3,469
			2	62.8	56.8	6.0	10.0	9.0	1.0	0.01566	0.01589	0.01578	0.00259	3,482
			3	62.8	56.8	6.0	10.0	9.0	1.0	0.01572	0.01591	0.01582	0.00260	3,476
			4	62.8	56.8	6.0	10.0	9.0	1.0	0.01572	0.01590	0.01581	0.00259	3,477
			5	63.0	56.9	6.0	10.0	9.0	1.0	0.01568	0.01590	0.01579	0.00259	3,489
	COLUMN AVERAGE			62.8	56.8	6.0	10.0	9.0	1.0	0.01570	0.01590	0.01580	0.00259	3,479
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00004	0.00001	0.00002	0.00000	7

SUBMITTED BY, DATE

RS 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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell I)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	06-29-1995

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

K1 =	1,803
K2 =	0.07728
K5 =	0.41203
R^2 =	0.92

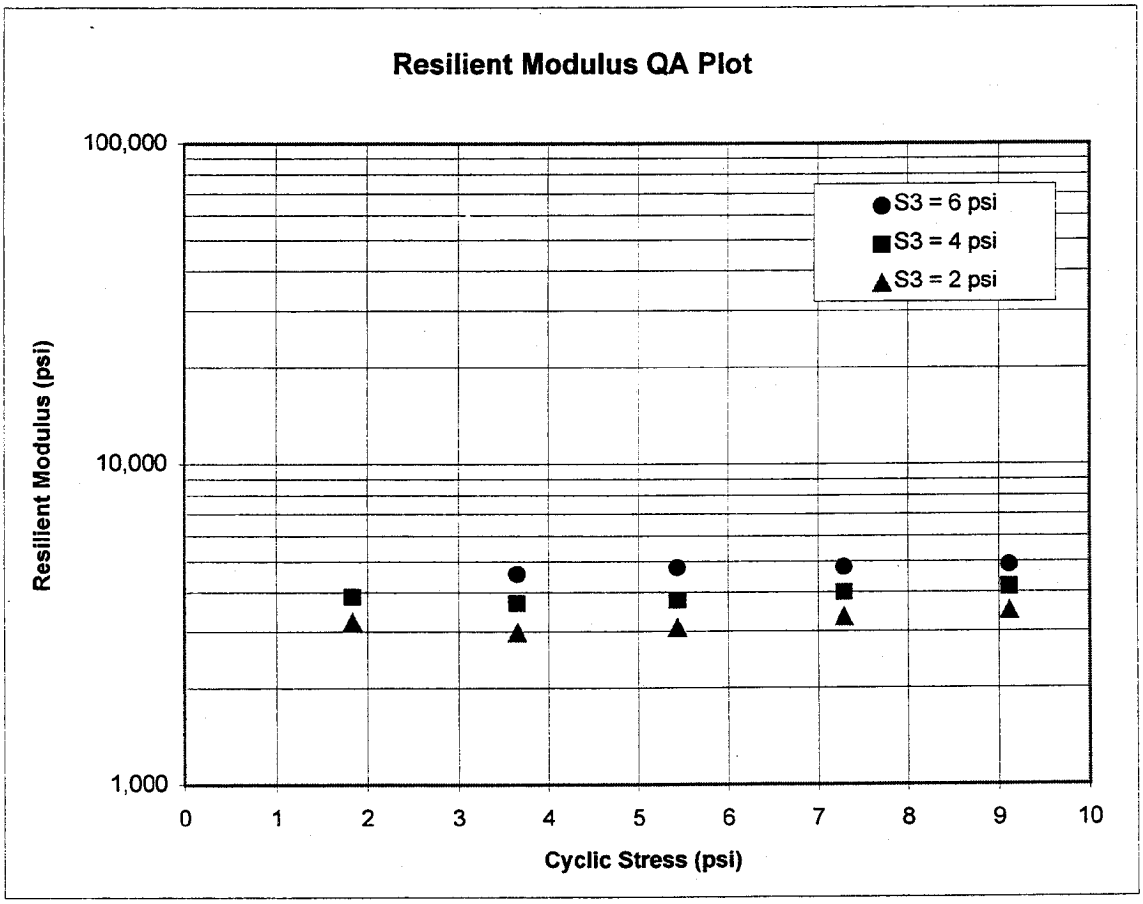
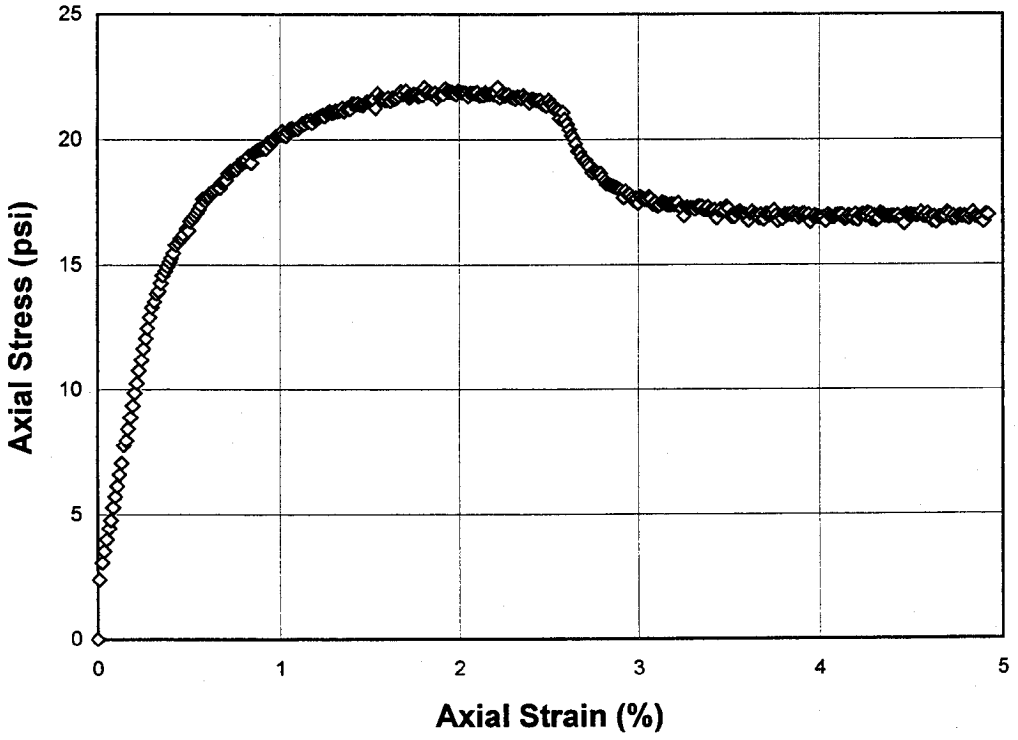


FIGURE 2 - Quick Shear Stress vs Strain

	PROJECT NAME:	TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
	LAW PROJECT NO.:	5810860101
1.	*MATERIAL SOURCE:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell I)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	06-29-1995



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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell I)
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	2.84
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.13
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.13
	INITIAL AREA, A_0, in^2	6.33
	INITIAL VOLUME $A_0 L_0$, in^3	38.80
7.	*SOIL SPECIMEN WEIGHT:*	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1001.20
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	1001.20
8.	*SOIL PROPERTIES.:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	24.1
	MAX. DRY DENSITY, pcf	84.7
	95 % MAX. DRY DENSITY, pcf	80.5
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	24.1
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	24.2
	COMPACTION DRY DENSITY, γ_d pcf	79.1
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	28.2
	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*	07-05-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Bowden 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Kingston
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (Cell I)
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 07-05-1995
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	
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	11.4	1.3	2.0	1.8	0.2	0.00190	0.00186	0.00188	0.00031	5,891
			2	12.8	11.5	1.3	2.0	1.8	0.2	0.00187	0.00184	0.00186	0.00030	5,993
			3	12.8	11.5	1.3	2.0	1.8	0.2	0.00188	0.00185	0.00187	0.00030	5,943
			4	12.8	11.5	1.3	2.0	1.8	0.2	0.00188	0.00185	0.00186	0.00030	5,960
			5	12.8	11.4	1.3	2.0	1.8	0.2	0.00187	0.00185	0.00186	0.00030	5,950
	COLUMN AVERAGE			12.8	11.5	1.3	2.0	1.8	0.2	0.00188	0.00185	0.00187	0.00030	5,947
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	37

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

SEQUENCE 2	6.0	4.0	1	25.4	22.9	2.5	4.0	3.6	0.4	0.00364	0.00365	0.00365	0.00059	6,089
			2	25.4	22.9	2.5	4.0	3.6	0.4	0.00364	0.00365	0.00365	0.00059	6,089
			3	25.4	23.0	2.5	4.0	3.6	0.4	0.00365	0.00365	0.00365	0.00059	6,104
			4	25.4	23.0	2.4	4.0	3.6	0.4	0.00365	0.00365	0.00365	0.00060	6,087
			5	25.4	22.9	2.5	4.0	3.6	0.4	0.00366	0.00367	0.00366	0.00060	6,066
	COLUMN AVERAGE			25.4	22.9	2.5	4.0	3.6	0.4	0.00365	0.00365	0.00365	0.00060	6,087
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	13
SEQUENCE 3	6.0	6.0	1	38.0	34.3	3.7	6.0	5.4	0.6	0.00592	0.00594	0.00593	0.00097	5,602
			2	38.0	34.3	3.7	6.0	5.4	0.6	0.00592	0.00594	0.00593	0.00097	5,600
			3	38.0	34.3	3.7	6.0	5.4	0.6	0.00591	0.00596	0.00593	0.00097	5,596
			4	38.0	34.3	3.7	6.0	5.4	0.6	0.00589	0.00594	0.00592	0.00096	5,614
			5	38.0	34.3	3.7	6.0	5.4	0.6	0.00591	0.00592	0.00592	0.00096	5,611
	COLUMN AVERAGE			38.0	34.3	3.7	6.0	5.4	0.6	0.00591	0.00594	0.00593	0.00097	5,605
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8
SEQUENCE 4	6.0	8.0	1	50.7	45.7	5.0	8.0	7.2	0.8	0.00815	0.00819	0.00817	0.00133	5,424
			2	50.7	45.7	5.0	8.0	7.2	0.8	0.00813	0.00819	0.00816	0.00133	5,426
			3	50.7	45.8	5.0	8.0	7.2	0.8	0.00812	0.00818	0.00815	0.00133	5,440
			4	50.8	45.8	5.0	8.0	7.2	0.8	0.00813	0.00817	0.00815	0.00133	5,448
			5	50.8	45.8	5.0	8.0	7.2	0.8	0.00814	0.00818	0.00816	0.00133	5,444
	COLUMN AVERAGE			50.7	45.8	5.0	8.0	7.2	0.8	0.00813	0.00818	0.00816	0.00133	5,436
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	11

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

SEQUENCE 5	6.0	10.0	1	63.6	57.4	6.2	10.1	9.1	1.0	0.01012	0.01019	0.01016	0.00166	5,476
			2	63.7	57.5	6.2	10.1	9.1	1.0	0.01015	0.01023	0.01019	0.00166	5,463
			3	63.6	57.3	6.2	10.0	9.1	1.0	0.01017	0.01023	0.01020	0.00166	5,447
			4	63.6	57.3	6.2	10.0	9.1	1.0	0.01015	0.01020	0.01018	0.00166	5,456
			5	63.6	57.4	6.2	10.0	9.1	1.0	0.01013	0.01020	0.01017	0.00166	5,466
	COLUMN AVERAGE			63.6	57.4	6.2	10.1	9.1	1.0	0.01014	0.01021	0.01018	0.00166	5,462
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	11
SEQUENCE 6	4.0	2.0	1	13.2	11.5	1.7	2.1	1.8	0.3	0.00219	0.00221	0.00220	0.00036	5,069
			2	13.2	11.5	1.7	2.1	1.8	0.3	0.00218	0.00220	0.00219	0.00036	5,080
			3	13.2	11.5	1.7	2.1	1.8	0.3	0.00218	0.00221	0.00219	0.00036	5,074
			4	13.2	11.5	1.7	2.1	1.8	0.3	0.00217	0.00219	0.00218	0.00036	5,127
			5	13.2	11.5	1.7	2.1	1.8	0.3	0.00218	0.00222	0.00220	0.00036	5,078
	COLUMN AVERAGE			13.2	11.5	1.7	2.1	1.8	0.3	0.00218	0.00220	0.00219	0.00036	5,086
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	23
SEQUENCE 7	4.0	4.0	1	25.4	22.9	2.4	4.0	3.6	0.4	0.00502	0.00504	0.00503	0.00082	4,413
			2	25.4	22.9	2.4	4.0	3.6	0.4	0.00502	0.00505	0.00503	0.00082	4,416
			3	25.4	22.9	2.4	4.0	3.6	0.4	0.00503	0.00503	0.00503	0.00082	4,414
			4	25.4	23.0	2.4	4.0	3.6	0.4	0.00502	0.00503	0.00503	0.00082	4,437
			5	25.5	23.0	2.4	4.0	3.6	0.4	0.00502	0.00505	0.00504	0.00082	4,428
	COLUMN AVERAGE			25.4	23.0	2.4	4.0	3.6	0.4	0.00502	0.00504	0.00503	0.00082	4,422
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00000	0.00000	11

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

SEQUENCE 8	4.0	6.0	1	38.0	34.3	3.7	6.0	5.4	0.6	0.00775	0.00779	0.00777	0.00127	4,279
			2	38.1	34.4	3.7	6.0	5.4	0.6	0.00774	0.00778	0.00776	0.00127	4,300
			3	38.1	34.4	3.7	6.0	5.4	0.6	0.00778	0.00779	0.00778	0.00127	4,283
			4	38.2	34.4	3.7	6.0	5.4	0.6	0.00774	0.00778	0.00776	0.00127	4,299
			5	38.1	34.4	3.7	6.0	5.4	0.6	0.00776	0.00781	0.00779	0.00127	4,279
	COLUMN AVERAGE			38.1	34.4	3.7	6.0	5.4	0.6	0.00775	0.00779	0.00777	0.00127	4,288
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	11
SEQUENCE 9	4.0	8.0	1	50.9	45.9	5.0	8.0	7.2	0.8	0.00996	0.00999	0.00998	0.00163	4,454
			2	50.8	45.9	5.0	8.0	7.2	0.8	0.00995	0.01000	0.00997	0.00163	4,455
			3	50.9	45.9	5.0	8.0	7.3	0.8	0.00995	0.00999	0.00997	0.00163	4,461
			4	50.9	45.9	5.0	8.0	7.3	0.8	0.00994	0.00998	0.00996	0.00162	4,468
			5	50.9	45.9	5.0	8.0	7.3	0.8	0.00994	0.00998	0.00996	0.00162	4,469
	COLUMN AVERAGE			50.9	45.9	5.0	8.0	7.3	0.8	0.00995	0.00999	0.00997	0.00163	4,461
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	7
SEQUENCE 10	4.0	10.0	1	63.5	57.3	6.2	10.0	9.1	1.0	0.01178	0.01183	0.01181	0.00193	4,700
			2	63.5	57.3	6.2	10.0	9.1	1.0	0.01180	0.01185	0.01182	0.00193	4,695
			3	63.5	57.3	6.2	10.0	9.1	1.0	0.01179	0.01187	0.01183	0.00193	4,695
			4	63.6	57.4	6.2	10.1	9.1	1.0	0.01181	0.01187	0.01184	0.00193	4,696
			5	63.6	57.4	6.2	10.1	9.1	1.0	0.01180	0.01187	0.01184	0.00193	4,696
	COLUMN AVERAGE			63.6	57.3	6.2	10.0	9.1	1.0	0.01179	0.01186	0.01183	0.00193	4,696
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	2

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

SEQUENCE 11	2.0	2.0	1	13.5	11.3	2.1	2.1	1.8	0.3	0.00273	0.00273	0.00273	0.00045	4,028
			2	13.5	11.4	2.1	2.1	1.8	0.3	0.00271	0.00271	0.00271	0.00044	4,067
			3	13.5	11.4	2.1	2.1	1.8	0.3	0.00269	0.00269	0.00269	0.00044	4,105
			4	13.5	11.4	2.1	2.1	1.8	0.3	0.00269	0.00269	0.00269	0.00044	4,117
			5	13.5	11.4	2.1	2.1	1.8	0.3	0.00270	0.00272	0.00271	0.00044	4,097
	COLUMN AVERAGE			13.5	11.4	2.1	2.1	1.8	0.3	0.00270	0.00271	0.00271	0.00044	4,083
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	36
SEQUENCE 12	2.0	4.0	1	25.1	22.6	2.4	4.0	3.6	0.4	0.00625	0.00625	0.00625	0.00102	3,507
			2	25.0	22.6	2.4	3.9	3.6	0.4	0.00629	0.00627	0.00628	0.00102	3,485
			3	25.0	22.6	2.4	3.9	3.6	0.4	0.00625	0.00625	0.00625	0.00102	3,495
			4	25.0	22.6	2.4	3.9	3.6	0.4	0.00628	0.00628	0.00628	0.00102	3,481
			5	25.0	22.6	2.4	3.9	3.6	0.4	0.00626	0.00626	0.00626	0.00102	3,494
	COLUMN AVERAGE			25.0	22.6	2.4	4.0	3.6	0.4	0.00627	0.00626	0.00626	0.00102	3,492
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	10
SEQUENCE 13	2.0	6.0	1	37.9	34.2	3.7	6.0	5.4	0.6	0.00938	0.00942	0.00940	0.00153	3,523
			2	37.9	34.2	3.7	6.0	5.4	0.6	0.00938	0.00941	0.00939	0.00153	3,529
			3	37.9	34.2	3.7	6.0	5.4	0.6	0.00940	0.00941	0.00940	0.00153	3,523
			4	37.9	34.2	3.7	6.0	5.4	0.6	0.00940	0.00940	0.00940	0.00153	3,521
			5	37.9	34.2	3.7	6.0	5.4	0.6	0.00940	0.00941	0.00941	0.00153	3,517
	COLUMN AVERAGE			37.9	34.2	3.7	6.0	5.4	0.6	0.00939	0.00941	0.00940	0.00153	3,523
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	4

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

SEQUENCE 14	2.0	8.0	1	50.7	45.8	5.0	8.0	7.2	0.8	0.01164	0.01168	0.01166	0.00190	3,804
			2	50.7	45.8	5.0	8.0	7.2	0.8	0.01165	0.01170	0.01168	0.00190	3,796
			3	50.7	45.8	4.9	8.0	7.2	0.8	0.01164	0.01169	0.01166	0.00190	3,803
			4	50.8	45.8	5.0	8.0	7.2	0.8	0.01161	0.01165	0.01163	0.00190	3,813
			5	50.8	45.8	5.0	8.0	7.2	0.8	0.01161	0.01165	0.01163	0.00190	3,816
	COLUMN AVERAGE			50.7	45.8	5.0	8.0	7.2	0.8	0.01163	0.01167	0.01165	0.00190	3,806
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	8
SEQUENCE 15	2.0	10.0	1	63.5	57.2	6.2	10.0	9.0	1.0	0.01359	0.01363	0.01361	0.00222	4,073
			2	63.5	57.2	6.2	10.0	9.0	1.0	0.01358	0.01362	0.01360	0.00222	4,078
			3	63.5	57.2	6.2	10.0	9.0	1.0	0.01358	0.01361	0.01359	0.00222	4,079
			4	63.5	57.2	6.2	10.0	9.0	1.0	0.01358	0.01358	0.01358	0.00222	4,082
			5	63.5	57.3	6.2	10.0	9.0	1.0	0.01357	0.01358	0.01357	0.00221	4,087
	COLUMN AVERAGE			63.5	57.2	6.2	10.0	9.0	1.0	0.01358	0.01360	0.01359	0.00222	4,080
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	5

SUBMITTED BY, DATE

R J Bruhnan 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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell I)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-05-1995

