Evaluation of the Consolid System of Soil Stabilization

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MLR-86-10

EVALUATION OF THE CONSOLID SYSTEM OF SOIL STABILIZATION

By
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May 1987

ABSTRACT

The Consolid System by American Consolid Inc. is a three product system that, according to product literature, "enables any soil, found anywhere, to be upgraded to achieve better characteristics necessary in improving road life and quality". Consolid was evaluated along with mixes of cement-fly ash and hydrated lime on two soils. The soils were an A-2-4(0) with zero plasticity index and an A-7-8(18) with a 31 plasticity index.

American Consolid Inc. recommended an application rate of 0.10% Consolid 444 and 1.00% Conservex by dry soil weight. The application rate chosen for cement-fly ash was 5% cement and 15% fly ash and for hydrated lime it was 6.5%. Testing involved triaxial testing of specimens after water soaking, unconfined compressive strength of specimens before and after water soaking, and freeze and thaw testing of specimens after water soaking. All specimens were compacted to standard proctor at optimum moisture.

The cement-fly ash treated mixes had the highest strength and durability followed by the hydrated lime treated mixes.

INTRODUCTION

The Consolid System by American Consolid Inc. is a three product system that, according to product literature, "enables any soil, found anywhere, to be upgraded to achieve better characteristics necessary in improving road life and quality". Increased CBR values, reduced permeability and reduced damage due to freeze-thaw cycles are the main purported benefits of the system. The standard application procedure is to mix in-place and compact at optimum moisture.

OBJECTIVE

The objective of the project was to evaluate the Consolid System by American Consolid Inc. of Davenport, Iowa as a stabilizer on Iowa soils. For comparison, a hydrated lime and a cement-fly ash mix were used.

MATERIALS

The following materials were used in the study:

Consolid 444
Conservex
Cement - Type I, standard laboratory blend of eight portland cements available in Iowa. (AC6-350)
Fly Ash - Ottumwa Class C
Hydrated Lime - AASHTO M 216, Linwood Stone Products
Soil #1 - A-2-4(0) with 0 P.I. (AAD7-5) (Report in Appendix A)
Soil #2 - A-7-8(18) with 31 P.I. (AAD7-6) (Report in Appendix A)

PROCEDURES

The following mixes were made:

Mix #1-1 - Soil #1 + 0.10% Consolid 444 + 1.00% Conservex
Mix #1-2 - Soil #1 + 5.0% cement + 15% fly ash
Mix #1-3 - Soil #1 + 6.5% hydrated lime
Mix #2-1 - Soil #2 + 0.10% Consolid 444 + 1.00% Conservex
Mix #2-2 - Soil #2 + 5.0% cement + 15% fly ash
Mix #2-3 - Soil #2 + 6.5% hydrated lime
Mix #2-5 - Soil #2 + 0.10% Consolid 444 + 1.00% Conservex (modified cure)
Quantities are base on percentage of dry soil weight.

Testing consisted of triaxial testing on three 2-inch diameter and 4.5-inch high specimens, unconfined compressive strength on four standard proctor samples and freeze-thaw testing on two standard proctor specimens.

The soils chosen for testing were selected to represent both the low plasticity index sandy soils and the relatively high plasticity index silty clay soils.

Preparation

Standard proctor moisture-density determinations were performed on the untreated soils, cement-fly ash mixes and lime mixes (Table 1).

Preparation of test samples began with the Consolid System and soil #1 on February 4, 1987. Paul Riaford, Jr. of American Consolid Inc. was present to provide handling and mixing instructions. Mix proportions for Consolid were those recommended by Mr. Riaford. The third product of the Consolid System; Solidry, a combination of "active ingredients", portland cement and hydrated lime; was not required for the test soils. Mix proportions for the cement-fly ash and lime were chosen based on previous experience and research conducted by the Iowa D.O.T. and Iowa State University on other Iowa soils.

The Consolid 444, a white milky substance, was added to the mixing water. The Conservex, an asphalt based substance, was added directly into the Lancaster mixer after the mixing water containing the Consolid 444. To compensate for the Conservex, the amount of mixing water to produce optimum density was reduced by 1.00 percent. Other than a slight ammonia odor and asphalt residue, the mix acted similar to untreated soil #1. Mixes #1-2, 1-3, 2-1, 2-2 and 2-3 were mixed in a similar manner as mix #1-1 on March 14. Nine standard proctor specimens were made for each mix. To obtain 2-inch diameter triaxial test specimens, a thin-walled sample tube was driven through the proctor specimen while still in the mold. The proctor specimen and the shelby tube were removed from the proctor mold. The triaxial specimens were then removed from the tube and trimmed. Three specimens were cut for triaxial testing, four specimens were used for unconfined compressive strength testing and two specimens were used for freeze and thaw testing.