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

K1 =	2,374
K2 =	-0.04388
K5 =	0.47386
R^2 =	0.89

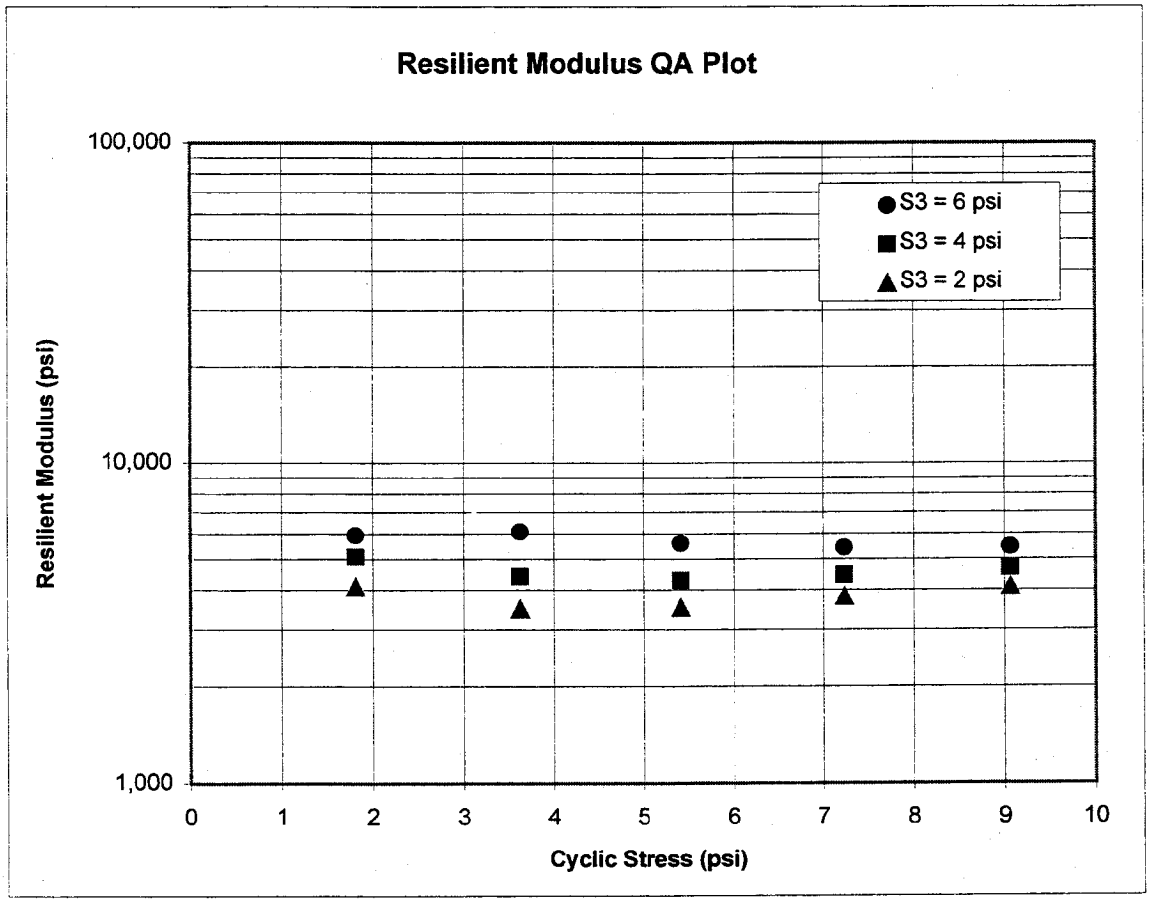
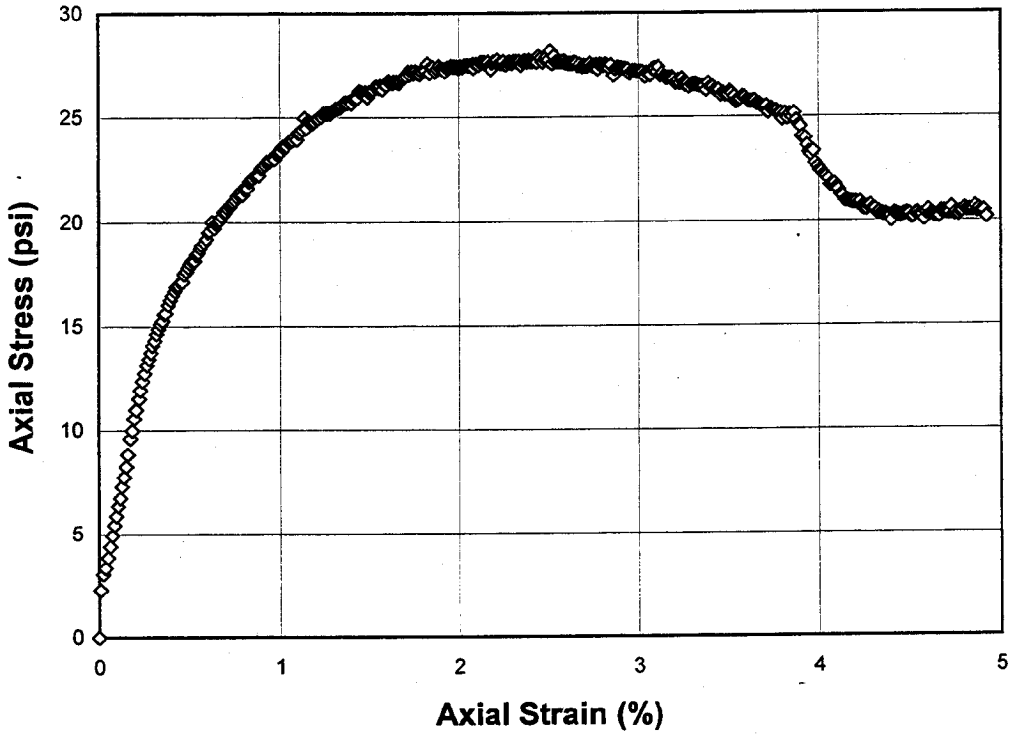


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell I)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-05-1995



KINGSTON

Ponded Fly Ash (Cell III)

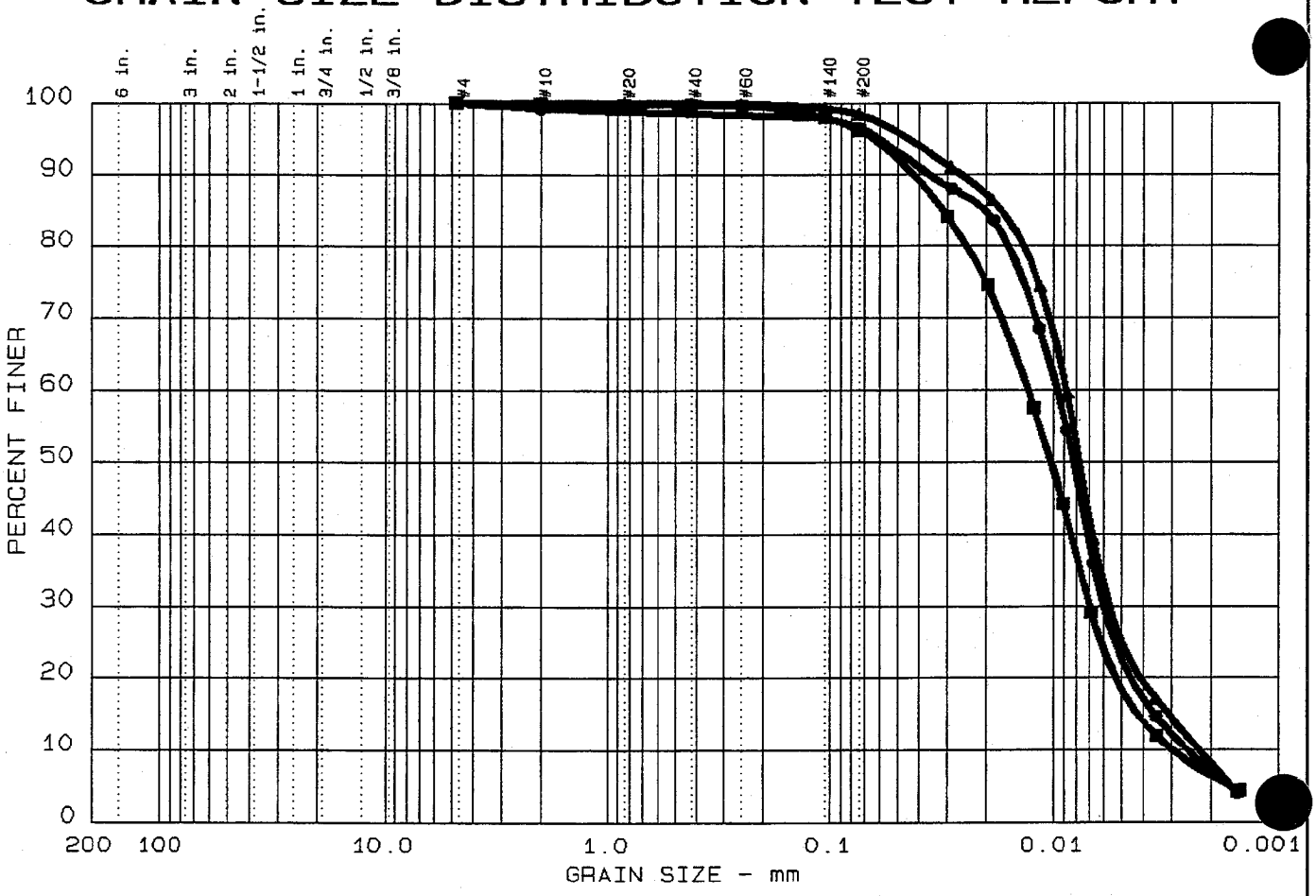
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Consolidation Test Report
Hydraulic Conductivity - Falling Head (2 Pages)
Triaxial Compression Test (2 Pages)
Direct Shear Test
California Bearing Ratio
Resilient Modulus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

TVA - KINGSTON
PONDED FLY ASH (CELL III)

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 96.5 22.6	0.0 98.3 25.0	0.0 96.1 18.4
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	2.31	2.29	2.34
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, %	81.0 23.5		
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %	84.4 23.7		
			Result	Dry Density, pcf	Moisture Content, %
Consolidation	ASTM D2435	Compression Index C_c	0.05	76.9	25.3
Hydraulic Conductivity	ASTM D 5084	Hydraulic Conductivity, cm/sec	3.4E-5	76.2	24.1
Triaxial Shear Strength Consolidated-Undrained (CU)	ASTM D4767	Effective Stress, Cohesion, c', ksf Effective Stress, Internal Friction Angle, ϕ', degrees	0.03 24.4	75.4	25.6
		Total Stress, Cohesion, c, ksf Total Stress, Internal Friction Angle, ϕ, degrees	0.00 17.8	75.4	25.6
Direct Shear Strength	ASTM D 3080	Cohesion, c, ksf Internal Friction Angle, ϕ, degrees	1.47 37.6	74.6	25.3
California Bearing Ratio	ASTM D 1883	CBR, %	1	76.8	23.1
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	4,350	74.4	25.4
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,199	80.6	23.9
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm	6,400		
pH of Soil	AASHTO T 289	pH	6.8		
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg	140		
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg	<10		

kif-fa3.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	0.0	3.5	73.9	22.6
▲	16	0.0	0.0	1.7	73.3	25.0
■	17	0.0	0.0	3.9	77.7	18.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP			0.01	0.006	0.0036	0.0025	1.48	3.8
▲	NL	NP			0.01	0.006	0.0031	0.0022	1.65	3.9
■	NL	NP			0.01	0.007	0.0042	0.0030	1.25	4.4

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

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

GRAIN SIZE DISTRIBUTION TEST REPORT

LAW ENGINEERING, INC.

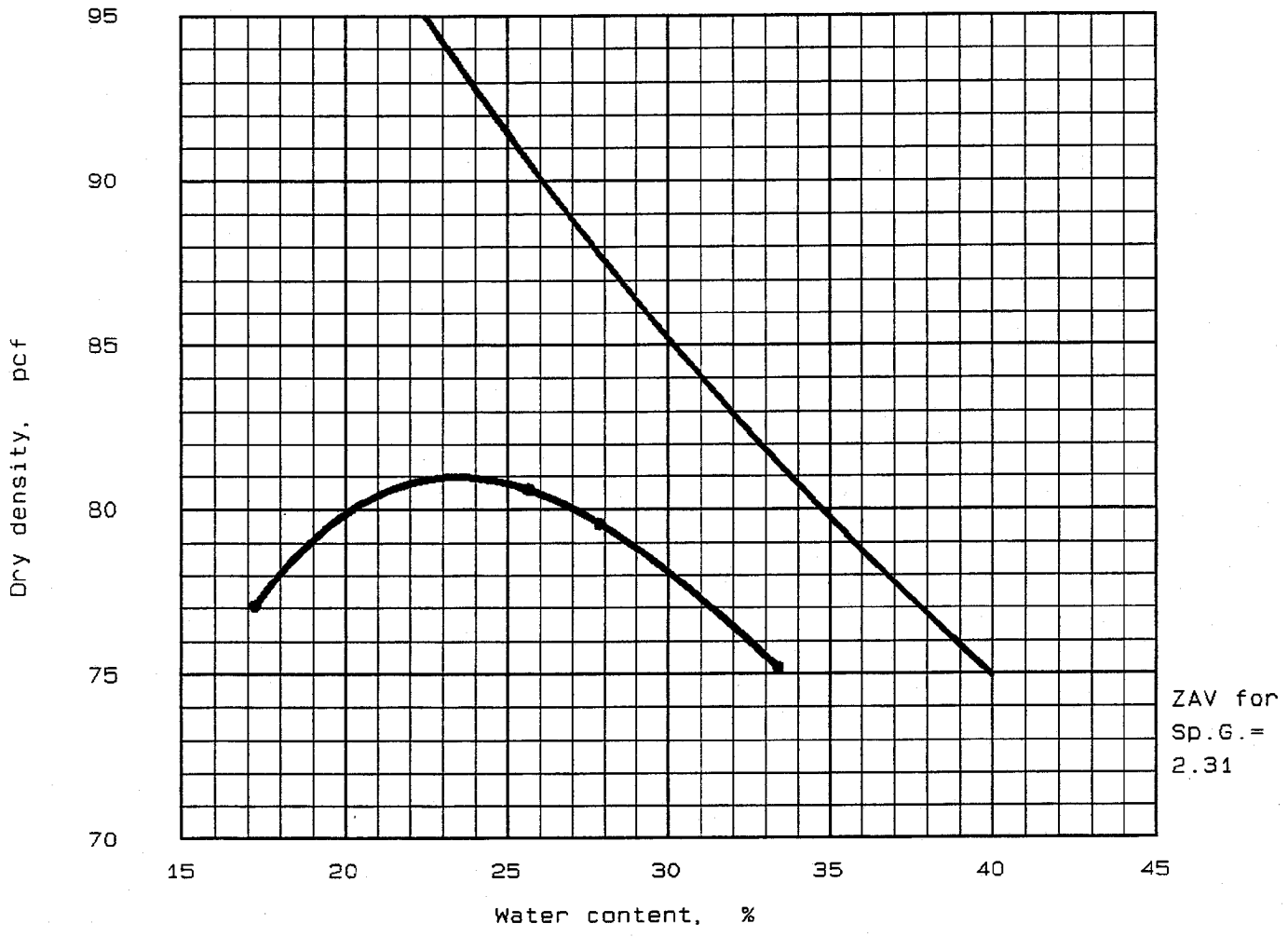
Remarks:

Tested by: JCR

Reviewed by: [illegible]

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)	36.1 %	2.31	NL	NP	0 %	97.0 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 23.5 % Maximum dry density = 81.0 pcf	

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

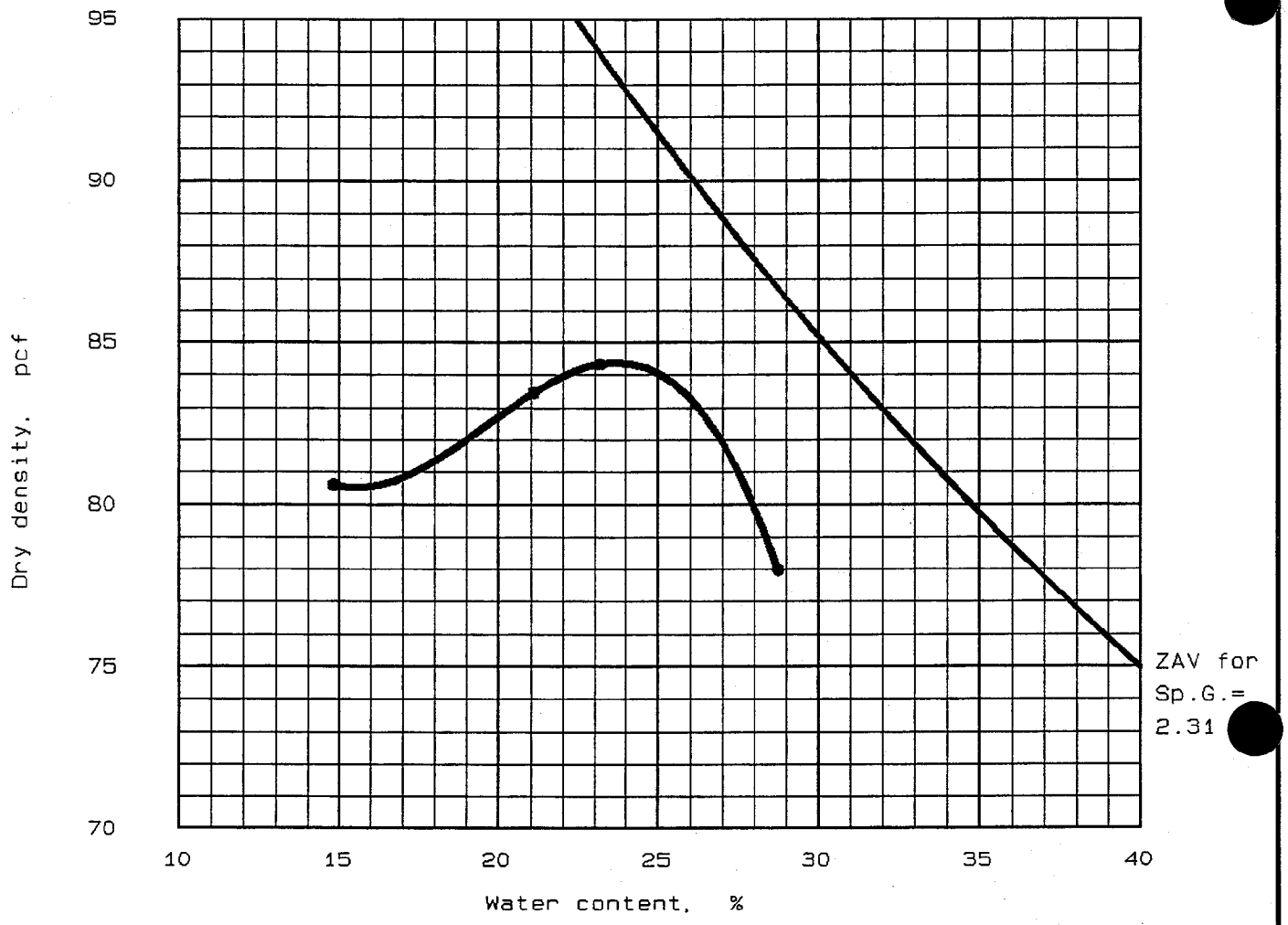
Remarks:
Tested by: EM / JCR
Reviewed by: RLB

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						
	ML	A-4 (0.0)	36.1 %	2.31	NL	NP	0 %	97.0 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 23.7 % Maximum dry density = 84.4 pcf	

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

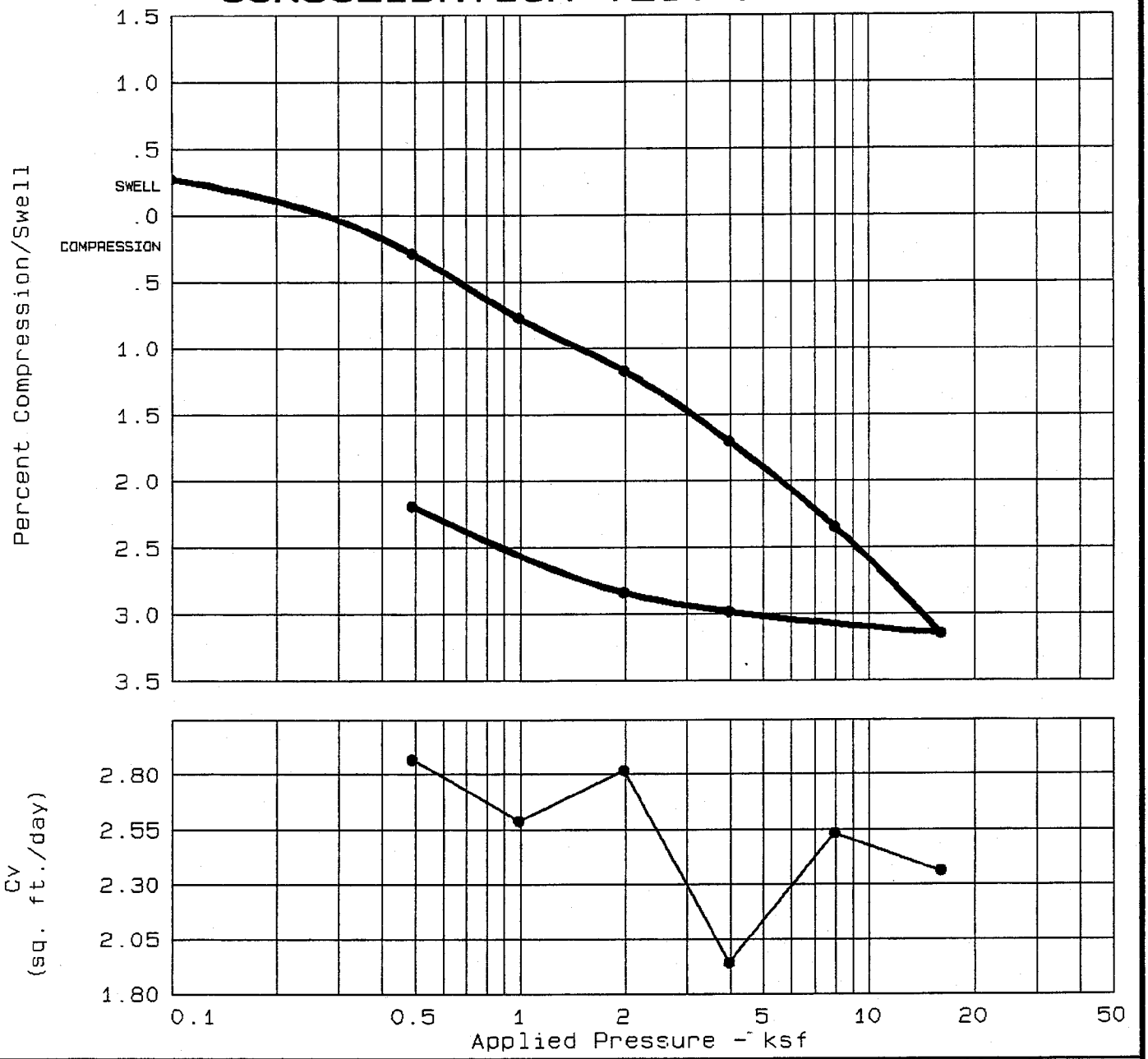
Remarks:
Tested by: JCR
Reviewed by: RLB

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
66.7 %	25.3	76.9	NL	NP	2.312	1.75	0.05	0.8774

TEST RESULTS

Compression Index = 0.05

MATERIAL DESCRIPTION

Class: USCS: ML

Project No.: 5810860101
Project: TVA - Kingston
Location: Ponded Fly Ash
Cell III
Date: 6/29/95

Remarks:

Tested by: AAK
Reviewed by: HD

CONSOLIDATION TEST REPORT

LAW ENGINEERING, INC.