Curing

Curing of the Consolid System treated soils was by oven drying at 100 degrees F. for seven days. To be effective, Mr. Riaford indicated that drying out of the treated soil is necessary. However, during the cure of mix #2-1 (the high clay content of soil with the Consolid System) cracks developed in the specimens. The cracks allowed water into the specimens during soaking causing the

specimens to expand and crumble. Additional specimens (mix #2-5) were made using the same mix, but using a modified cure. The specimens were sealed in 1 gallon cans to maintain the moisture content and placed in the oven at 100 degrees F. for 7 days. No cracking occurred with the modified cure. Curing of the remaining treated specimens was by moist cure at 72 degrees F. and 100 percent humidity for seven days. After the cure period, the three triaxial specimens and four of the six proctor specimens were placed in water for two days. The two remaining proctor specimens from each mix were cured for two additional days.

Testing

Triaxial testing was performed on three specimens from each mix after the two day soak. The results are in Appendix B.

Unconfined compressive strength testing was performed after the triaxial testing using two water soaked proctor specimens and two dry proctor specimens from each mix. The results are in Table 2. Weight, height, and diameter measurements were obtained before and after soaking (Table 3 and Table 4).

The remaining two specimens for each mix were used for freeze-thaw testing. After soaking and measuring, the specimens were placed on water saturated blotters 1/4-inch thick and placed in a freezing cabinet at -10 degrees F. Twenty four hours later the specimens were removed and allowed to partially thaw. When the specimens could be separated from the blotters, weight and size measurements were again taken. The specimens and holders were placed in water so that only the blotters were in contact with the water and then placed in the moist room until the next day. Once measurements were taken, the specimens were returned to the freeze cabinet for another 24-hour period. Freezing and thawing was continued until twelve cycles were completed or until the specimen disintegrated or could no longer be measured accurately. Results of the testing are in Appendix C. A summary is in Table 5.
Figure 1 - Figure 6 shows condition of the specimens during testing.

DISCUSSION OF RESULTS

Both water exposure and freezing and thawing exposure were used to simulate field conditions. The effect of water soaking was most evident on high clay soil (Soil #2) (Table 2 and Table 3). The average expansion in size from water soaking ranged from +0.07% for the lime treatment and soil #2 to +1.5% for the consolid treatment and soil #2. Cement-fly ash and soil #2 average expansion was +0.17%. Average shrinkage of the soil #1 mixes was less than -0.10% in all cases. Unconfined compressive strengths after soaking ranged from 1257 psi for cement-fly ash and soil #1 to 0 and 9 psi for Consolid and soil #2.

The two mixes treated with cement-fly ash were the only specimens to withstand the 12 cycles of freeze and thaw intact. Consolid specimens went to 2-1/2 cycles soil #1 and 2 cycles with soil #2 before failing.

COSTS

Materials

The approximate cost of each material is as follows:

Consolid 444	$ 6.00/gal.	$0.75/lb.
Conservex with MC-30	1.82/gal.	0.23/lb.
Portland Cement	60.00/ton	0.03/lb.
Fly Ash	20.00/ton	0.01/lb.
Hydrated Lime	60.00 ton	0.03/lb.

Materials Costs per Cubic Yard of Mixture

Consolid System - a two layer treatment is recommended by American Consolid - 4" deep treatment with both Consolid 444 and Conservex over a 6" deep treatment with Consolid 444 only.

4"/10" (27 cu. ft. x 98.9 pcf) x 1.0% x $0.23/lb.	=	$2.46
10"/10" (27 cu. ft. x 98.9 pcf) x 0.1% x $0.75/lb.	=	2.00
Consolid System Cost Per Cubic Yard	=	$4.46

Cement and Fly Ash - (Cement 4.17% of dry mix and fly ash 12.5% of dry mix)

(27 cu. ft. x 100.8 pcf) x 4.17% x $0.03/lb.	=	$3.40
(27 cu. ft. x 100.8 pcf) x 12.5% x $0.01/lb.	=	3.40
Cement-Fly Ash Cost per Cubic Yard	=	$6.80

Hydrated Lime - (6.1% of dry mix)

(27 cu. ft. x 92.8 pcf) x 6.1% x $0.03/lb.	=	$4.58
Hydrated Lime Cost per Cubic Yard	=	$4.58

Note: Soil densities are those from Soil #2 tested.

CONCLUSIONS

Based on strength and durability as tested in the laboratory, cement-fly ash treatment of the soils performed better than both hydrated lime treatment and Consolid treatment at the rates used. Lime treatment also performed better than Consolid treatment at the rates applied.

RECOMMENDATIONS

Based on this study, no more than a limited number of field trials should be undertaken at this time.

Table 1

OPTIMUM MOISTURE DETERMINATION

Mix No.	Material	Dry Density (PCF)	Percent Moisture
1-4	Soil #1	126.1	9.5
1-2	Soil #1 FA/C, 15/5	132.4	7.7
1-3	Soil #1 6.5 Lime	125.2	10.55
2-4	Soil #2	98.9	22.4
2-2	Soil #2 FA/C, 15/5	100.8	17.2
2-3	Soil #2 6.5 Lime	92.8	25.45

Table 2

AVG. COMPRESSIVE STRENGTH (P.S.I.)