Fig. No._____

HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*HEJ*
Project Name	*TVA - Kingston*	Test Date	*06/12/95*
Material (Source)	*Ponded Fly Ash (Cell III)*	Reviewed By	*RLB*
		Review Date	*09/06/95*

ASTM D5084 - Falling Head

Sample Type:	*Remolded*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*24.1*
Wet Unit Weight, pcf:	*94.6*
Dry Unit Weight, pcf:	*76.2*
Compaction, %:	*94.1*
Hydraulic Conductivity, cm/sec. @20 °C:	***3.4E-05***

PERMEABILITY TEST - FALLING HEAD
(ASTM D5084 - 90)

LAW ENGINEERING

Job Number	5810860101	Tested By	HEJ
Project Name	TVA - Kingston	Test Date	06/12/95
Material (Source)	Ponded Fly Ash (Cell III)	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	755.14
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, %	24.1
		Wet Soil + Tare, grams	936.90	Wet Unit Wt, pcf	94.6
		Tare Weight, grams	0.00	Dry Unit Wt, pcf	76.2

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
				2062	0.0	22.0	125.08	103.08	3.5E-05	21	3.5E-05
				2384	0.0	25.0	125.08	100.08	3.5E-05	21	3.4E-05
				2185	0.0	23.0	125.08	102.08	3.5E-05	21	3.4E-05

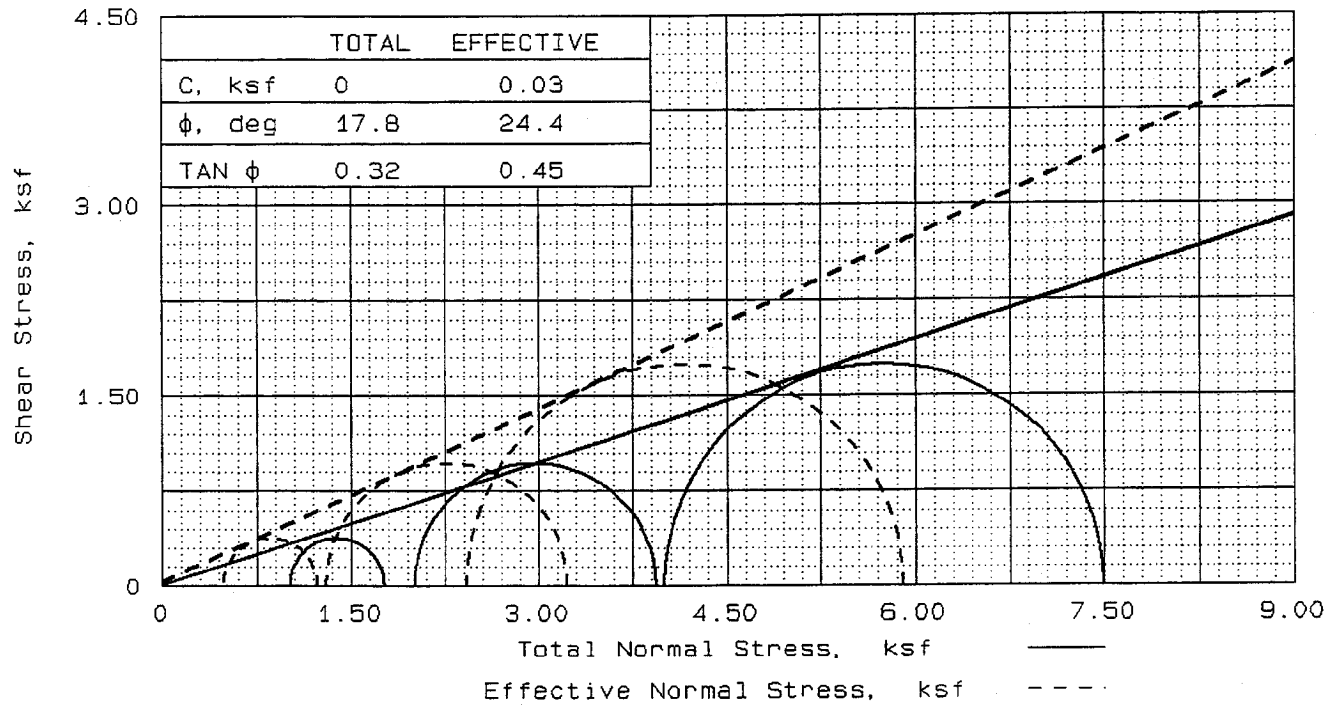
No. of Trial	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
3	Remolded	81.0	94.1	Vertical

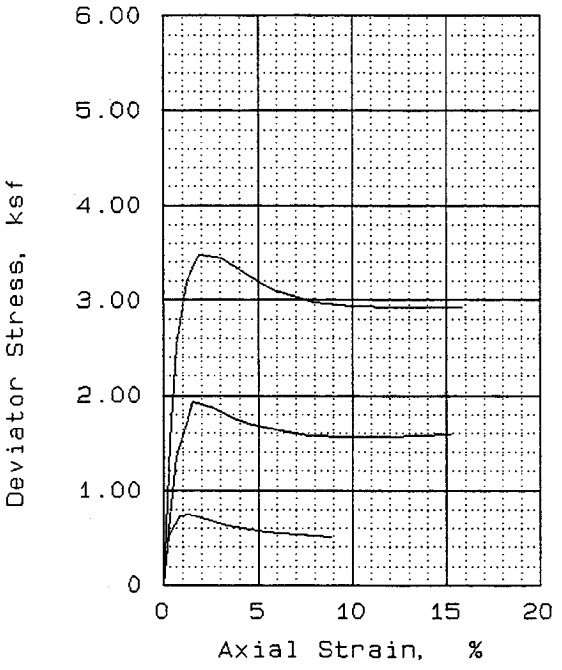
Avg. k at 20 °C 3.4E-05 cm/sec

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





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	26.7	24.1	25.9
	DRY DENSITY, pcf	74.7	76.2	75.2
	SATURATION, %	66.3	62.3	65.1
	VOID RATIO	0.930	0.892	0.917
	DIAMETER, in	2.83	2.83	2.83
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	39.6	36.1	38.0
	DRY DENSITY, pcf	75.3	78.6	76.8
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.916	0.835	0.879
	DIAMETER, in	2.82	2.80	2.80
	HEIGHT, in	6.00	5.96	6.00
BACK PRESSURE, ksf		4.41	3.60	3.57
CELL PRESSURE, ksf		5.41	7.60	5.57
FAILURE STRESS, ksf		0.75	3.49	1.93
PORE PRESSURE, ksf		4.94	5.18	4.28
STRAIN RATE, %/min.		0.100	0.100	0.100
ULTIMATE STRESS, ksf				
PORE PRESSURE, ksf				
$\bar{\sigma}_1$ FAILURE, ksf		1.23	5.91	3.23
$\bar{\sigma}_3$ FAILURE, ksf		0.48	2.42	1.3

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

LL= NL PL= NP PI=
SPECIFIC GRAVITY= 2.31
REMARKS: Tested by: HB

Reviewed by: RLB

FIG. NO.

CLIENT:

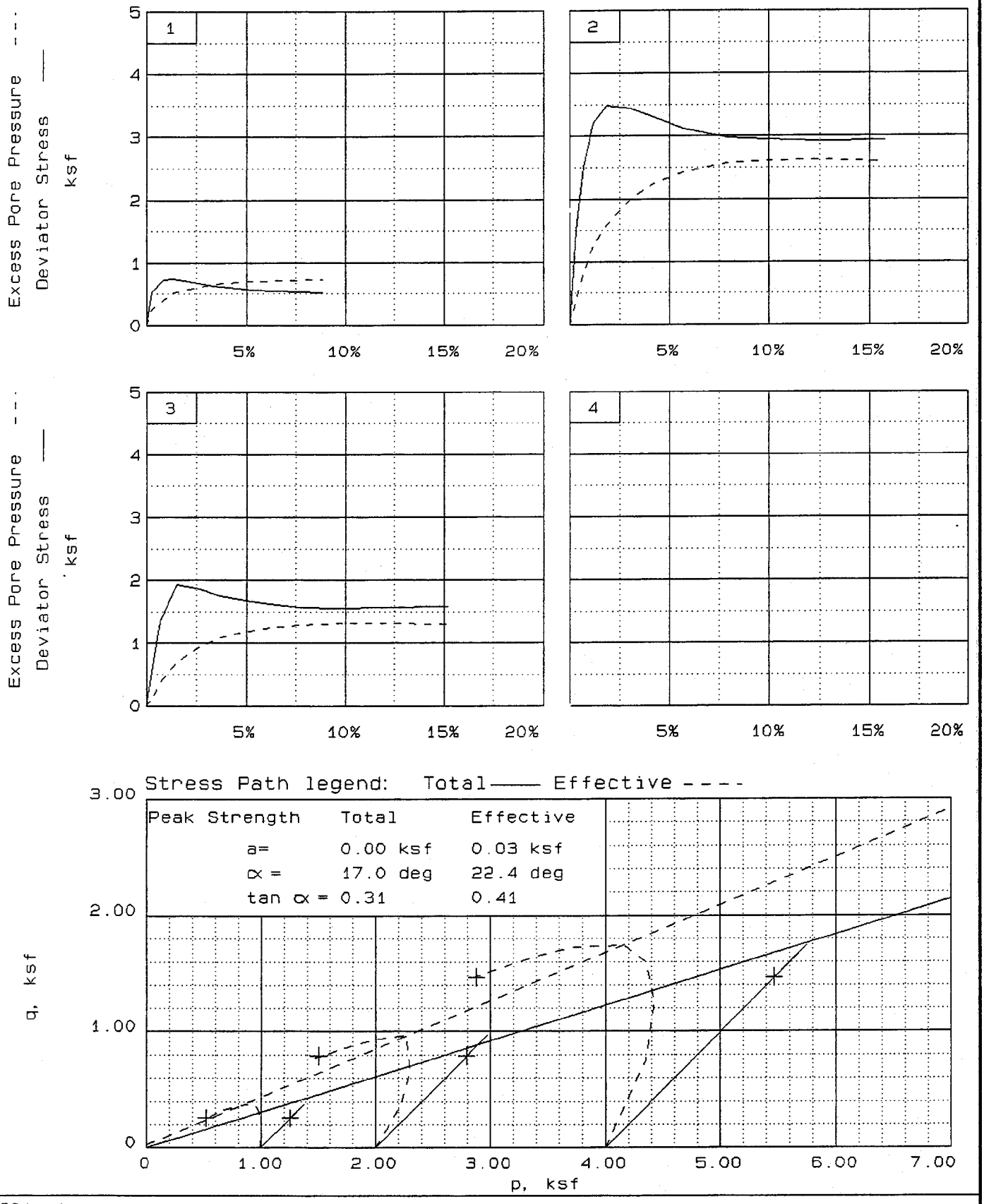
PROJECT: TVA - Kingston

SAMPLE LOCATION: Ponded Fly Ash
Cell III

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

TRIAXIAL COMPRESSION TEST

LAW ENGINEERING, INC.

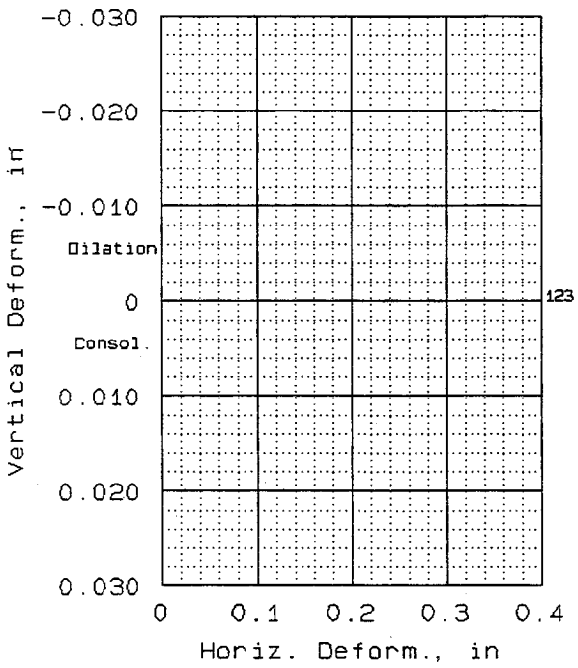


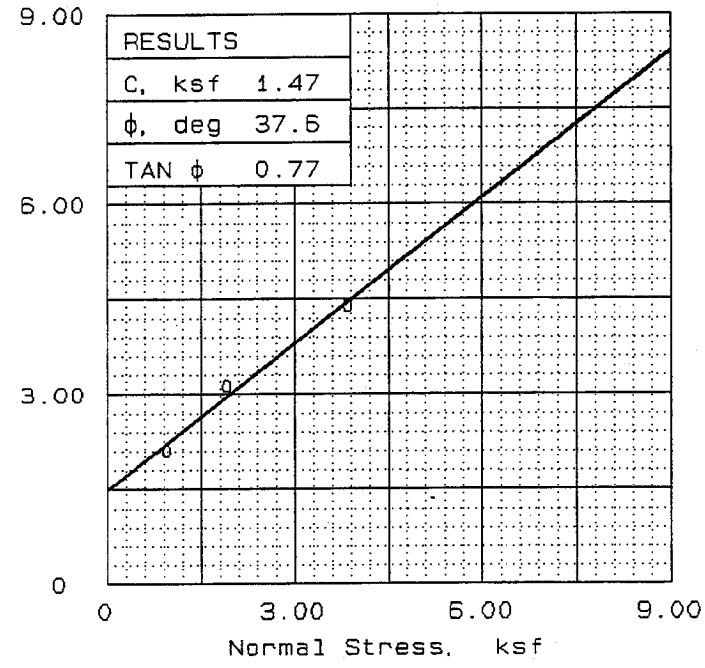
Client:

Project: TVA - Kingston

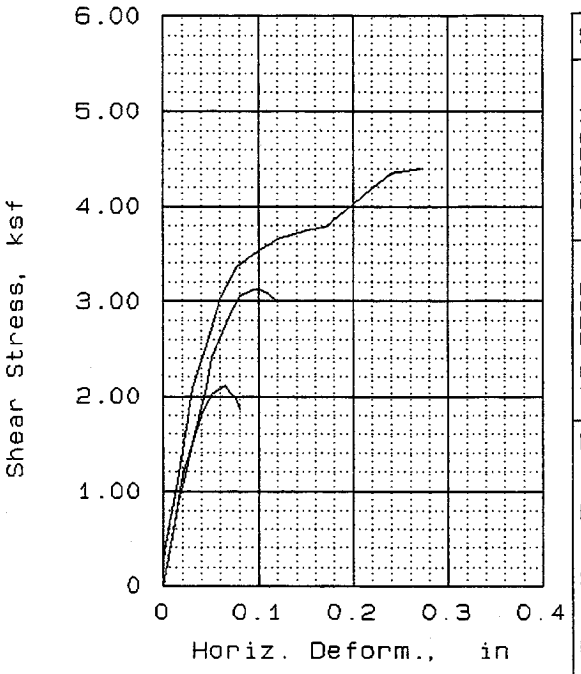
Location: Ponded Fly Ash Cell III

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





RESULTS	
C, ksf	1.47
ϕ, deg	37.6
TAN ϕ	0.77



SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	25.0	25.6	25.3
	DRY DENSITY, pcf	75.3	74.4	74.1
	SATURATION, %	63.2	62.9	61.7
	VOID RATIO	0.914	0.939	0.946
	DIAMETER, in	2.50	2.50	2.50
	HEIGHT, in	0.81	0.81	0.81
AT TEST	WATER CONTENT, %	25.0	25.6	25.3
	DRY DENSITY, pcf	75.3	74.4	74.1
	SATURATION, %	63.2	62.9	61.7
	VOID RATIO	0.914	0.939	0.946
	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		2.11	3.13	4.40
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= 2.31

REMARKS: Tested by: HJ

Reviewed by: RLB

FIG. NO.

CLIENT:

PROJECT: TVA - Kingston

SAMPLE LOCATION: Ponded Fly Ash Cell III

PROJ. NO.: 5810860101 DATE: 30 August, 1995

DIRECT SHEAR TEST

LAW ENGINEERING, INC.

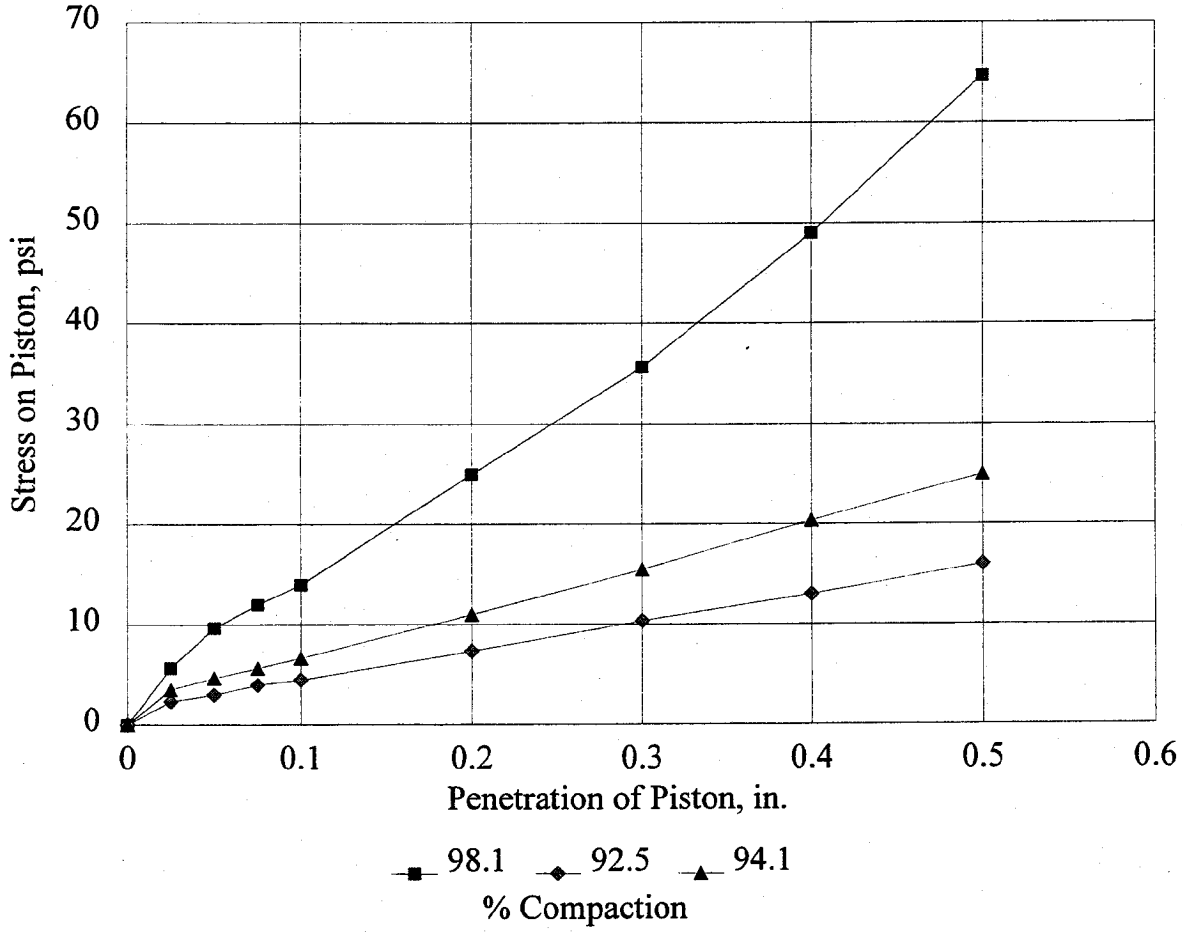
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Kingston	**Test Date**	07/31/95
Material (Source)	Ponded Fly Ash (Cell III)	**Reviewed By**	RLB
		Review Date	08/30/95

Compaction, %	98.1	92.5	94.1
Before Soak Dry Density, pcf	79.4	74.9	76.2
Before Soak Moisture Content,	24.7	21.5	23.1
After Soak Dry Density, pcf	76.3	71.7	72.9
After Soak Moisture Content, %	33.6	37.2	36.7
CBR @ 0.1 in.	1.4	0.5	0.7
CBR @ 0.2 in.	1.7	0.5	0.7



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:*		Kingston
2.	*MATERIAL DESCRIPTION:*		Ponded Fly Ash (Cell III)
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	2.86
		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_o , inch		6.09
	INITIAL AREA, A_o , in^2		6.28
	INITIAL VOLUME $A_o L_o$, in^3		38.26
7.	*SOIL SPECIMEN WEIGHT:*		
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams		937.95
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams		0.00
	WEIGHT OF WET SOIL USED, grams		937.95
8.	*SOIL PROPERTIES .:*		
	IN SITU MOISTURE CONTENT (NUCLEAR), %		N/A
	IN SITU WET DENSITY (NUCLEAR), pcf		N/A
	or		
	OPTIMUM MOISTURE CONTENT, %		23.5
	MAX. DRY DENSITY, pcf		81.0
	95 % MAX. DRY DENSITY, pcf		77.0
9.	*SPECIMEN PROPERTIES:*		
	COMPACTION MOISTURE CONTENT, %		25.4
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %		25.4
	COMPACTION DRY DENSITY, γ_d pcf		74.4
10.	*QUICK SHEAR TEST*		
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)		Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi		24.6
	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*		08-04-1995

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:* Kingston
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (Cell III)
3. *REMOLDING TARGETS:* 95% Standard Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-04-1995
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	0.00174	0.00177	0.00176	0.00029	6,297
			2	12.8	11.6	1.2	2.0	1.8	0.2	0.00175	0.00178	0.00177	0.00029	6,379
			3	12.7	11.5	1.2	2.0	1.8	0.2	0.00177	0.00178	0.00178	0.00029	6,274
			4	12.7	11.5	1.2	2.0	1.8	0.2	0.00173	0.00177	0.00175	0.00029	6,360
			5	12.8	11.6	1.2	2.0	1.8	0.2	0.00176	0.00178	0.00177	0.00029	6,328
	COLUMN AVERAGE			12.7	11.5	1.2	2.0	1.8	0.2	0.00175	0.00178	0.00176	0.00029	6,328
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	44

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

SEQUENCE 2	6.0	4.0	1	25.3	22.9	2.4	4.0	3.6	0.4	0.00366	0.00372	0.00369	0.00061	6,010
			2	25.1	22.7	2.4	4.0	3.6	0.4	0.00367	0.00372	0.00369	0.00061	5,969
			3	25.1	22.8	2.4	4.0	3.6	0.4	0.00365	0.00370	0.00368	0.00060	5,998
			4	25.2	22.8	2.4	4.0	3.6	0.4	0.00367	0.00371	0.00369	0.00061	5,990
			5	25.1	22.8	2.4	4.0	3.6	0.4	0.00367	0.00371	0.00369	0.00061	5,974
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00366	0.00371	0.00369	0.00061	5,988
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17
SEQUENCE 3	6.0	6.0	1	37.7	34.1	3.6	6.0	5.4	0.6	0.00588	0.00596	0.00592	0.00097	5,575
			2	37.6	34.0	3.6	6.0	5.4	0.6	0.00589	0.00596	0.00592	0.00097	5,564
			3	37.6	34.0	3.6	6.0	5.4	0.6	0.00590	0.00594	0.00592	0.00097	5,558
			4	37.6	34.0	3.6	6.0	5.4	0.6	0.00588	0.00595	0.00591	0.00097	5,576
			5	37.6	34.0	3.6	6.0	5.4	0.6	0.00588	0.00596	0.00592	0.00097	5,571
	COLUMN AVERAGE			37.6	34.0	3.6	6.0	5.4	0.6	0.00589	0.00595	0.00592	0.00097	5,569
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	8
SEQUENCE 4	6.0	8.0	1	50.3	45.5	4.8	8.0	7.2	0.8	0.00815	0.00824	0.00819	0.00135	5,381
			2	50.2	45.5	4.7	8.0	7.2	0.8	0.00815	0.00826	0.00821	0.00135	5,367
			3	50.2	45.4	4.8	8.0	7.2	0.8	0.00815	0.00826	0.00821	0.00135	5,363
			4	50.3	45.5	4.8	8.0	7.2	0.8	0.00813	0.00824	0.00819	0.00134	5,382
			5	50.4	45.6	4.7	8.0	7.3	0.8	0.00815	0.00828	0.00822	0.00135	5,382
	COLUMN AVERAGE			50.3	45.5	4.8	8.0	7.2	0.8	0.00815	0.00826	0.00820	0.00135	5,375
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	9

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

SEQUENCE 5	6.0	10.0	1	62.7	56.7	6.1	10.0	9.0	1.0	0.01027	0.01040	0.01034	0.00170	5,312
			2	62.7	56.6	6.0	10.0	9.0	1.0	0.01027	0.01041	0.01034	0.00170	5,304
			3	62.8	56.8	6.0	10.0	9.0	1.0	0.01025	0.01040	0.01033	0.00170	5,326
			4	62.7	56.7	6.1	10.0	9.0	1.0	0.01026	0.01039	0.01032	0.00170	5,318
			5	62.7	56.7	6.0	10.0	9.0	1.0	0.01025	0.01040	0.01033	0.00170	5,317
	COLUMN AVERAGE			62.7	56.7	6.1	10.0	9.0	1.0	0.01026	0.01040	0.01033	0.00170	5,316
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8
SEQUENCE 6	4.0	2.0	1	13.0	11.3	1.7	2.1	1.8	0.3	0.00199	0.00205	0.00202	0.00033	5,416
			2	13.1	11.4	1.7	2.1	1.8	0.3	0.00197	0.00205	0.00201	0.00033	5,490
			3	13.0	11.3	1.7	2.1	1.8	0.3	0.00199	0.00204	0.00202	0.00033	5,429
			4	13.0	11.3	1.7	2.1	1.8	0.3	0.00199	0.00203	0.00201	0.00033	5,448
			5	13.1	11.4	1.7	2.1	1.8	0.3	0.00199	0.00205	0.00202	0.00033	5,455
	COLUMN AVERAGE			13.0	11.3	1.7	2.1	1.8	0.3	0.00199	0.00204	0.00202	0.00033	5,448
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	28
SEQUENCE 7	4.0	4.0	1	24.9	22.6	2.3	4.0	3.6	0.4	0.00474	0.00482	0.00478	0.00079	4,572
			2	24.9	22.6	2.3	4.0	3.6	0.4	0.00474	0.00482	0.00478	0.00079	4,573
			3	24.9	22.6	2.3	4.0	3.6	0.4	0.00474	0.00483	0.00479	0.00079	4,572
			4	24.9	22.5	2.3	4.0	3.6	0.4	0.00475	0.00483	0.00479	0.00079	4,560
			5	24.8	22.5	2.3	4.0	3.6	0.4	0.00474	0.00483	0.00479	0.00079	4,550
	COLUMN AVERAGE			24.9	22.5	2.3	4.0	3.6	0.4	0.00474	0.00483	0.00479	0.00079	4,565
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	10

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

SEQUENCE 8	4.0	6.0	1	37.3	33.7	3.6	5.9	5.4	0.6	0.00760	0.00772	0.00766	0.00126	4,262
			2	37.4	33.8	3.6	5.9	5.4	0.6	0.00761	0.00772	0.00766	0.00126	4,272
			3	37.4	33.9	3.6	6.0	5.4	0.6	0.00760	0.00773	0.00766	0.00126	4,282
			4	37.4	33.8	3.6	5.9	5.4	0.6	0.00761	0.00772	0.00766	0.00126	4,276
			5	37.4	33.8	3.6	6.0	5.4	0.6	0.00761	0.00772	0.00766	0.00126	4,277
	COLUMN AVERAGE			37.4	33.8	3.6	5.9	5.4	0.6	0.00760	0.00772	0.00766	0.00126	4,274
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	8
SEQUENCE 9	4.0	8.0	1	50.1	45.3	4.8	8.0	7.2	0.8	0.01002	0.01017	0.01009	0.00166	4,348
			2	50.0	45.2	4.8	8.0	7.2	0.8	0.01004	0.01017	0.01010	0.00166	4,337
			3	49.9	45.1	4.8	7.9	7.2	0.8	0.01002	0.01017	0.01010	0.00166	4,330
			4	49.9	45.1	4.8	7.9	7.2	0.8	0.01002	0.01016	0.01009	0.00166	4,328
			5	49.9	45.1	4.8	7.9	7.2	0.8	0.01002	0.01016	0.01009	0.00166	4,332
	COLUMN AVERAGE			50.0	45.2	4.8	8.0	7.2	0.8	0.01003	0.01016	0.01009	0.00166	4,335
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	8
SEQUENCE 10	4.0	10.0	1	62.3	56.3	6.0	9.9	9.0	1.0	0.01200	0.01214	0.01207	0.00198	4,520
			2	62.3	56.3	6.0	9.9	9.0	1.0	0.01198	0.01214	0.01206	0.00198	4,522
			3	62.4	56.3	6.0	9.9	9.0	1.0	0.01199	0.01214	0.01206	0.00198	4,523
			4	62.3	56.3	6.0	9.9	9.0	1.0	0.01198	0.01215	0.01206	0.00198	4,522
			5	62.4	56.3	6.0	9.9	9.0	1.0	0.01198	0.01215	0.01207	0.00198	4,525
	COLUMN AVERAGE			62.3	56.3	6.0	9.9	9.0	1.0	0.01199	0.01215	0.01207	0.00198	4,522
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	2

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

SEQUENCE 11	2.0	2.0	1	13.4	11.2	2.1	2.1	1.8	0.3	0.00245	0.00253	0.00249	0.00041	4,381
			2	13.4	11.3	2.1	2.1	1.8	0.3	0.00246	0.00254	0.00250	0.00041	4,361
			3	13.4	11.3	2.1	2.1	1.8	0.3	0.00246	0.00251	0.00249	0.00041	4,383
			4	13.4	11.3	2.1	2.1	1.8	0.3	0.00246	0.00254	0.00250	0.00041	4,364
			5	13.4	11.3	2.1	2.1	1.8	0.3	0.00247	0.00253	0.00250	0.00041	4,373
	COLUMN AVERAGE			13.4	11.3	2.1	2.1	1.8	0.3	0.00246	0.00253	0.00250	0.00041	4,372
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	10
SEQUENCE 12	2.0	4.0	1	24.4	22.1	2.4	3.9	3.5	0.4	0.00589	0.00602	0.00596	0.00098	3,586
			2	24.4	22.0	2.4	3.9	3.5	0.4	0.00591	0.00600	0.00595	0.00098	3,582
			3	24.4	22.0	2.4	3.9	3.5	0.4	0.00590	0.00601	0.00596	0.00098	3,587
			4	24.4	22.0	2.4	3.9	3.5	0.4	0.00591	0.00600	0.00595	0.00098	3,588
			5	24.4	22.0	2.4	3.9	3.5	0.4	0.00590	0.00601	0.00596	0.00098	3,584
	COLUMN AVERAGE			24.4	22.0	2.4	3.9	3.5	0.4	0.00590	0.00601	0.00595	0.00098	3,585
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	2
SEQUENCE 13	2.0	6.0	1	36.6	33.0	3.6	5.8	5.3	0.6	0.00925	0.00940	0.00933	0.00153	3,432
			2	36.7	33.1	3.6	5.8	5.3	0.6	0.00928	0.00938	0.00933	0.00153	3,439
			3	36.6	33.0	3.6	5.8	5.3	0.6	0.00927	0.00939	0.00933	0.00153	3,429
			4	36.6	33.0	3.6	5.8	5.2	0.6	0.00926	0.00939	0.00933	0.00153	3,427
			5	36.6	33.0	3.6	5.8	5.2	0.6	0.00926	0.00939	0.00932	0.00153	3,426
	COLUMN AVERAGE			36.6	33.0	3.6	5.8	5.3	0.6	0.00926	0.00939	0.00933	0.00153	3,431
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	5

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

SEQUENCE 14	2.0	8.0	1	49.5	44.6	4.9	7.9	7.1	0.8	0.01182	0.01196	0.01189	0.00195	3,639
			2	49.5	44.6	4.9	7.9	7.1	0.8	0.01182	0.01194	0.01188	0.00195	3,637
			3	49.5	44.6	4.8	7.9	7.1	0.8	0.01182	0.01194	0.01188	0.00195	3,638
			4	49.5	44.6	4.8	7.9	7.1	0.8	0.01180	0.01196	0.01188	0.00195	3,639
			5	49.4	44.5	4.8	7.9	7.1	0.8	0.01181	0.01197	0.01189	0.00195	3,630
	COLUMN AVERAGE			49.5	44.6	4.9	7.9	7.1	0.8	0.01181	0.01195	0.01188	0.00195	3,637
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	4
SEQUENCE 15	2.0	10.0	1	62.5	56.4	6.1	9.9	9.0	1.0	0.01381	0.01399	0.01390	0.00228	3,930
			2	62.4	56.3	6.1	9.9	9.0	1.0	0.01381	0.01400	0.01391	0.00228	3,923
			3	62.3	56.2	6.1	9.9	8.9	1.0	0.01380	0.01398	0.01389	0.00228	3,924
			4	62.4	56.3	6.1	9.9	9.0	1.0	0.01380	0.01397	0.01388	0.00228	3,930
			5	62.5	56.4	6.1	9.9	9.0	1.0	0.01381	0.01398	0.01390	0.00228	3,933
	COLUMN AVERAGE			62.4	56.3	6.1	9.9	9.0	1.0	0.01381	0.01399	0.01390	0.00228	3,928
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	4

SUBMITTED BY, DATE

RS Bauchman 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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell III)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-04-1995

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

K1 =	2,592
K2 =	-0.10787
K5 =	0.48134
R^2 =	0.91

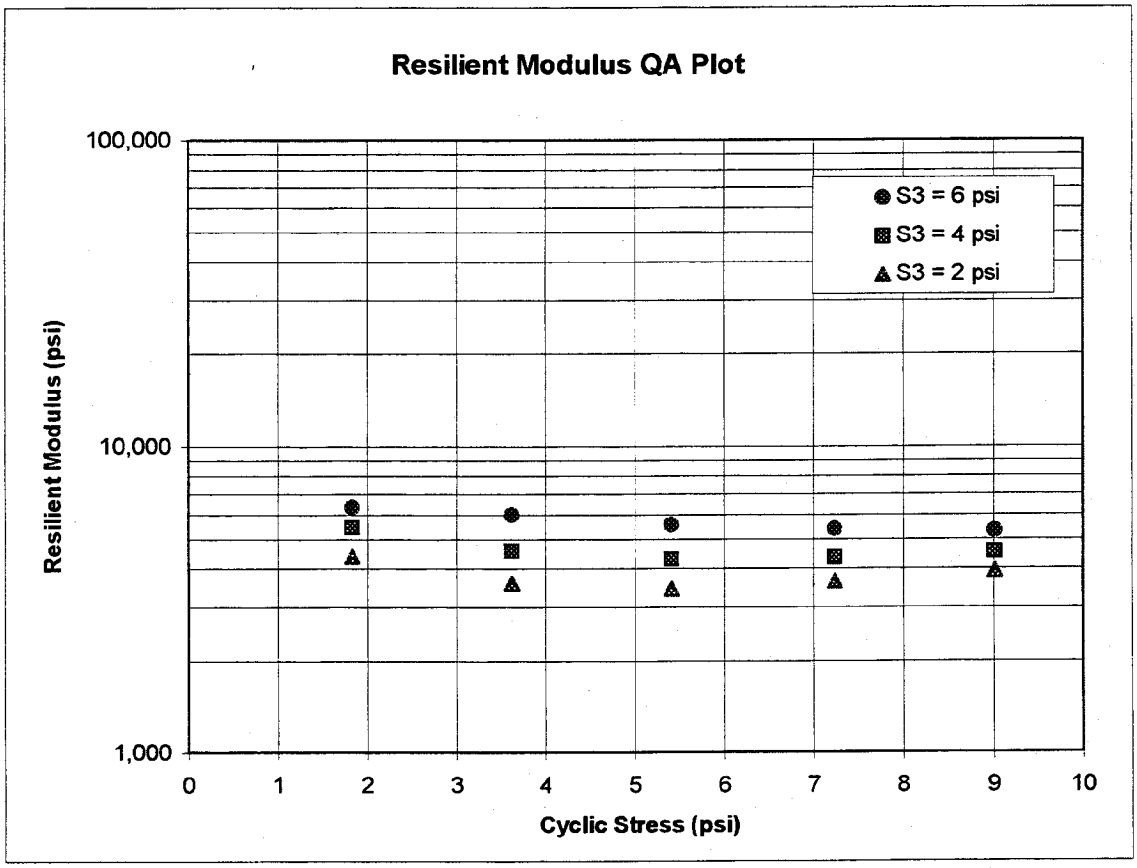
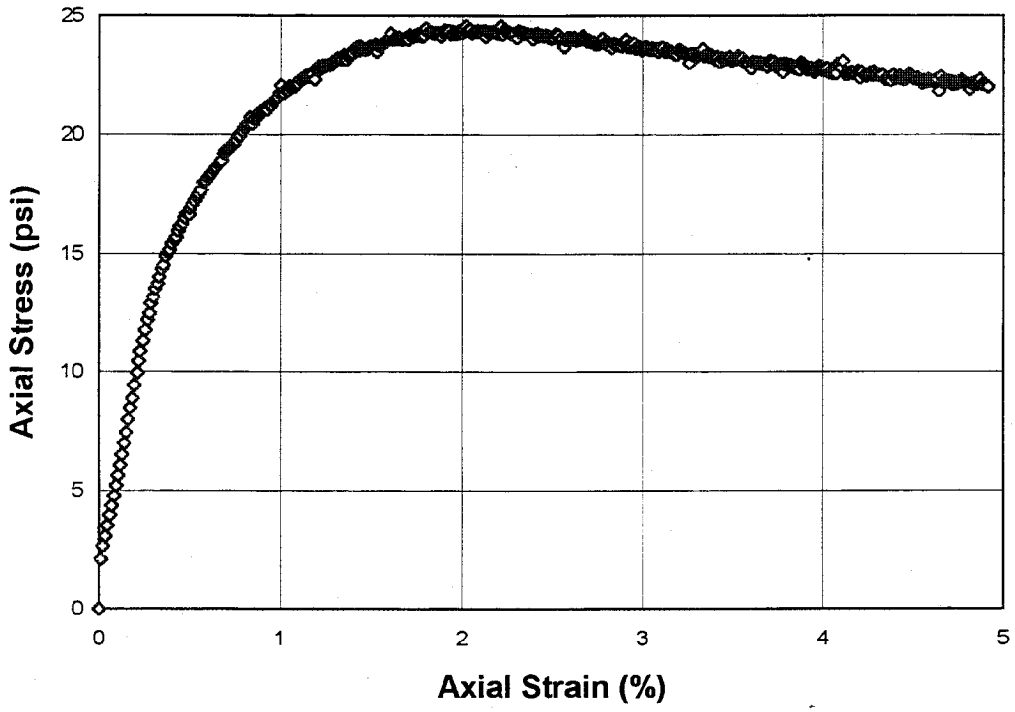