Mix No.	Material	Cure + Soak	Cure Only	% Loss
1-1	Soil #1 + Consolid	30	104	71
1-2	Soil #1 + FA/C,15/5	1257	1138	0
1-3	Soil #1 + 6.5 Lime	24	28	14
2-1	Soil #2 + Consolid	0	347	100
2-2	Soil #2 + FA/C,15/5	138	166	17
2-3	Soil #2 + 6.5 Lime	53	114	54
2-5	Soil #2 + Consolid (Mod Cure)	9	64	86

Table 3

WEIGHT MEASUREMENT BEFORE AND AFTER SOAK

Mix No.	Material	Wet Wt.(GM)	Dry Wt.(GM)	% Moist.	Wt. After Cure (GM)	Wt. After Soak (GM)	Final % Moist
1-1	Soil #1 +	2054.5	1878.0	9.4	1879.6	1951.5	3.91
	Consolid	2058.5	1881.5	9.4	1880.9	1947.0	3.48
1-2	Soil #1 +	2165.5	2007.0	7.9	2162.2	2174.1	8.33
	FA/C,15/5	2163.0	2004.6	7.9	2157.4	2171.7	8.34
1-3	Soil #1 +	2077.5	1873.3	10.9	2073.2	2080.3	11.05
	6.5 Lime	2083.5	1878.7	10.9	2079.1	2087.5	11.11
2-1	Soil #2 +	1878.5	1543.5	21.7	1584.8	0.0	
	Consolid	1866.0	1533.3	21.7	1582.8	0.0	
2-2	Soil #2 +	1799.5	1531.5	17.5	1792.0	1881.7	22.87
	FA/C,15/5	1778.5	1513.6	17.5	1772.2	1868.3	23.43
2-3	Soil #2 +	1768.5	1401.3	26.2	1759.5	1802.9	28.66
	6.5 Lime	1756.5	1391.8	26.2	1747.5	1793.0	28.83
2-5	Soil #2 +	1871.5	1524.0	22.8	1837.5	1913.5	25.56
	Consolid	1866.0	1519.5	22.8	1846.8	1906.7	25.48
	(MOD)						

Table 4

DIMENSION MEASUREMENTS BEFORE AND AFTER SOAK

Mix No.	Material	Avg. Heigth (In.) Before Soak	Avg. Heigth (In.) After Soak	Avg. Diam. (In.) Before Soak	Avg. Diam. (In.) After Soak	Expansion/ Shrink.-%
1-1	Soil #1 + Consolid	4.592 4.598	4.587 4.597	4.000 4.000	3.997 3.997	-0.07
1-2	Soil #1 + FA/C,15/5	4.608 4.614	4.602 4.620	4.009 4.007	4.007 4.004	-0.03
1-3	Soil #1 + 6.5 Lime	4.579 4.598	4.580 4.595	4.000 3.998	3.998 3.996	-0.04
2-1	Soil #2 + Consolid					
2-2	Soil #2 + FA/C,15/5	4.587 4.592	4.590 4.604	3.994 3.993	4.001 4.002	0.17
2-3	Soil #2 + 6.5 Lime	4.604 4.592	4.606 4.600	3.998 3.999	4.000 4.000	0.07
2-5	Soil #2 + Consolid (MOD)	4.566 4.582	4.648 4.644	3.966 3.982	4.024 4.037	1.50

Table 5

RESULTS OF FREEZE-THAW TESTING

Mix No.	Material	Number of Cycles Obtained	Strength after 12 Cycles (PSI)	Remarks
1-1	Soil #1 + Consolid	2-1/2 2-1/2	-- --	Both specimens crumbled at measurements
1-2	Soil #1 + FA/C, 15/5	12 12	1795 2105	
1-3	Soil #1 + 6.5 Lime	2 11	-- --	Both fell apart at measurements
2-1	Soil #2 + Consolid	0 0	-- --	Both specimens did not withstand water soak
2-2	Soil #2 + FA/C, 15/5	12 12	17.4 9.9	Both specimens flaking on sides beginning in cycle #5
2-3	Soil #2 + 6.5 Lime	3 5-1/2	-- --	Both fell apart at measurements.
2-5	Soil #2 + Consolid (Mod Cure)	2 2	-- --	Both split in half at cycle #2, Freeze and thaw continued through 12 cycles with no handling or measuring of specimens.