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell III)
3.	*REMOLDING TARGETS:*	95% Standard Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-04-1995



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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell III)
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	2.83
	MIDDLE	2.83
	BOTTOM	2.83
	AVERAGE	2.83
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.81
	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	6.19
	INITIAL VOLUME A_0L_0, in^3	38.01
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	997.40
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED, grams	997.40
8.	*SOIL PROPERTIES*.:	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	23.7
	MAX. DRY DENSITY, pcf	84.4
	95 % MAX. DRY DENSITY, pcf	80.2
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	23.9
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	23.5
	COMPACTION DRY DENSITY, γ_d pcf	80.6
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	38.1
	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*	07-06-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

R J Bouchum 9/5/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Kingston
2. *MATERIAL DESCRIPTION:* Ponded Fly Ash (Cell III)
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 07-06-1995
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	12.4	11.2	1.3	2.0	1.8	0.2	0.00147	0.00161	0.00154	0.00025	7,180
			2	12.4	11.1	1.3	2.0	1.8	0.2	0.00148	0.00162	0.00155	0.00025	7,092
			3	12.3	11.1	1.2	2.0	1.8	0.2	0.00150	0.00164	0.00157	0.00026	7,019
			4	12.4	11.2	1.2	2.0	1.8	0.2	0.00147	0.00162	0.00154	0.00025	7,199
			5	12.4	11.1	1.2	2.0	1.8	0.2	0.00151	0.00163	0.00157	0.00026	7,035
	COLUMN AVERAGE			12.4	11.1	1.2	2.0	1.8	0.2	0.00149	0.00163	0.00156	0.00025	7,105
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	82

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

SEQUENCE 2	6.0	4.0	1	24.7	22.4	2.3	4.0	3.6	0.4	0.00317	0.00321	0.00319	0.00052	6,958
			2	24.7	22.4	2.4	4.0	3.6	0.4	0.00317	0.00324	0.00321	0.00052	6,926
			3	24.8	22.4	2.4	4.0	3.6	0.4	0.00320	0.00323	0.00321	0.00052	6,917
			4	24.7	22.4	2.3	4.0	3.6	0.4	0.00318	0.00322	0.00320	0.00052	6,929
			5	24.7	22.4	2.3	4.0	3.6	0.4	0.00319	0.00323	0.00321	0.00052	6,918
	COLUMN AVERAGE			24.7	22.4	2.3	4.0	3.6	0.4	0.00318	0.00323	0.00320	0.00052	6,930
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17
SEQUENCE 3	6.0	6.0	1	37.0	33.3	3.6	6.0	5.4	0.6	0.00499	0.00503	0.00501	0.00082	6,594
			2	36.9	33.3	3.6	6.0	5.4	0.6	0.00501	0.00505	0.00503	0.00082	6,560
			3	36.9	33.3	3.7	6.0	5.4	0.6	0.00502	0.00505	0.00504	0.00082	6,551
			4	37.0	33.3	3.7	6.0	5.4	0.6	0.00500	0.00504	0.00502	0.00082	6,581
			5	37.0	33.3	3.7	6.0	5.4	0.6	0.00500	0.00506	0.00503	0.00082	6,572
	COLUMN AVERAGE			37.0	33.3	3.7	6.0	5.4	0.6	0.00500	0.00505	0.00503	0.00082	6,572
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	17
SEQUENCE 4	6.0	8.0	1	49.5	44.6	4.9	8.0	7.2	0.8	0.00701	0.00700	0.00701	0.00114	6,320
			2	49.5	44.6	4.9	8.0	7.2	0.8	0.00697	0.00698	0.00697	0.00114	6,348
			3	49.6	44.7	4.9	8.0	7.2	0.8	0.00700	0.00701	0.00700	0.00114	6,331
			4	49.6	44.7	4.9	8.0	7.2	0.8	0.00701	0.00701	0.00701	0.00114	6,321
			5	49.5	44.7	4.9	8.0	7.2	0.8	0.00700	0.00701	0.00701	0.00114	6,320
	COLUMN AVERAGE			49.5	44.7	4.9	8.0	7.2	0.8	0.00700	0.00700	0.00700	0.00114	6,328
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00002	0.00000	12

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

SEQUENCE 5	6.0	10.0	1	62.1	56.0	6.1	10.0	9.1	1.0	0.00885	0.00885	0.00885	0.00144	6,278
			2	62.1	56.0	6.1	10.0	9.0	1.0	0.00884	0.00886	0.00885	0.00144	6,272
			3	62.1	56.0	6.1	10.0	9.0	1.0	0.00882	0.00886	0.00884	0.00144	6,281
			4	62.1	56.0	6.1	10.0	9.0	1.0	0.00881	0.00886	0.00883	0.00144	6,286
			5	62.1	56.0	6.1	10.0	9.0	1.0	0.00886	0.00884	0.00885	0.00144	6,270
	COLUMN AVERAGE			62.1	56.0	6.1	10.0	9.0	1.0	0.00884	0.00885	0.00885	0.00144	6,277
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	6
SEQUENCE 6	4.0	2.0	1	12.9	11.2	1.7	2.1	1.8	0.3	0.00169	0.00177	0.00173	0.00028	6,418
			2	12.8	11.1	1.7	2.1	1.8	0.3	0.00171	0.00180	0.00175	0.00029	6,307
			3	12.9	11.2	1.7	2.1	1.8	0.3	0.00169	0.00179	0.00174	0.00028	6,374
			4	12.8	11.1	1.7	2.1	1.8	0.3	0.00169	0.00179	0.00174	0.00028	6,328
			5	12.8	11.1	1.7	2.1	1.8	0.3	0.00171	0.00180	0.00175	0.00029	6,281
	COLUMN AVERAGE			12.8	11.1	1.7	2.1	1.8	0.3	0.00170	0.00179	0.00174	0.00028	6,342
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	55
SEQUENCE 7	4.0	4.0	1	24.6	22.2	2.3	4.0	3.6	0.4	0.00402	0.00408	0.00405	0.00066	5,445
			2	24.5	22.2	2.3	4.0	3.6	0.4	0.00404	0.00410	0.00407	0.00066	5,409
			3	24.5	22.2	2.3	4.0	3.6	0.4	0.00405	0.00412	0.00408	0.00067	5,394
			4	24.6	22.3	2.3	4.0	3.6	0.4	0.00403	0.00410	0.00406	0.00066	5,439
			5	24.6	22.3	2.3	4.0	3.6	0.4	0.00402	0.00407	0.00405	0.00066	5,463
	COLUMN AVERAGE			24.6	22.3	2.3	4.0	3.6	0.4	0.00403	0.00409	0.00406	0.00066	5,430
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00002	0.00000	28

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

SEQUENCE 8	4.0	6.0	1	37.1	33.4	3.7	6.0	5.4	0.6	0.00653	0.00655	0.00654	0.00106	5,066
			2	37.2	33.5	3.7	6.0	5.4	0.6	0.00652	0.00655	0.00653	0.00106	5,085
			3	37.2	33.5	3.7	6.0	5.4	0.6	0.00649	0.00655	0.00652	0.00106	5,101
			4	37.1	33.4	3.7	6.0	5.4	0.6	0.00652	0.00655	0.00653	0.00106	5,075
			5	37.1	33.4	3.7	6.0	5.4	0.6	0.00653	0.00655	0.00654	0.00106	5,066
	COLUMN AVERAGE			37.2	33.5	3.7	6.0	5.4	0.6	0.00652	0.00655	0.00653	0.00106	5,078
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00000	0.00001	0.00000	15
SEQUENCE 9	4.0	8.0	1	49.9	45.0	4.8	8.1	7.3	0.8	0.00861	0.00861	0.00861	0.00140	5,185
			2	49.9	45.0	4.9	8.1	7.3	0.8	0.00860	0.00857	0.00858	0.00140	5,202
			3	49.8	45.0	4.8	8.0	7.3	0.8	0.00862	0.00862	0.00862	0.00140	5,176
			4	49.8	44.9	4.9	8.0	7.3	0.8	0.00863	0.00861	0.00862	0.00140	5,171
			5	49.8	45.0	4.9	8.0	7.3	0.8	0.00860	0.00861	0.00860	0.00140	5,181
	COLUMN AVERAGE			49.8	45.0	4.9	8.1	7.3	0.8	0.00861	0.00860	0.00861	0.00140	5,183
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00002	0.00000	12
SEQUENCE 10	4.0	10.0	1	62.4	56.3	6.1	10.1	9.1	1.0	0.01033	0.01030	0.01032	0.00168	5,412
			2	62.4	56.3	6.1	10.1	9.1	1.0	0.01029	0.01030	0.01030	0.00168	5,422
			3	62.3	56.3	6.1	10.1	9.1	1.0	0.01028	0.01030	0.01029	0.00168	5,425
			4	62.3	56.2	6.1	10.1	9.1	1.0	0.01032	0.01030	0.01031	0.00168	5,409
			5	62.3	56.2	6.1	10.1	9.1	1.0	0.01033	0.01031	0.01032	0.00168	5,402
	COLUMN AVERAGE			62.3	56.3	6.1	10.1	9.1	1.0	0.01031	0.01030	0.01031	0.00168	5,414
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00000	0.00001	0.00000	10

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

SEQUENCE 11	2.0	2.0	1	13.3	11.3	2.1	2.2	1.8	0.3	0.00207	0.00213	0.00210	0.00034	5,330
			2	13.3	11.3	2.1	2.2	1.8	0.3	0.00207	0.00214	0.00210	0.00034	5,314
			3	13.3	11.2	2.1	2.1	1.8	0.3	0.00208	0.00215	0.00211	0.00034	5,255
			4	13.3	11.2	2.1	2.1	1.8	0.3	0.00208	0.00216	0.00212	0.00035	5,236
			5	13.3	11.3	2.1	2.2	1.8	0.3	0.00209	0.00217	0.00213	0.00035	5,250
	COLUMN AVERAGE			13.3	11.2	2.1	2.1	1.8	0.3	0.00208	0.00215	0.00211	0.00034	5,277
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	42
SEQUENCE 12	2.0	4.0	1	24.3	22.0	2.3	3.9	3.6	0.4	0.00493	0.00497	0.00495	0.00081	4,407
			2	24.3	22.0	2.3	3.9	3.6	0.4	0.00495	0.00501	0.00498	0.00081	4,377
			3	24.3	22.0	2.3	3.9	3.6	0.4	0.00493	0.00498	0.00495	0.00081	4,401
			4	24.4	22.1	2.3	3.9	3.6	0.4	0.00494	0.00499	0.00496	0.00081	4,409
			5	24.3	22.0	2.3	3.9	3.5	0.4	0.00495	0.00504	0.00499	0.00081	4,363
	COLUMN AVERAGE			24.3	22.0	2.3	3.9	3.6	0.4	0.00494	0.00500	0.00497	0.00081	4,391
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00003	0.00002	0.00000	21
SEQUENCE 13	2.0	6.0	1	36.4	33.0	3.4	5.9	5.3	0.5	0.00782	0.00784	0.00783	0.00128	4,184
			2	36.7	33.5	3.2	5.9	5.4	0.5	0.00788	0.00791	0.00789	0.00129	4,204
			3	36.8	33.3	3.5	5.9	5.4	0.6	0.00784	0.00785	0.00784	0.00128	4,205
			4	36.8	33.5	3.2	5.9	5.4	0.5	0.00791	0.00792	0.00792	0.00129	4,202
			5	36.7	33.5	3.2	5.9	5.4	0.5	0.00789	0.00789	0.00789	0.00129	4,213
	COLUMN AVERAGE			36.7	33.4	3.3	5.9	5.4	0.5	0.00787	0.00788	0.00787	0.00128	4,201
	STANDARD DEV.			0.1	0.2	0.1	0.0	0.0	0.0	0.00004	0.00003	0.00004	0.00001	11

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

SEQUENCE 14	2.0	8.0	1	49.3	44.8	4.5	8.0	7.2	0.7	0.01017	0.01012	0.01015	0.00165	4,382
			2	49.3	44.8	4.5	8.0	7.2	0.7	0.01017	0.01013	0.01015	0.00165	4,382
			3	49.4	44.9	4.5	8.0	7.3	0.7	0.01014	0.01012	0.01013	0.00165	4,397
			4	49.5	45.0	4.5	8.0	7.3	0.7	0.01015	0.01014	0.01015	0.00165	4,395
			5	49.4	44.9	4.5	8.0	7.3	0.7	0.01013	0.01009	0.01011	0.00165	4,405
	COLUMN AVERAGE			49.4	44.9	4.5	8.0	7.3	0.7	0.01015	0.01012	0.01014	0.00165	4,392
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	10
SEQUENCE 15	2.0	10.0	1	62.0	56.0	6.0	10.0	9.0	1.0	0.01182	0.01180	0.01181	0.00192	4,703
			2	62.0	56.0	6.0	10.0	9.0	1.0	0.01182	0.01178	0.01180	0.00192	4,709
			3	62.0	56.0	6.0	10.0	9.0	1.0	0.01182	0.01178	0.01180	0.00192	4,705
			4	62.0	56.0	6.0	10.0	9.0	1.0	0.01182	0.01178	0.01180	0.00192	4,707
			5	62.0	56.0	6.0	10.0	9.0	1.0	0.01182	0.01178	0.01180	0.00192	4,706
	COLUMN AVERAGE			62.0	56.0	6.0	10.0	9.0	1.0	0.01182	0.01178	0.01180	0.00192	4,706
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	2

SUBMITTED BY, DATE

RJ Bourham 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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell III)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-06-1995

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

K1 =	3,254
K2 =	-0.09252
K5 =	0.43051
R^2 =	0.91

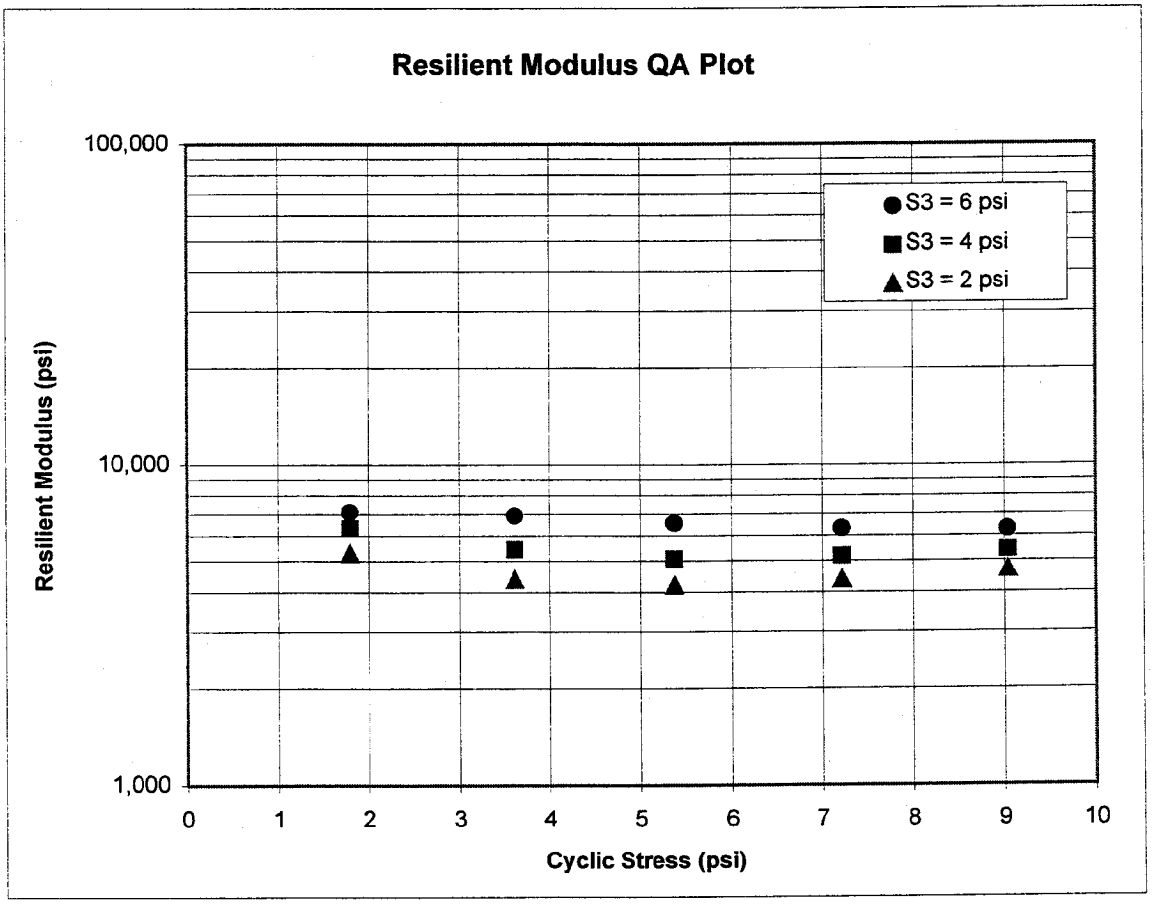
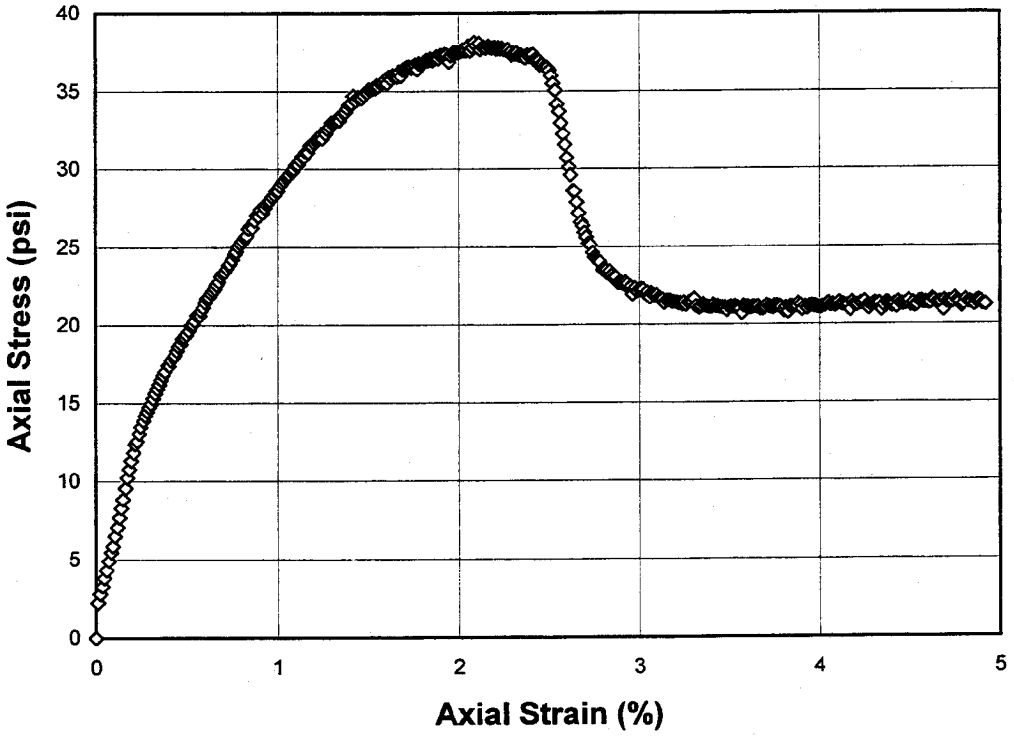


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Ponded Fly Ash (Cell III)
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	07-06-1995



KINGSTON

Bottom Ash - From Pond

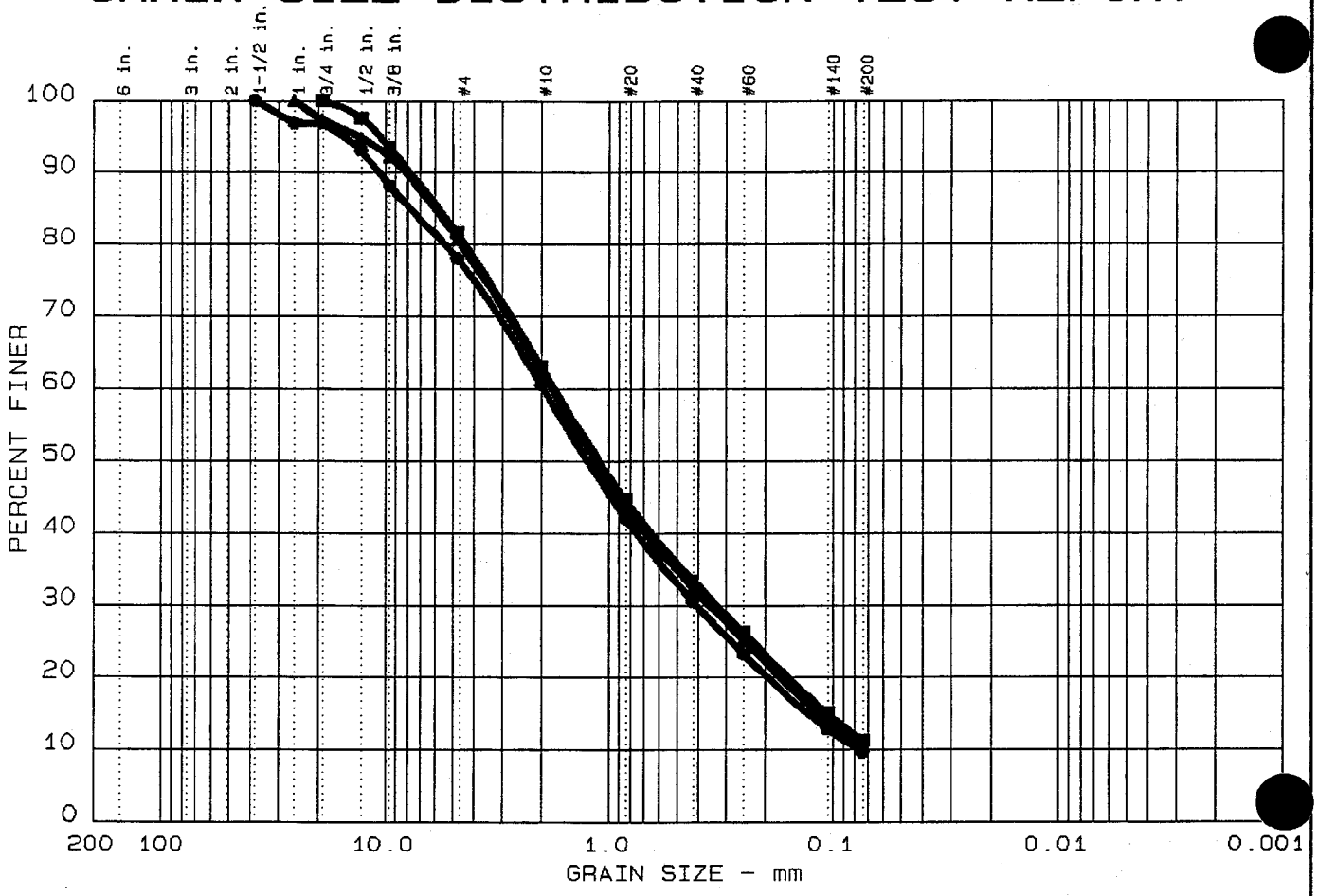
Grain Size Distribution Test Report
Moisture-Density Relationship (Standard Proctor)
Moisture-Density Relationship (Modified Proctor)
Relative Density Test
Hydraulic Conductivity - Constant Head (2 Pages)
California Bearing Ratio
Resilient Modulus (Standard Proctor) (9 Pages)
Resilient Modulus (Modified Proctor) (9 Pages)

TVA - KINGSTON
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	21.9 9.7	19.3 10.7	18.4 11.3
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	2.37	2.34	2.33
Classification	ASTM D 2487 AASHTO M 145	Unified Soil Classification System (USCS) AASHTO Classification	SW-SM A-1-b	SP-SM A-1-b	SP-SM A-1-b
				Composite Sample	
Moisture-Density Relations (Standard Effort)	ASTM D 698	Maximum Dry Density, pcf Optimum Moisture Content, %		89.0 24.1	
Moisture-Density Relations (Modified Effort)	ASTM D 1557	Maximum Dry Density, pcf Optimum Moisture Content, %		97.6 21.0	
Relative Density	ASTM D 4254 ASTM D 4253	Minimum Dry Density, pcf Maximum Dry Density (Dry Method), pcf		71.0 88.4	
			Result	**Dry Density, pcf**	**Moisture Content, %**
Hydraulic Conductivity	ASTM D 2434	Hydraulic Conductivity, cm/sec	9.1E-3	81.9	0.0
Angle of Repose	LAW TP6	Angle of Repose, degrees	31.3	71.0	0.0
California Bearing Ratio	ASTM D 1883	CBR, %	60	82.0	25.1
Resilient Modulus (Standard Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	4,938	84.7	22.3
Resilient Modulus (Modified Compactive Effort)	SHRP P46	Resilient Modulus at 4psi axial stress and 4psi confining pressure	5,807	93.3	17.7
Soil Resistivity	AASHTO T 288	Minimum Resistivity, Ohm-cm		1,900	
pH of Soil	AASHTO T 289	pH		4.0	
Water Soluble Sulfate Ion	AASHTO T 290	Sulfate Ion Content, mg/kg		490	
Water Soluble Chloride Ion	AASHTO T 290	Chloride Ion Content, mg/kg		<10	

kif-ba.xls

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	21.9	68.4	9.7	
▲	19	0.0	19.3	70.0	10.7	
■	20	0.0	18.4	70.3	11.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NL	NP	7.67	1.95	1.24	0.407	0.1287	0.0766	1.11	25.4
▲	NL	NP	5.96	1.78	1.15	0.355	0.1148			
■	NL	NP	5.69	1.74	1.10	0.327	0.1047			

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

Project No.: 5810860101
Project: TVA - Kingston
● 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.

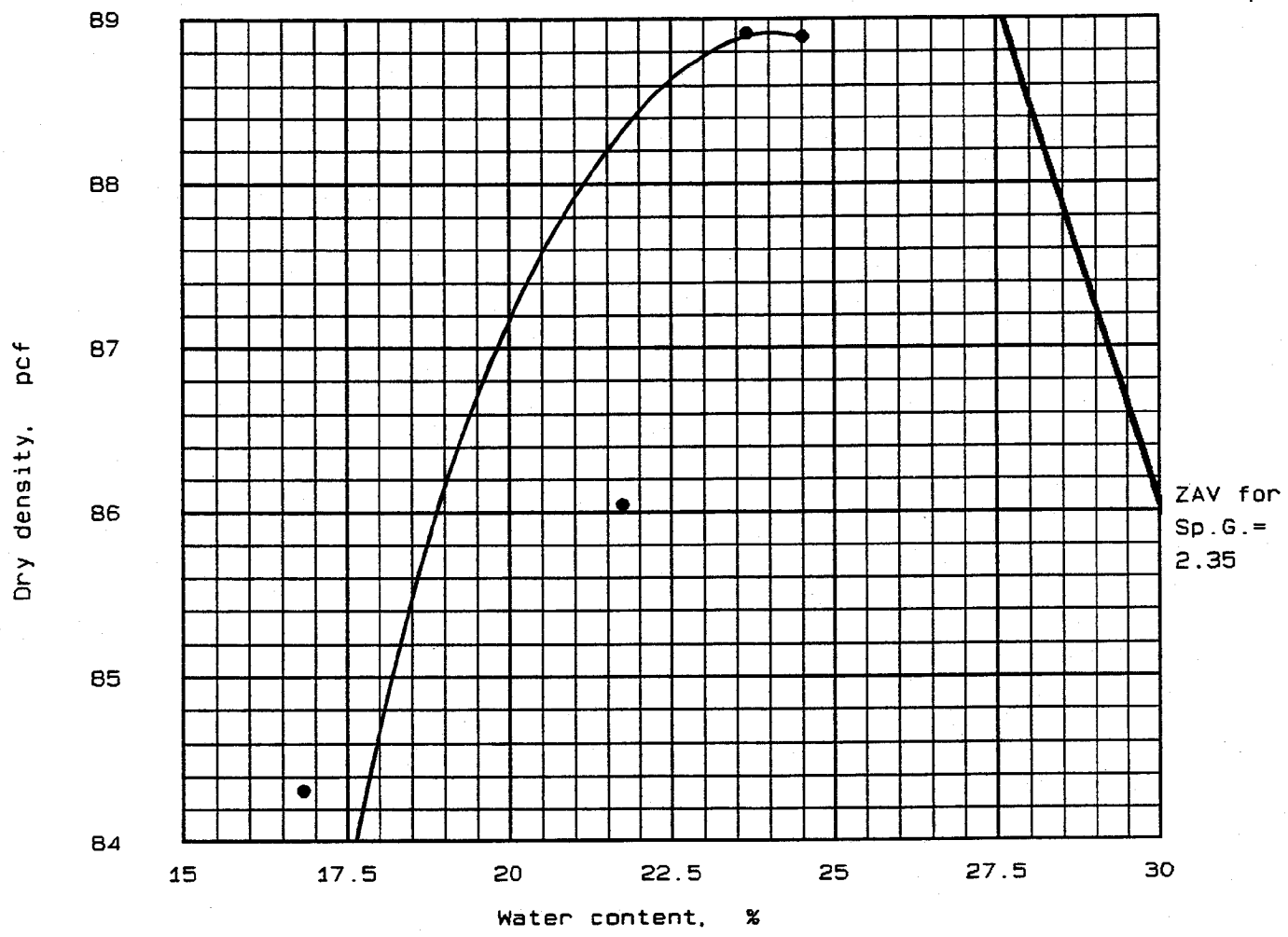
Remarks:

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						
	SP-SM (SW-SM)	A-1-b	12.6 %	2.35	NL	NP	19.9 %	10.6 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = **24.1 %** Maximum dry density = **89.0** pcf	

Project No.: 5810860101
Project: TVA - Kingston
Location: Bottom Ash

Date: July 25, 1995

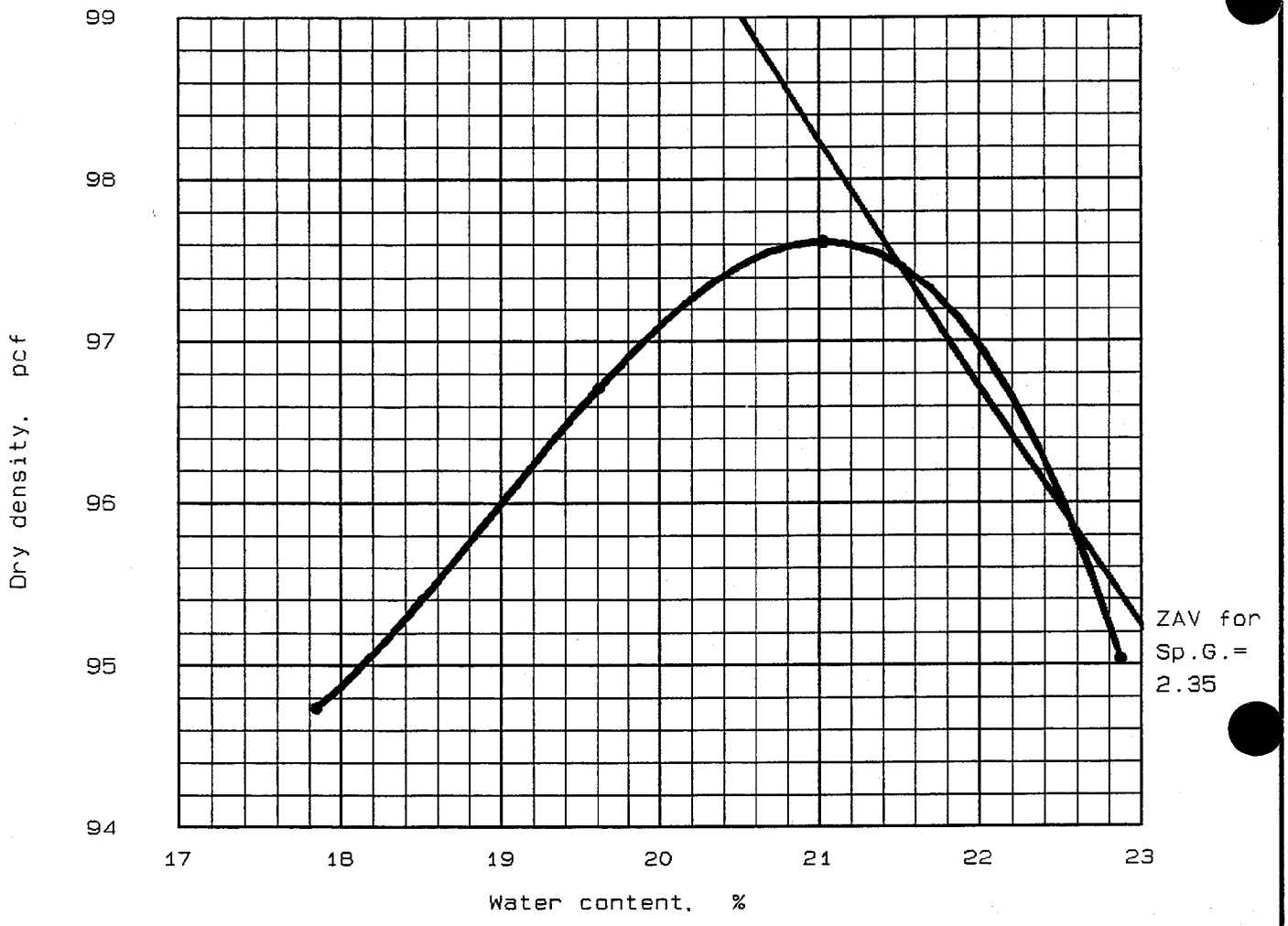
Remarks:
Tested by: CS
Reviewed by: RLB

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						
	SP-SM (SW-SM)	A-1-b	12.6 %	2.35	NL	NP	19.9 %	10.6 %

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 21.0 % Maximum dry density = 97.6 pcf	

Project No.: 5810860101
Project: TVA - Kingston
Location: Bottom Ash

Date: July 25, 1995

MOISTURE-DENSITY RELATIONSHIP

LAW ENGINEERING, INC.

Remarks:

Tested by: CS/JCR

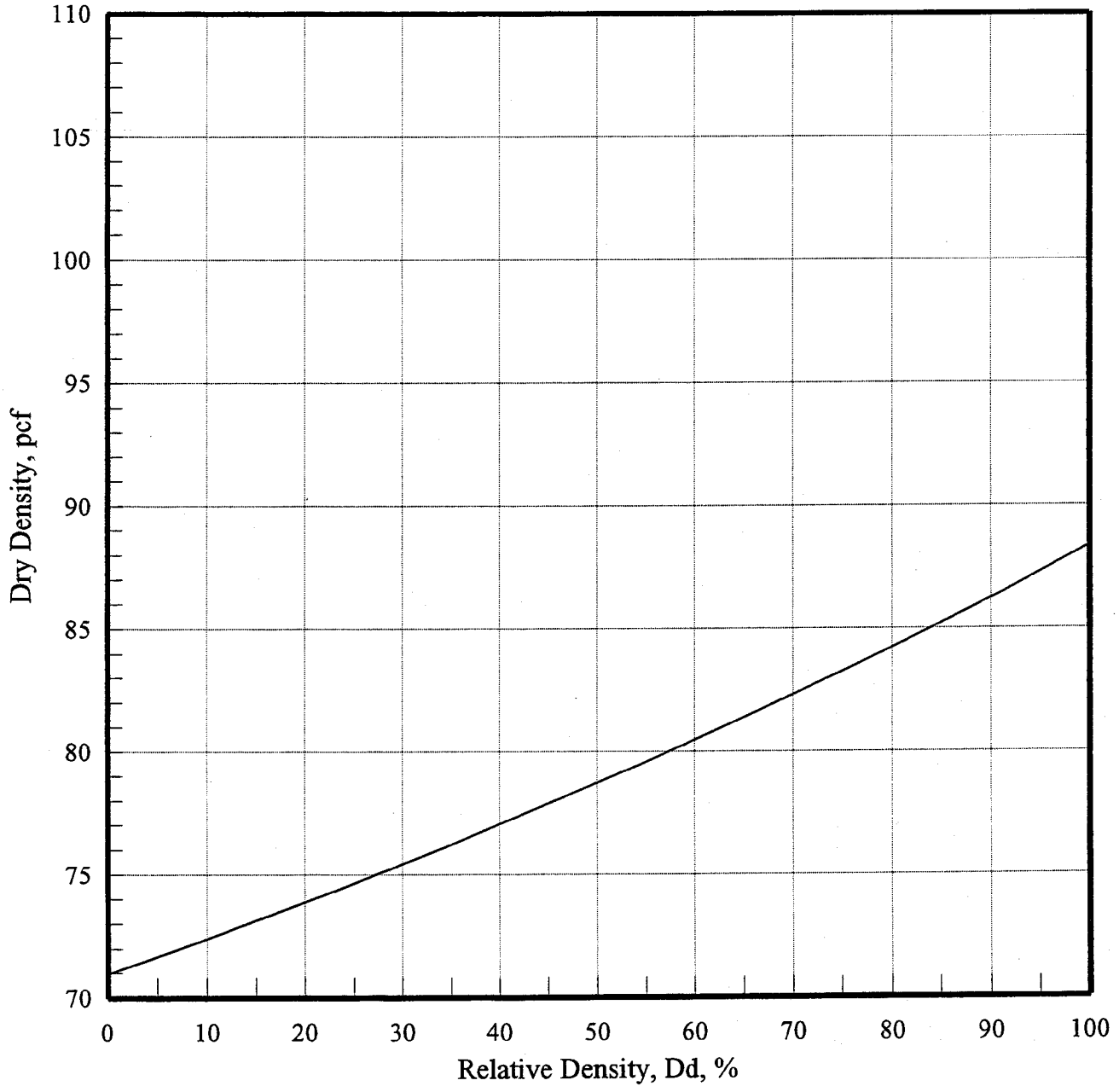
Reviewed by: RLB

Figure No. _____

Relative Density Test

TVA - Kingston, Bottom Ash

Law Project No. 5810860101



HYDRAULIC CONDUCTIVITY

LAW ENGINEERING

Project No.	*5810860101*	Tested By	*JCR*
Project Name	*TVA - Kingston*	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:	*81.9*
Dry Unit Weight, pcf:	*81.9*
Compaction, %:	*92.1*
Hydraulic Conductivity, cm/sec. @20° C:	***9.1E-03***

PERMEABILITY TEST - Constant Head
(ASTM D2434 - 68)

LAW ENGINEERING

Project No. 5810860101
Project Name TVA - Kingston
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	5.161	Location 1	2.858	Wet Soil + Pan, grams	717.90
Location 2	5.195	Location 2	2.875	Dry Soil+Pan, grams	717.90
Location3	5.153	Location 3	2.868	Pan Weight, grams	0.00
Average	5.170	Average	2.867	Moisture Content, %	0.0
		Sample wet weight, grams	717.90	Wet Unit Wt, pcf	81.9
		Membrane, Cap weight, grams	0.00	Dry Unit Wt, pcf	81.9

Time (sec)	Q (cm^3)	H (cm)	k (cm/sec)	Temp ° C	k (cm/sec at 20° C)	i (cm/cm)
600	100.00	5.08	1.0E-02	20.0	1.0E-02	0.39
1200	175.00	5.08	9.1E-03	20.0	9.1E-03	0.39

No. of Trials	Sample Type	Max. Density (pcf)	Compaction %	Sample Orientation
2	Remolded	89.0	92.1	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 = 13.131 cm