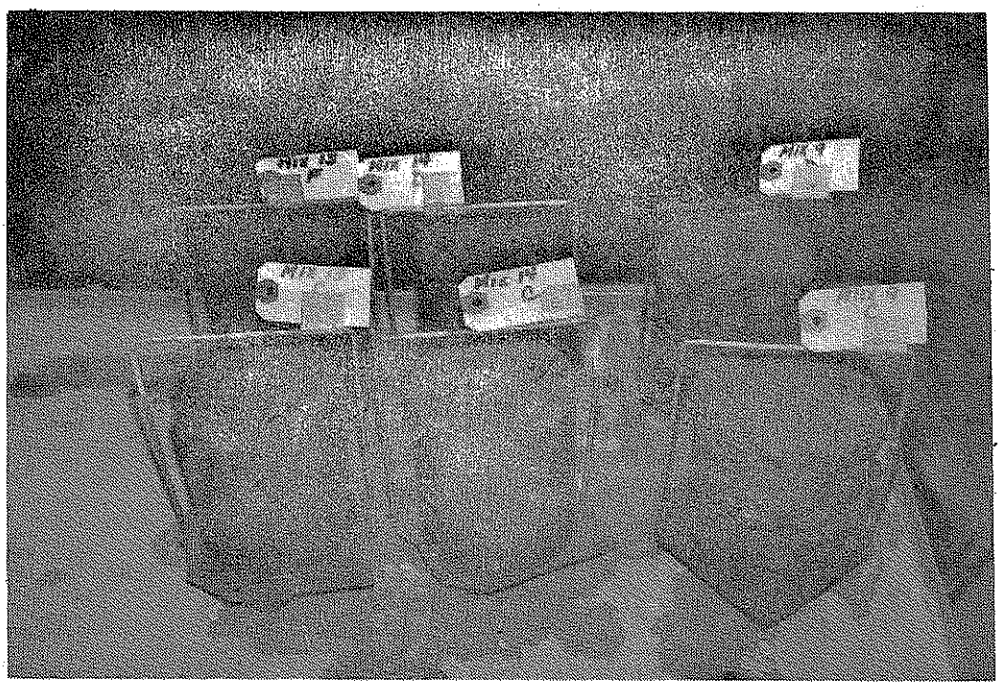


Figure 1. Soil #2 Treatments after Soaking
Mix #2-2 Left, Mix #2-3 Center and Mix #2-1 Right