Avg. k at 20° C 9.1E-03 cm/sec

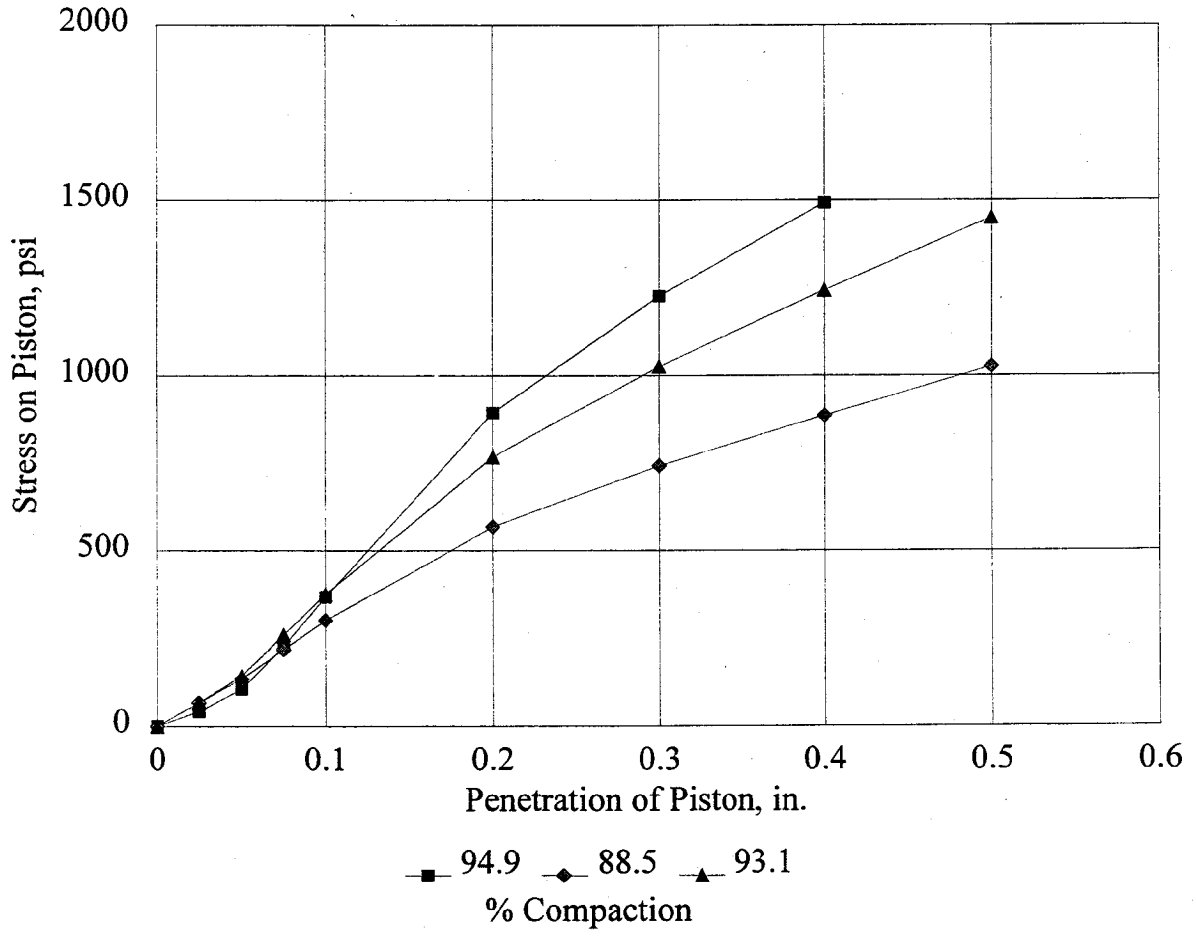
California Bearing Ratio

(ASTM D1883-92)

LAW ENGINEERING

Project No.	5810860101	**Tested By**	EM
Project Name	TVA - Kingston	**Test Date**	08/03/95
Material (Source)	Bottom Ash	**Reviewed By**	RLB
		Review Date	08/16/95

Compaction, %	94.9	88.5	93.1
Before Soak Dry Density, pcf	84.5	78.7	82.8
Before Soak Moisture Content,	24.8	25.5	25.0
After Soak Dry Density, pcf	84.7	78.8	82.8
After Soak Moisture Content, %	25.3	26.8	26.3
CBR @ 0.1 in.	36.7	30.0	37.5
CBR @ 0.2 in.	59.4	37.8	51.1



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:*	Kingston
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	2.85
	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	6.05
	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	38.13
7.	*SOIL SPECIMEN WEIGHT*:	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1037.90
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	0.00
	WEIGHT OF WET SOIL USED , grams	1037.90
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	24.1
	MAX. DRY DENSITY, pcf	89.0
	95 % MAX. DRY DENSITY, pcf	84.6
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	22.3
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	22.3
	COMPACTION DRY DENSITY, γ_d pcf	84.7
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	26.4
	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 Y Bindheim 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. MATERIAL SOURCE: Kingston
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	1.2	2.0	1.8	0.2	0.00144	0.00146	0.00145	0.00024	7,637
			2	12.9	11.7	1.2	2.0	1.9	0.2	0.00145	0.00147	0.00146	0.00024	7,672
			3	12.9	11.7	1.2	2.1	1.9	0.2	0.00144	0.00148	0.00146	0.00024	7,712
			4	12.9	11.7	1.2	2.1	1.9	0.2	0.00146	0.00146	0.00146	0.00024	7,716
			5	13.0	11.8	1.2	2.1	1.9	0.2	0.00145	0.00147	0.00146	0.00024	7,733
	COLUMN AVERAGE			12.9	11.7	1.2	2.0	1.9	0.2	0.00145	0.00147	0.00146	0.00024	7,694
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	39

Source: Kingston Description: Bottom Ash 95% Standard 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	0.00269	0.00269	0.00269	0.00044	8,219
			2	25.1	22.8	2.3	4.0	3.6	0.4	0.00269	0.00270	0.00270	0.00045	8,132
			3	25.2	23.0	2.3	4.0	3.6	0.4	0.00268	0.00268	0.00268	0.00044	8,230
			4	25.1	22.8	2.3	4.0	3.6	0.4	0.00267	0.00266	0.00267	0.00044	8,215
			5	25.2	22.9	2.3	4.0	3.6	0.4	0.00268	0.00268	0.00268	0.00044	8,197
	COLUMN AVERAGE			25.2	22.9	2.3	4.0	3.6	0.4	0.00268	0.00268	0.00268	0.00044	8,199
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	39
SEQUENCE 3	6.0	6.0	1	38.0	34.5	3.5	6.0	5.5	0.5	0.00399	0.00395	0.00397	0.00066	8,349
			2	38.0	34.5	3.5	6.0	5.5	0.6	0.00400	0.00396	0.00398	0.00066	8,319
			3	38.1	34.6	3.5	6.0	5.5	0.6	0.00402	0.00396	0.00399	0.00066	8,332
			4	37.9	34.3	3.6	6.0	5.4	0.6	0.00401	0.00395	0.00398	0.00066	8,278
			5	37.9	34.4	3.5	6.0	5.5	0.6	0.00400	0.00397	0.00399	0.00066	8,294
	COLUMN AVERAGE			38.0	34.5	3.5	6.0	5.5	0.6	0.00401	0.00396	0.00398	0.00066	8,314
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	29
SEQUENCE 4	6.0	8.0	1	50.4	45.6	4.8	8.0	7.2	0.8	0.00535	0.00531	0.00533	0.00088	8,220
			2	50.6	45.8	4.8	8.0	7.3	0.8	0.00536	0.00532	0.00534	0.00088	8,234
			3	50.7	45.9	4.8	8.0	7.3	0.8	0.00537	0.00532	0.00534	0.00088	8,247
			4	50.6	45.8	4.8	8.0	7.3	0.8	0.00538	0.00532	0.00535	0.00088	8,217
			5	50.8	46.0	4.8	8.1	7.3	0.8	0.00539	0.00533	0.00536	0.00089	8,241
	COLUMN AVERAGE			50.6	45.8	4.8	8.0	7.3	0.8	0.00537	0.00532	0.00534	0.00088	8,232
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	13

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

SEQUENCE 5	6.0	10.0	1	63.2	57.2	6.0	10.0	9.1	0.9	0.00677	0.00671	0.00674	0.00111	8,149
			2	63.1	57.1	6.0	10.0	9.1	1.0	0.00675	0.00671	0.00673	0.00111	8,145
			3	63.0	57.0	6.0	10.0	9.0	1.0	0.00675	0.00669	0.00672	0.00111	8,142
			4	63.6	57.6	6.0	10.1	9.1	1.0	0.00678	0.00672	0.00675	0.00112	8,185
			5	63.3	57.3	6.0	10.0	9.1	0.9	0.00680	0.00673	0.00676	0.00112	8,139
	COLUMN AVERAGE			63.2	57.2	6.0	10.0	9.1	1.0	0.00677	0.00671	0.00674	0.00111	8,152
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	19
SEQUENCE 6	4.0	2.0	1	13.4	11.7	1.6	2.1	1.9	0.3	0.00221	0.00220	0.00221	0.00036	5,107
			2	13.6	12.0	1.6	2.2	1.9	0.3	0.00221	0.00221	0.00221	0.00037	5,203
			3	13.4	11.8	1.6	2.1	1.9	0.3	0.00223	0.00220	0.00222	0.00037	5,113
			4	13.4	11.8	1.6	2.1	1.9	0.3	0.00221	0.00221	0.00221	0.00037	5,145
			5	13.4	11.7	1.6	2.1	1.9	0.3	0.00221	0.00223	0.00222	0.00037	5,072
	COLUMN AVERAGE			13.5	11.8	1.6	2.1	1.9	0.3	0.00222	0.00221	0.00221	0.00037	5,128
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	49
SEQUENCE 7	4.0	4.0	1	25.3	22.9	2.3	4.0	3.6	0.4	0.00439	0.00435	0.00437	0.00072	5,033
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00438	0.00435	0.00436	0.00072	5,025
			3	25.1	22.8	2.4	4.0	3.6	0.4	0.00437	0.00434	0.00435	0.00072	5,024
			4	25.3	23.0	2.4	4.0	3.6	0.4	0.00439	0.00436	0.00437	0.00072	5,047
			5	25.3	22.9	2.3	4.0	3.6	0.4	0.00438	0.00436	0.00437	0.00072	5,038
	COLUMN AVERAGE			25.2	22.9	2.3	4.0	3.6	0.4	0.00438	0.00435	0.00437	0.00072	5,033
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	10

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

SEQUENCE 8	4.0	6.0	1	38.3	34.8	3.6	6.1	5.5	0.6	0.00601	0.00596	0.00598	0.00099	5,578
			2	38.4	34.8	3.6	6.1	5.5	0.6	0.00601	0.00597	0.00599	0.00099	5,582
			3	38.5	34.9	3.6	6.1	5.5	0.6	0.00605	0.00598	0.00601	0.00099	5,568
			4	38.4	34.9	3.6	6.1	5.5	0.6	0.00600	0.00597	0.00599	0.00099	5,591
			5	38.4	34.9	3.5	6.1	5.5	0.6	0.00602	0.00597	0.00599	0.00099	5,592
	COLUMN AVERAGE			38.4	34.9	3.6	6.1	5.5	0.6	0.00602	0.00597	0.00599	0.00099	5,582
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	10
SEQUENCE 9	4.0	8.0	1	50.7	45.9	4.8	8.0	7.3	0.8	0.00755	0.00750	0.00752	0.00124	5,853
			2	50.6	45.8	4.8	8.0	7.3	0.8	0.00755	0.00751	0.00753	0.00125	5,832
			3	50.9	46.1	4.8	8.1	7.3	0.8	0.00756	0.00749	0.00753	0.00124	5,875
			4	50.8	46.0	4.8	8.1	7.3	0.8	0.00754	0.00749	0.00751	0.00124	5,874
			5	50.7	45.9	4.8	8.0	7.3	0.8	0.00755	0.00750	0.00752	0.00124	5,860
	COLUMN AVERAGE			50.7	45.9	4.8	8.0	7.3	0.8	0.00755	0.00750	0.00752	0.00124	5,859
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	18
SEQUENCE 10	4.0	10.0	1	63.0	56.9	6.0	10.0	9.0	1.0	0.00898	0.00894	0.00896	0.00148	6,097
			2	63.1	57.0	6.1	10.0	9.0	1.0	0.00898	0.00896	0.00897	0.00148	6,103
			3	63.1	57.0	6.1	10.0	9.1	1.0	0.00900	0.00896	0.00898	0.00148	6,099
			4	63.0	57.0	6.1	10.0	9.0	1.0	0.00896	0.00895	0.00896	0.00148	6,104
			5	63.0	57.0	6.1	10.0	9.0	1.0	0.00898	0.00893	0.00896	0.00148	6,105
	COLUMN AVERAGE			63.0	57.0	6.1	10.0	9.0	1.0	0.00898	0.00895	0.00896	0.00148	6,102
	STANDARD DEV.			0.1	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	4

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

SEQUENCE 11	2.0	2.0	1	13.7	11.7	2.1	2.2	1.8	0.3	0.00324	0.00320	0.00322	0.00053	3,472
			2	13.8	11.7	2.0	2.2	1.9	0.3	0.00326	0.00321	0.00323	0.00053	3,483
			3	13.6	11.5	2.1	2.2	1.8	0.3	0.00323	0.00319	0.00321	0.00053	3,432
			4	13.8	11.7	2.1	2.2	1.9	0.3	0.00326	0.00320	0.00323	0.00053	3,482
			5	13.8	11.8	2.1	2.2	1.9	0.3	0.00326	0.00320	0.00323	0.00053	3,495
	COLUMN AVERAGE			13.7	11.7	2.1	2.2	1.9	0.3	0.00325	0.00320	0.00323	0.00053	3,473
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	24
SEQUENCE 12	2.0	4.0	1	25.4	23.0	2.3	4.0	3.7	0.4	0.00614	0.00609	0.00611	0.00101	3,617
			2	25.5	23.1	2.3	4.0	3.7	0.4	0.00616	0.00609	0.00612	0.00101	3,627
			3	25.6	23.2	2.4	4.1	3.7	0.4	0.00618	0.00610	0.00614	0.00102	3,632
			4	25.5	23.2	2.4	4.1	3.7	0.4	0.00617	0.00608	0.00613	0.00101	3,633
			5	25.5	23.1	2.4	4.0	3.7	0.4	0.00616	0.00609	0.00612	0.00101	3,626
	COLUMN AVERAGE			25.5	23.1	2.4	4.0	3.7	0.4	0.00616	0.00609	0.00613	0.00101	3,627
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	6
SEQUENCE 13	2.0	6.0	1	37.7	34.1	3.6	6.0	5.4	0.6	0.00783	0.00777	0.00780	0.00129	4,190
			2	37.8	34.2	3.6	6.0	5.4	0.6	0.00781	0.00774	0.00777	0.00129	4,229
			3	37.8	34.2	3.6	6.0	5.4	0.6	0.00780	0.00772	0.00776	0.00128	4,233
			4	37.9	34.4	3.6	6.0	5.5	0.6	0.00781	0.00774	0.00778	0.00129	4,241
			5	37.8	34.2	3.6	6.0	5.4	0.6	0.00779	0.00774	0.00777	0.00128	4,233
	COLUMN AVERAGE			37.8	34.2	3.6	6.0	5.4	0.6	0.00781	0.00774	0.00778	0.00129	4,225
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	20

Source: Kingston Description: Bottom Ash 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	0.00926	0.00917	0.00921	0.00152	4,768
			2	50.6	45.7	4.8	8.0	7.3	0.8	0.00924	0.00915	0.00919	0.00152	4,776
			3	50.7	45.9	4.8	8.0	7.3	0.8	0.00926	0.00917	0.00921	0.00152	4,782
			4	50.7	45.9	4.8	8.0	7.3	0.8	0.00925	0.00915	0.00920	0.00152	4,785
			5	50.6	45.8	4.8	8.0	7.3	0.8	0.00924	0.00914	0.00919	0.00152	4,787
	COLUMN AVERAGE			50.6	45.8	4.8	8.0	7.3	0.8	0.00925	0.00916	0.00920	0.00152	4,780
	STANDARD DEV.			0.1	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	62.8	56.7	6.1	10.0	9.0	1.0	0.01073	0.01063	0.01068	0.00177	5,097
			2	62.9	56.8	6.1	10.0	9.0	1.0	0.01075	0.01066	0.01071	0.00177	5,096
			3	63.2	57.1	6.1	10.0	9.1	1.0	0.01077	0.01062	0.01070	0.00177	5,122
			4	63.2	57.1	6.1	10.0	9.1	1.0	0.01073	0.01064	0.01069	0.00177	5,128
			5	63.3	57.2	6.1	10.0	9.1	1.0	0.01078	0.01067	0.01072	0.00177	5,120
	COLUMN AVERAGE			63.1	57.0	6.1	10.0	9.0	1.0	0.01075	0.01065	0.01070	0.00177	5,113
	STANDARD DEV.			0.2	0.2	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00002	0.00000	15

SUBMITTED BY, DATE

R P 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:*	Kingston
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 =	1,427
K2 =	0.13665
K5 =	0.75876
R^2 =	0.91

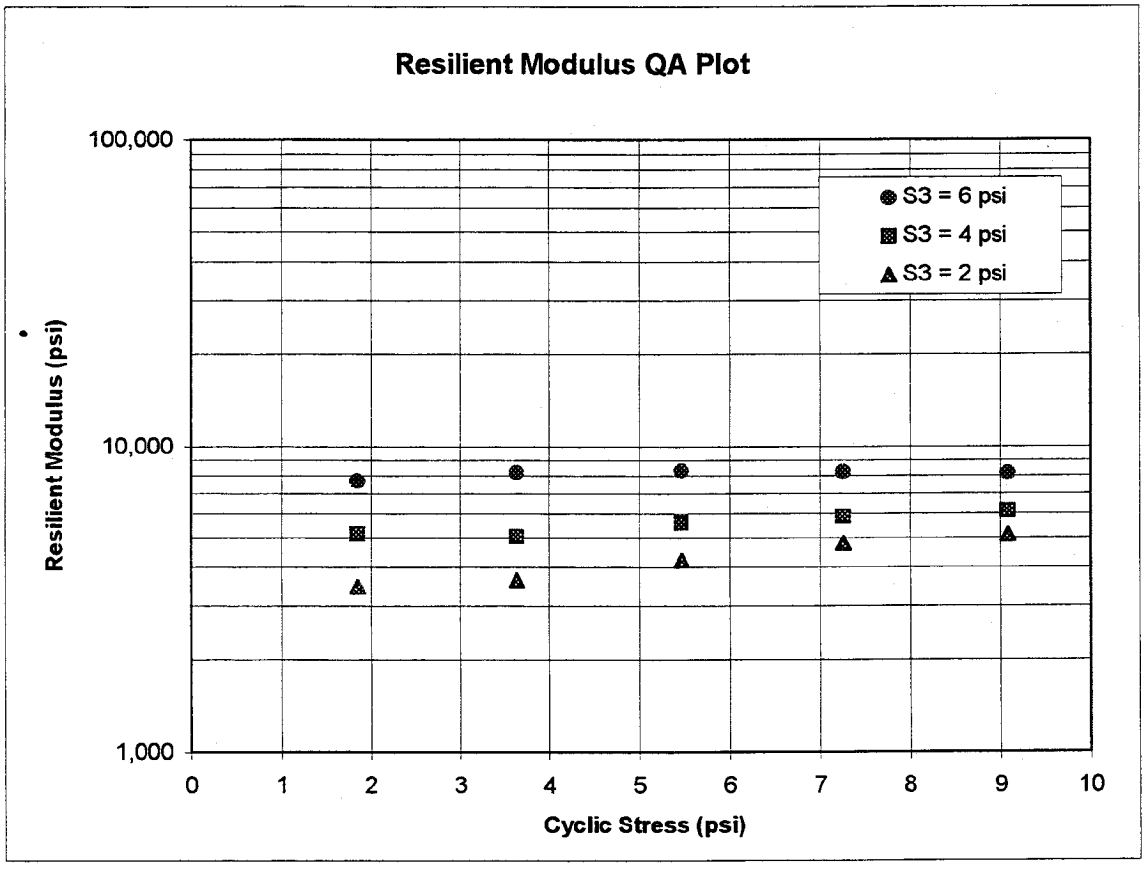
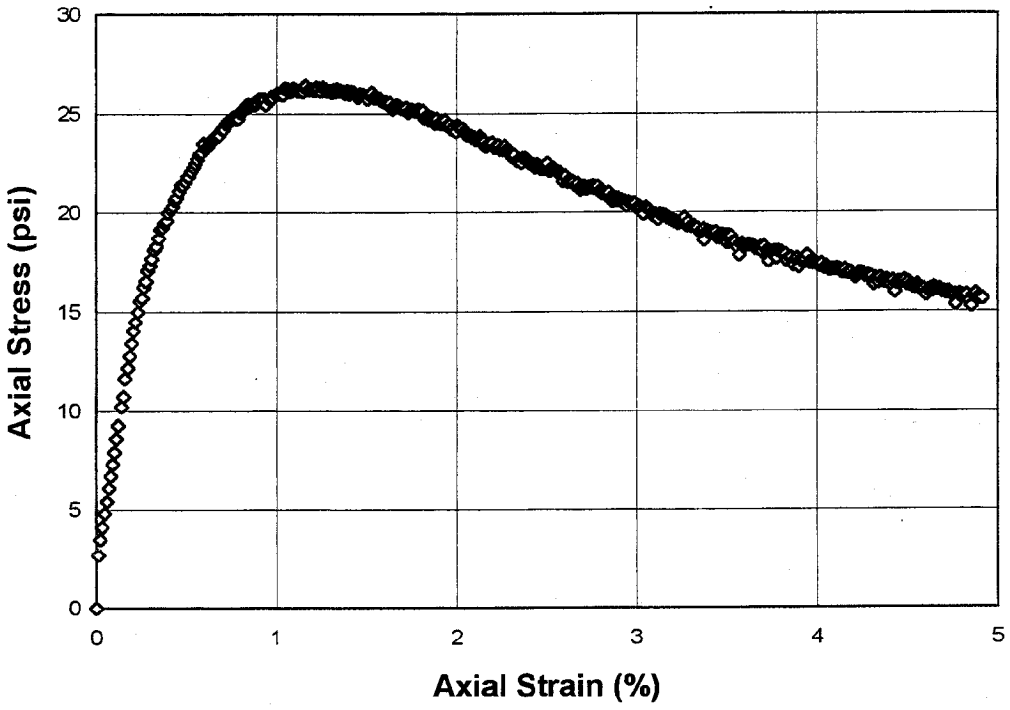


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Kingston
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:*	Kingston
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	2.86
	BOTTOM	2.86
	AVERAGE	2.86
	MEMBRANE THICKNESS (1), inch	0.01
	MEMBRANE THICKNESS (2), inch	0.01
	NET DIAM., inch	2.84
	HEIGHT OF SPECIMEN, CAP AND BASE, inch	6.08
	HEIGHT OF CAP AND BASE, inch	0.00
	INITIAL LENGTH, L_0 , inch	6.08
	INITIAL AREA, A_0 , in^2	6.33
	INITIAL VOLUME $A_0 L_0$, in^3	38.50
7.	*SOIL SPECIMEN WEIGHT:*	
	INITIAL WEIGHT OF CONTAINER AND WET SOIL, grams	1785.00
	FINAL WEIGHT OF CONTAINER AND WET SOIL, grams	674.90
	WEIGHT OF WET SOIL USED, grams	1110.10
8.	*SOIL PROPERTIES .:*	
	IN SITU MOISTURE CONTENT (NUCLEAR), %	N/A
	IN SITU WET DENSITY (NUCLEAR), pcf	N/A
	or	
	OPTIMUM MOISTURE CONTENT, %	21.0
	MAX. DRY DENSITY, pcf	97.6
	95 % MAX. DRY DENSITY, pcf	92.7
9.	*SPECIMEN PROPERTIES:*	
	COMPACTION MOISTURE CONTENT, %	17.7
	MOISTURE CONTENT AFTER RESILIENT MODULUS TESTING, %	17.7
	COMPACTION DRY DENSITY, γ_d pcf	93.3
10.	*QUICK SHEAR TEST*	
	STRESS - STRAIN PLOT ATTACHED (Y = YES, N = NO)	Y
	TRIAXIAL SHEAR MAXIMUM STRENGTH (MAX. LOAD/X-SECTION AREA), psi	66.8
	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*	08-23-1995

GENERAL REMARKS:

SUBMITTED BY, DATE

RJ Boudreau 9/10/95

LABORATORY MANAGER

PROJECT NAME: TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.: 5810860101
1. *MATERIAL SOURCE:* Kingston
2. *MATERIAL DESCRIPTION:* Bottom Ash
3. *REMOLDING TARGETS:* 95% Modified Dry Density at Optimum Moisture Content
4. *MATERIAL TYPE* 2
5. *TEST DATE* 08-23-1995
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	12.5	11.2	1.3	2.0	1.8	0.2	0.00144	0.00132	0.00138	0.00023	7,786
			2	12.5	11.2	1.3	2.0	1.8	0.2	0.00147	0.00136	0.00142	0.00023	7,638
			3	12.5	11.2	1.3	2.0	1.8	0.2	0.00144	0.00135	0.00139	0.00023	7,754
			4	12.5	11.2	1.3	2.0	1.8	0.2	0.00146	0.00136	0.00141	0.00023	7,664
			5	12.6	11.3	1.3	2.0	1.8	0.2	0.00146	0.00135	0.00141	0.00023	7,711
	COLUMN AVERAGE			12.5	11.2	1.3	2.0	1.8	0.2	0.00146	0.00135	0.00140	0.00023	7,711
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00002	0.00001	0.00000	61

Source: Kingston Description: Bottom Ash 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	0.00272	0.00243	0.00258	0.00042	8,514
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00272	0.00247	0.00259	0.00043	8,454
			3	25.2	22.8	2.4	4.0	3.6	0.4	0.00275	0.00244	0.00259	0.00043	8,463
			4	25.2	22.8	2.4	4.0	3.6	0.4	0.00275	0.00242	0.00259	0.00043	8,487
			5	25.2	22.8	2.4	4.0	3.6	0.4	0.00275	0.00242	0.00258	0.00042	8,487
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00274	0.00243	0.00259	0.00043	8,481
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00002	0.00001	0.00000	24
SEQUENCE 3	6.0	6.0	1	38.0	34.4	3.7	6.0	5.4	0.6	0.00382	0.00343	0.00363	0.00060	9,112
			2	38.0	34.4	3.7	6.0	5.4	0.6	0.00381	0.00344	0.00363	0.00060	9,108
			3	38.0	34.4	3.6	6.0	5.4	0.6	0.00381	0.00344	0.00362	0.00060	9,120
			4	38.0	34.3	3.6	6.0	5.4	0.6	0.00381	0.00343	0.00362	0.00059	9,124
			5	38.0	34.3	3.7	6.0	5.4	0.6	0.00381	0.00344	0.00363	0.00060	9,100
	COLUMN AVERAGE			38.0	34.4	3.6	6.0	5.4	0.6	0.00381	0.00344	0.00362	0.00060	9,113
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	10
SEQUENCE 4	6.0	8.0	1	50.8	45.9	4.9	8.0	7.3	0.8	0.00489	0.00447	0.00468	0.00077	9,429
			2	50.7	45.8	4.9	8.0	7.2	0.8	0.00490	0.00447	0.00469	0.00077	9,404
			3	50.8	45.9	4.9	8.0	7.2	0.8	0.00490	0.00448	0.00469	0.00077	9,400
			4	50.8	45.9	4.9	8.0	7.3	0.8	0.00490	0.00446	0.00468	0.00077	9,432
			5	50.8	45.9	4.9	8.0	7.3	0.8	0.00490	0.00448	0.00469	0.00077	9,411
	COLUMN AVERAGE			50.8	45.9	4.9	8.0	7.3	0.8	0.00490	0.00447	0.00469	0.00077	9,415
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.00001	0.00001	0.00000	15

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

SEQUENCE 5	6.0	10.0	1	63.6	57.4	6.2	10.1	9.1	1.0	0.00599	0.00551	0.00575	0.00095	9,601
			2	63.6	57.4	6.2	10.1	9.1	1.0	0.00597	0.00552	0.00575	0.00094	9,611
			3	63.7	57.5	6.2	10.1	9.1	1.0	0.00598	0.00552	0.00575	0.00095	9,611
			4	63.7	57.5	6.2	10.1	9.1	1.0	0.00598	0.00554	0.00576	0.00095	9,597
			5	63.6	57.5	6.1	10.1	9.1	1.0	0.00599	0.00552	0.00575	0.00095	9,605
	COLUMN AVERAGE			63.6	57.5	6.2	10.1	9.1	1.0	0.00598	0.00552	0.00575	0.00095	9,605
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00000	0.00000	6
SEQUENCE 6	4.0	2.0	1	12.8	11.1	1.7	2.0	1.8	0.3	0.00191	0.00178	0.00185	0.00030	5,801
			2	12.9	11.2	1.7	2.0	1.8	0.3	0.00193	0.00181	0.00187	0.00031	5,755
			3	12.9	11.2	1.7	2.0	1.8	0.3	0.00194	0.00182	0.00188	0.00031	5,738
			4	12.8	11.2	1.7	2.0	1.8	0.3	0.00193	0.00180	0.00187	0.00031	5,746
			5	12.8	11.2	1.7	2.0	1.8	0.3	0.00190	0.00179	0.00185	0.00030	5,821
	COLUMN AVERAGE			12.8	11.2	1.7	2.0	1.8	0.3	0.00192	0.00180	0.00186	0.00031	5,772
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	37
SEQUENCE 7	4.0	4.0	1	25.1	22.7	2.4	4.0	3.6	0.4	0.00380	0.00351	0.00365	0.00060	5,985
			2	25.2	22.8	2.4	4.0	3.6	0.4	0.00380	0.00352	0.00366	0.00060	5,997
			3	25.2	22.8	2.4	4.0	3.6	0.4	0.00379	0.00351	0.00365	0.00060	6,015
			4	25.2	22.8	2.4	4.0	3.6	0.4	0.00381	0.00353	0.00367	0.00060	5,984
			5	25.2	22.9	2.3	4.0	3.6	0.4	0.00379	0.00351	0.00365	0.00060	6,027
	COLUMN AVERAGE			25.2	22.8	2.4	4.0	3.6	0.4	0.00380	0.00351	0.00366	0.00060	6,002
	STANDARD DEV.			0.0	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	19

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

SEQUENCE 8	4.0	6.0	1	38.1	34.6	3.5	6.0	5.5	0.6	0.00527	0.00484	0.00505	0.00083	6,580
			2	38.1	34.7	3.4	6.0	5.5	0.5	0.00525	0.00484	0.00505	0.00083	6,614
			3	38.1	34.7	3.4	6.0	5.5	0.5	0.00527	0.00486	0.00506	0.00083	6,583
			4	38.1	34.7	3.4	6.0	5.5	0.5	0.00527	0.00486	0.00506	0.00083	6,591
			5	38.0	34.7	3.4	6.0	5.5	0.5	0.00525	0.00484	0.00504	0.00083	6,612
	COLUMN AVERAGE			38.1	34.7	3.4	6.0	5.5	0.5	0.00526	0.00485	0.00505	0.00083	6,596
	STANDARD DEV.			0.0	0.1	0.1	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	16
SEQUENCE 9	4.0	8.0	1	51.1	46.3	4.8	8.1	7.3	0.8	0.00643	0.00594	0.00619	0.00102	7,195
			2	51.2	46.3	4.9	8.1	7.3	0.8	0.00646	0.00595	0.00620	0.00102	7,185
			3	51.2	46.4	4.8	8.1	7.3	0.8	0.00645	0.00596	0.00620	0.00102	7,190
			4	51.4	46.5	4.8	8.1	7.4	0.8	0.00646	0.00597	0.00622	0.00102	7,201
			5	51.2	46.3	4.9	8.1	7.3	0.8	0.00645	0.00595	0.00620	0.00102	7,185
	COLUMN AVERAGE			51.2	46.4	4.8	8.1	7.3	0.8	0.00645	0.00595	0.00620	0.00102	7,191
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	7
SEQUENCE 10	4.0	10.0	1	63.9	57.8	6.1	10.1	9.1	1.0	0.00755	0.00701	0.00728	0.00120	7,634
			2	64.0	57.8	6.1	10.1	9.1	1.0	0.00753	0.00701	0.00727	0.00120	7,647
			3	63.9	57.8	6.1	10.1	9.1	1.0	0.00754	0.00701	0.00728	0.00120	7,634
			4	63.9	57.8	6.1	10.1	9.1	1.0	0.00753	0.00702	0.00728	0.00120	7,635
			5	63.8	57.7	6.1	10.1	9.1	1.0	0.00757	0.00702	0.00729	0.00120	7,612
	COLUMN AVERAGE			63.9	57.8	6.1	10.1	9.1	1.0	0.00754	0.00701	0.00728	0.00120	7,633
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	13

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

SEQUENCE 11	2.0	2.0	1	13.1	11.0	2.0	2.1	1.7	0.3	0.00263	0.00251	0.00257	0.00042	4,137
			2	13.1	11.0	2.0	2.1	1.7	0.3	0.00261	0.00249	0.00255	0.00042	4,159
			3	13.1	11.0	2.0	2.1	1.7	0.3	0.00262	0.00249	0.00256	0.00042	4,145
			4	13.1	11.0	2.0	2.1	1.7	0.3	0.00262	0.00249	0.00256	0.00042	4,142
			5	13.0	11.0	2.0	2.1	1.7	0.3	0.00263	0.00250	0.00257	0.00042	4,129
	COLUMN AVERAGE			13.1	11.0	2.0	2.1	1.7	0.3	0.00262	0.00250	0.00256	0.00042	4,143
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	11
SEQUENCE 12	2.0	4.0	1	25.1	22.8	2.4	4.0	3.6	0.4	0.00515	0.00489	0.00502	0.00083	4,362
			2	25.1	22.8	2.4	4.0	3.6	0.4	0.00515	0.00487	0.00501	0.00082	4,369
			3	25.1	22.7	2.3	4.0	3.6	0.4	0.00517	0.00489	0.00503	0.00083	4,347
			4	25.1	22.8	2.4	4.0	3.6	0.4	0.00516	0.00489	0.00503	0.00083	4,350
			5	25.1	22.8	2.4	4.0	3.6	0.4	0.00515	0.00489	0.00502	0.00083	4,361
	COLUMN AVERAGE			25.1	22.8	2.4	4.0	3.6	0.4	0.00516	0.00489	0.00502	0.00083	4,358
	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	38.4	34.8	3.6	6.1	5.5	0.6	0.00678	0.00638	0.00658	0.00108	5,080
			2	38.4	34.7	3.6	6.1	5.5	0.6	0.00679	0.00640	0.00660	0.00108	5,063
			3	38.4	34.7	3.6	6.1	5.5	0.6	0.00681	0.00641	0.00661	0.00109	5,054
			4	38.3	34.7	3.6	6.1	5.5	0.6	0.00680	0.00640	0.00660	0.00108	5,057
			5	38.2	34.6	3.6	6.0	5.5	0.6	0.00679	0.00641	0.00660	0.00108	5,042
	COLUMN AVERAGE			38.3	34.7	3.6	6.1	5.5	0.6	0.00679	0.00640	0.00660	0.00108	5,059
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	14

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

SEQUENCE 14	2.0	8.0	1	51.1	46.2	4.9	8.1	7.3	0.8	0.00796	0.00753	0.00774	0.00127	5,741
			2	51.1	46.2	4.8	8.1	7.3	0.8	0.00795	0.00753	0.00774	0.00127	5,743
			3	51.1	46.3	4.9	8.1	7.3	0.8	0.00796	0.00752	0.00774	0.00127	5,748
			4	51.1	46.3	4.9	8.1	7.3	0.8	0.00798	0.00753	0.00775	0.00127	5,739
			5	51.3	46.4	4.8	8.1	7.3	0.8	0.00799	0.00754	0.00776	0.00128	5,748
	COLUMN AVERAGE			51.1	46.3	4.8	8.1	7.3	0.8	0.00797	0.00753	0.00775	0.00127	5,744
	STANDARD DEV.			0.1	0.1	0.0	0.0	0.0	0.0	0.00002	0.00001	0.00001	0.00000	4
SEQUENCE 15	2.0	10.0	1	64.2	58.1	6.1	10.1	9.2	1.0	0.00899	0.00852	0.00875	0.00144	6,384
			2	64.2	58.1	6.1	10.1	9.2	1.0	0.00899	0.00852	0.00875	0.00144	6,384
			3	64.2	58.2	6.1	10.2	9.2	1.0	0.00900	0.00853	0.00877	0.00144	6,380
			4	64.3	58.2	6.1	10.2	9.2	1.0	0.00899	0.00853	0.00876	0.00144	6,387
			5	64.3	58.2	6.1	10.2	9.2	1.0	0.00900	0.00855	0.00878	0.00144	6,377
	COLUMN AVERAGE			64.2	58.2	6.1	10.2	9.2	1.0	0.00899	0.00853	0.00876	0.00144	6,382
	STANDARD DEV.			0.0	0.0	0.0	0.0	0.0	0.0	0.00001	0.00001	0.00001	0.00000	4

SUBMITTED BY, DATE

RJ Bruchen 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:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-23-1995

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

K1 =	1,822
K2 =	0.19126
K5 =	0.64487
R^2 =	0.95

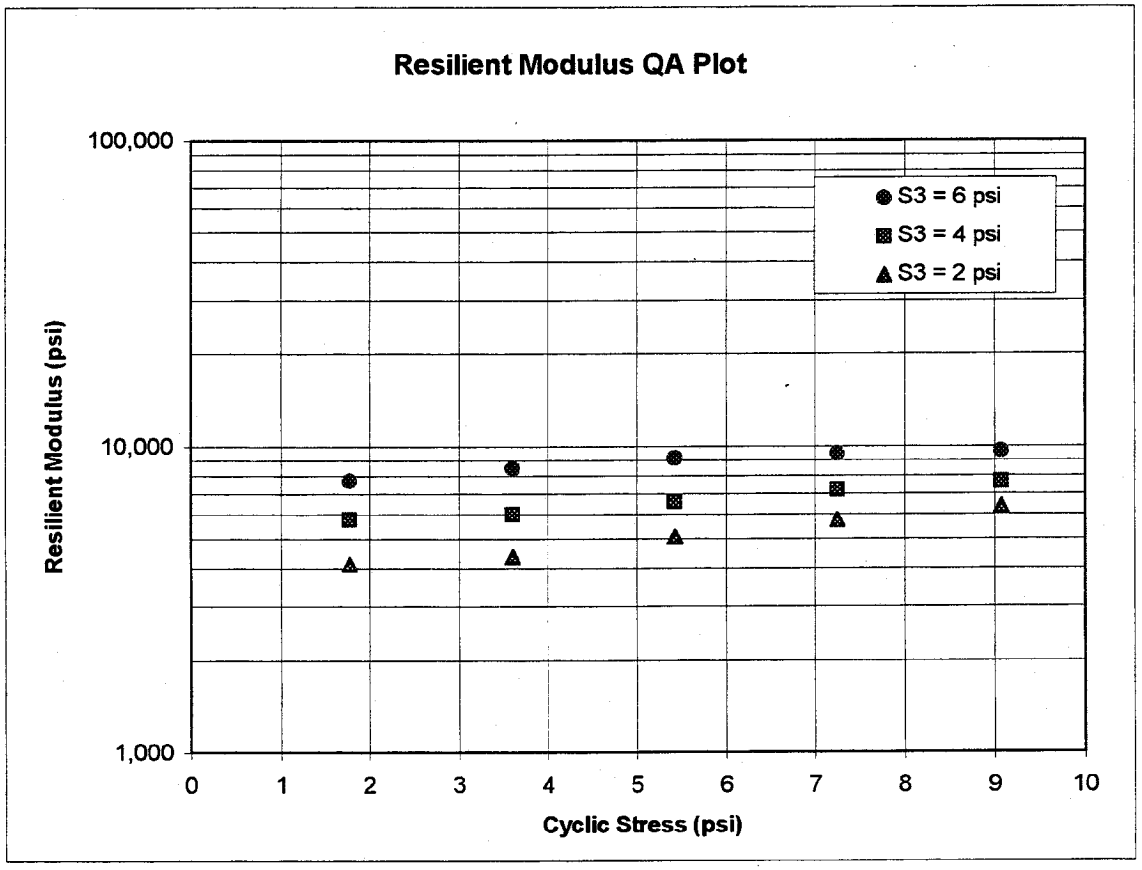


FIGURE 2 - Quick Shear Stress vs Strain

PROJECT NAME:		TVA - Fly Ash, Bottom Ash and Scrubber Gypsum Study
LAW PROJECT NO.:		5810860101
1.	*MATERIAL SOURCE:*	Kingston
2.	*MATERIAL DESCRIPTION:*	Bottom Ash
3.	*REMOLDING TARGETS:*	95% Modified Dry Density at Optimum Moisture Content
4.	*MATERIAL TYPE*	2
5.	*TEST DATE*	08-23-1995