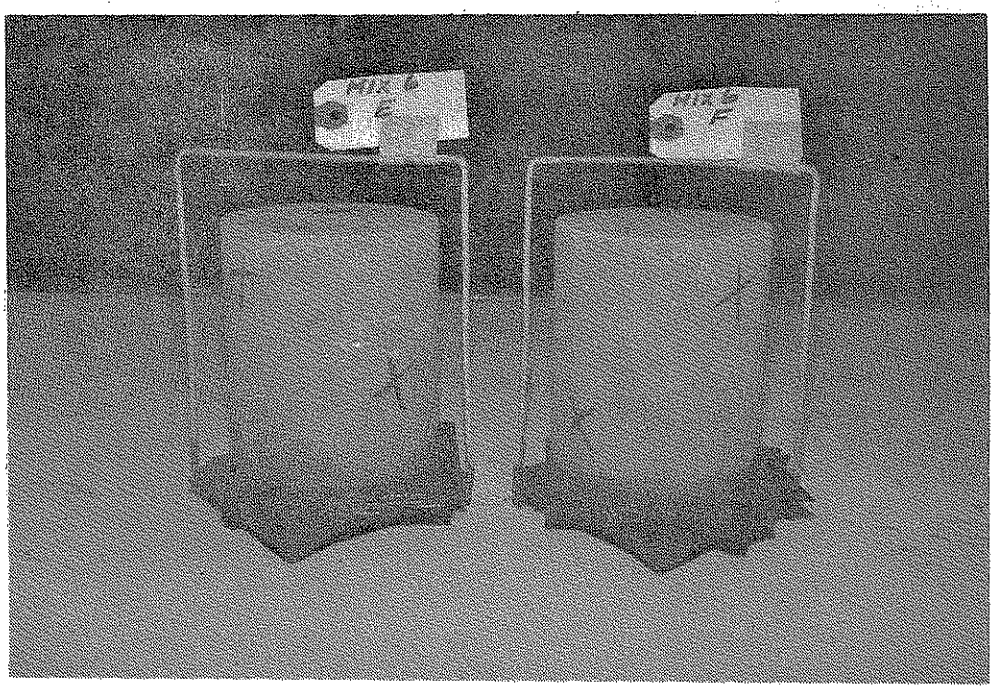


Figure 2. Mix #1-2 After 4 Cycles of Freeze-Thaw

Figure 3. Mix #1-3 After 4 Cycles of Freeze-Thaw

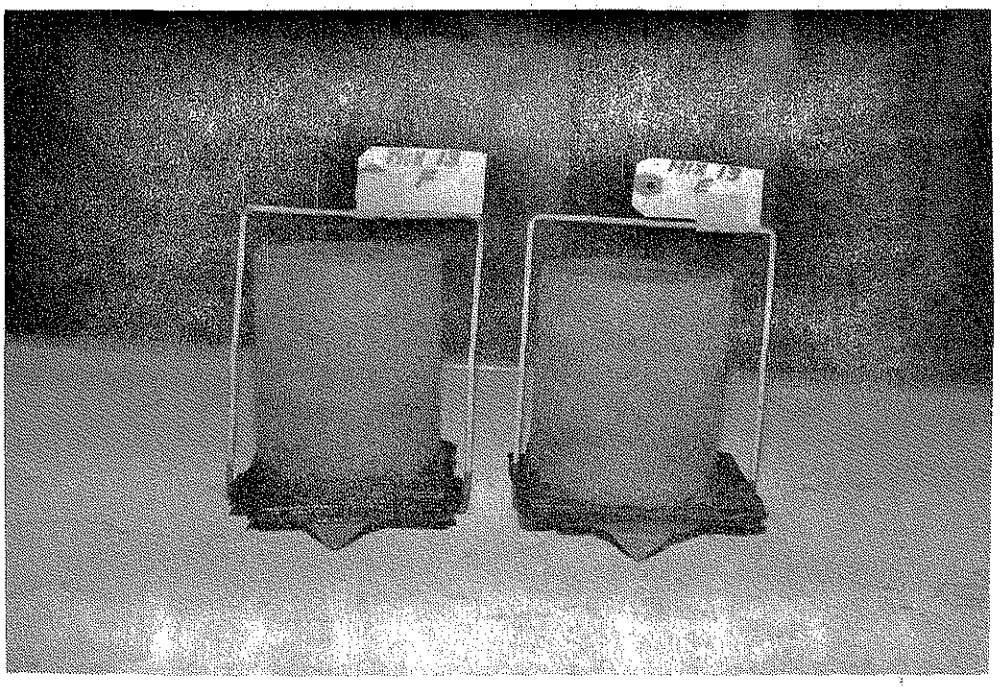


Figure 4. Mix #2-2 After 4 Cycles of Freeze-Thaw

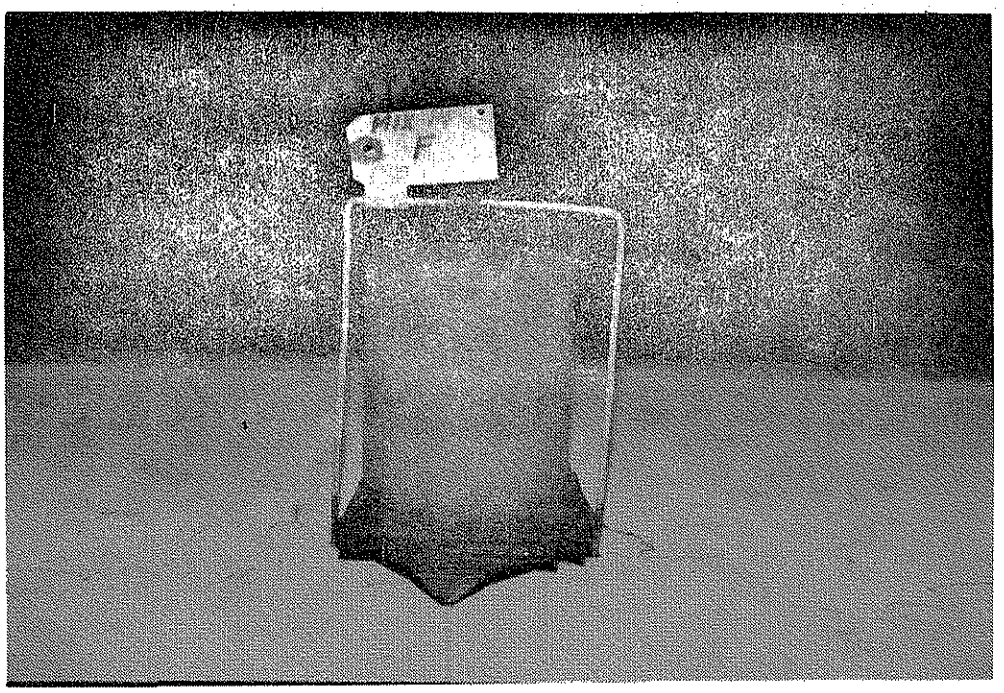


Figure 5. Mix #2-3 After 4 Cycles of Freeze-Thaw

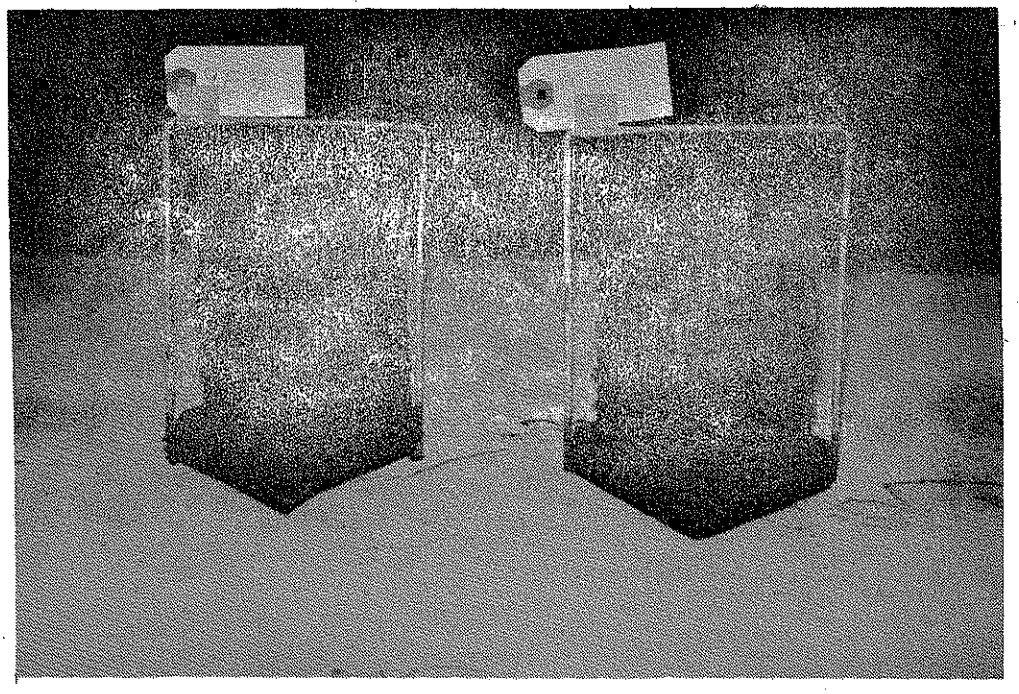


Figure 6. Mix #2-5 After 2 Cycles of Freeze-Thaw

APPENDIX A
SOILS TEST REPORTS

Iowa Department of Transportation
Office of Materials
TEST REPORT-SOIL

SOILS

SOIL DESIGN

Size	% Pass.
*********	
2 in.	
1 1/2 in.	
1.06 in.	
3/4 in.	
3/8 in.	
No. 4	
No. 8	
No. 10	100
No. 30	
No. 40	52
No. 60	
No. 100	22
No. 200	16
.002 mm.	3

Liquid Limit
Plastic Limit 0
Plastic Index

Gravel 0
Sand 84
Silt 13
Clay 3

Class Name LO SA
AASHTO Class 2-4(0)
Color GR BR

County NONE Senders No. LOW AAD7-5
Project DEPT. INFO.

Road No.
Sampled on 01-09-87
Report. on 01-15-87
Sampled by S. STEEL
Location
Other Loc.

Layer Depth
Shelby Depth
Water Level

Remarks: SANDY SOIL FOR "CONSOLID" RESEARCH

Mary J Shaler

Testing Engineer _____

Iowa Department of Transportation
Office of Materials
TEST REPORT-SOIL

SOILS

SOIL DESIGN

Size	% Pass.
2 in.	
1 1/2 in.	
1.06 in.	
3/4 in.	
3/8 in.	
No. 4	
No. 8	
No. 10	100
No. 30	
No. 40	99
No. 60	
No. 100	93
No. 200	90
.002 mm.	40

Liquid Limit 48
Plastic Limit 17
Plastic Index 31

Gravel 0
Sand 10
Silt 50
Clay 40

Class Name SI CL LO
AASHTO Class 7-6(18)
Color DK BR

County
Project DEPT. INFO.

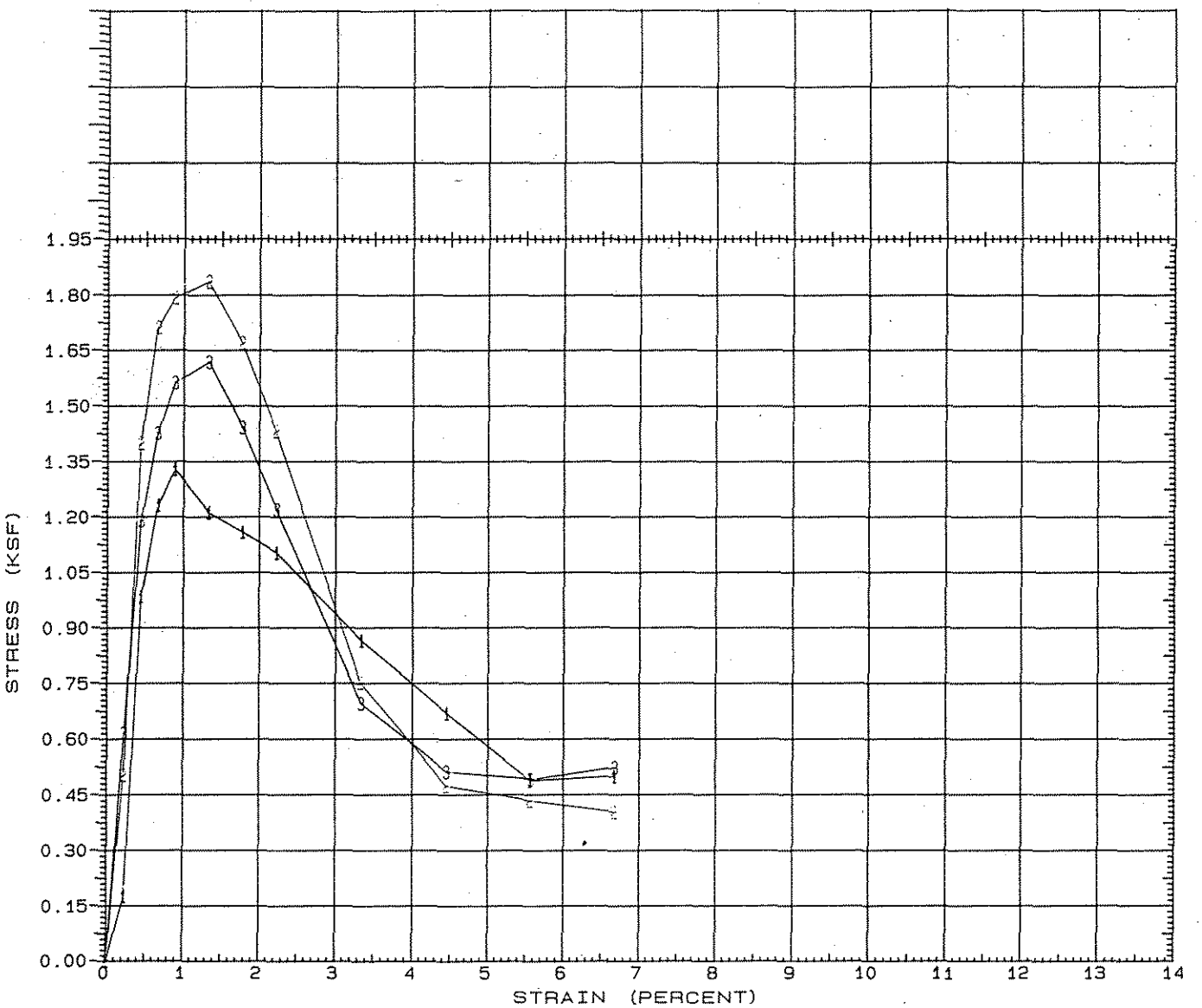
Senders No. HIGH AAD7-6

Road No.
Sampled on
Report. on 01-29-87
Sampled by STEVE STEEL
Location
Other Loc.
Remarks: HIGH CLAY SOIL FOR "CONSOLID" RESEARCH

Layer Depth
Shelby Depth
Water Level

Testing Engineer _____

APPENDIX B
TRIAXIAL TEST REPORTS



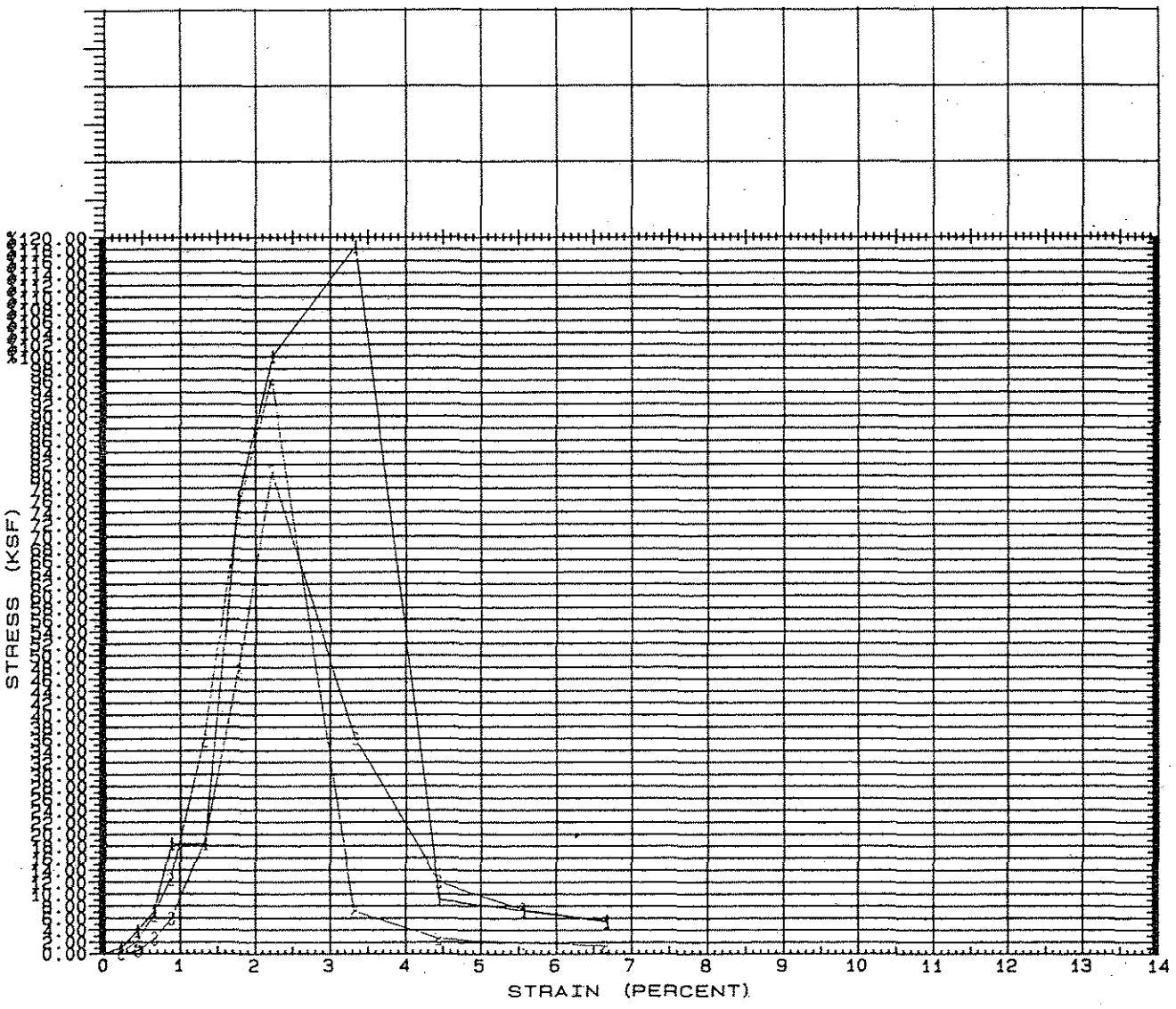
COUNTY N/A
LAB NO. AAD7-5
PROJECT Dept. Information
SENDER'S NO. Mix # 1-1
LOCATION N/A
LAYER N/A

Test	Run 1	Run 2	Run 3
Depth	N/A	N/A	N/A
Wet Density	137.8	138.6	138.6
Dry Density	125.9	126.7	126.7
Before Moist. (%)	9.5	9.4	9.4
After Moist. (%)	7.2	6.1	5.8
AASHTO Class	A-	A-	A-
Class Name			
Preconsol. (KSF)	.72	5.04	2.88
Run (KSF)	.72	5.04	2.88

Run 1 Uneven Absorbtion

Run 2 Uneven Absorbtion

Run 3 Uneven Absorbtion



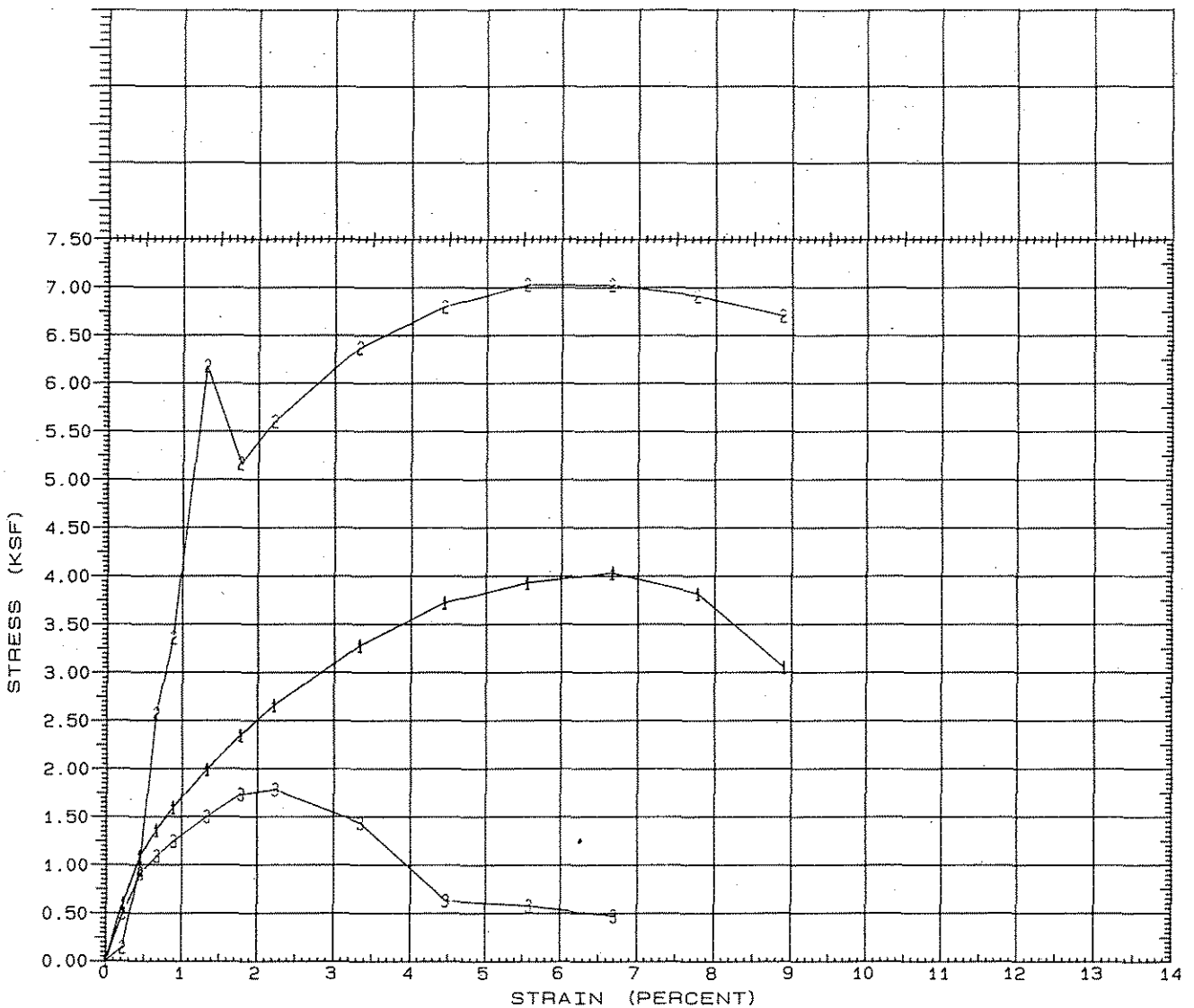
COUNTY	N\A
LAB NO.	AAD7-5
PROJECT	DEPT. INFO.
SENDER'S NO.	MIX #1-2
LOCATION	N\A
LAYER	N\A

Test	Run 1	Run 2	Run 3
Depth			
Wet Density	148.0	144.5	144.7
Dry Density	136.9	133.9	134.2
Before Moist. (%)	8.1	7.9	7.8
After Moist. (%)	7.2	7.9	8.4
AASHTO Class	A-	A-	A-
Class Name			
Preconsol. (KSF)	.72	5.04	2.88
Run (KSF)	.72	5.04	2.88

Run 1 LONG CRACKS

Run 2 CRACKS

Run 3



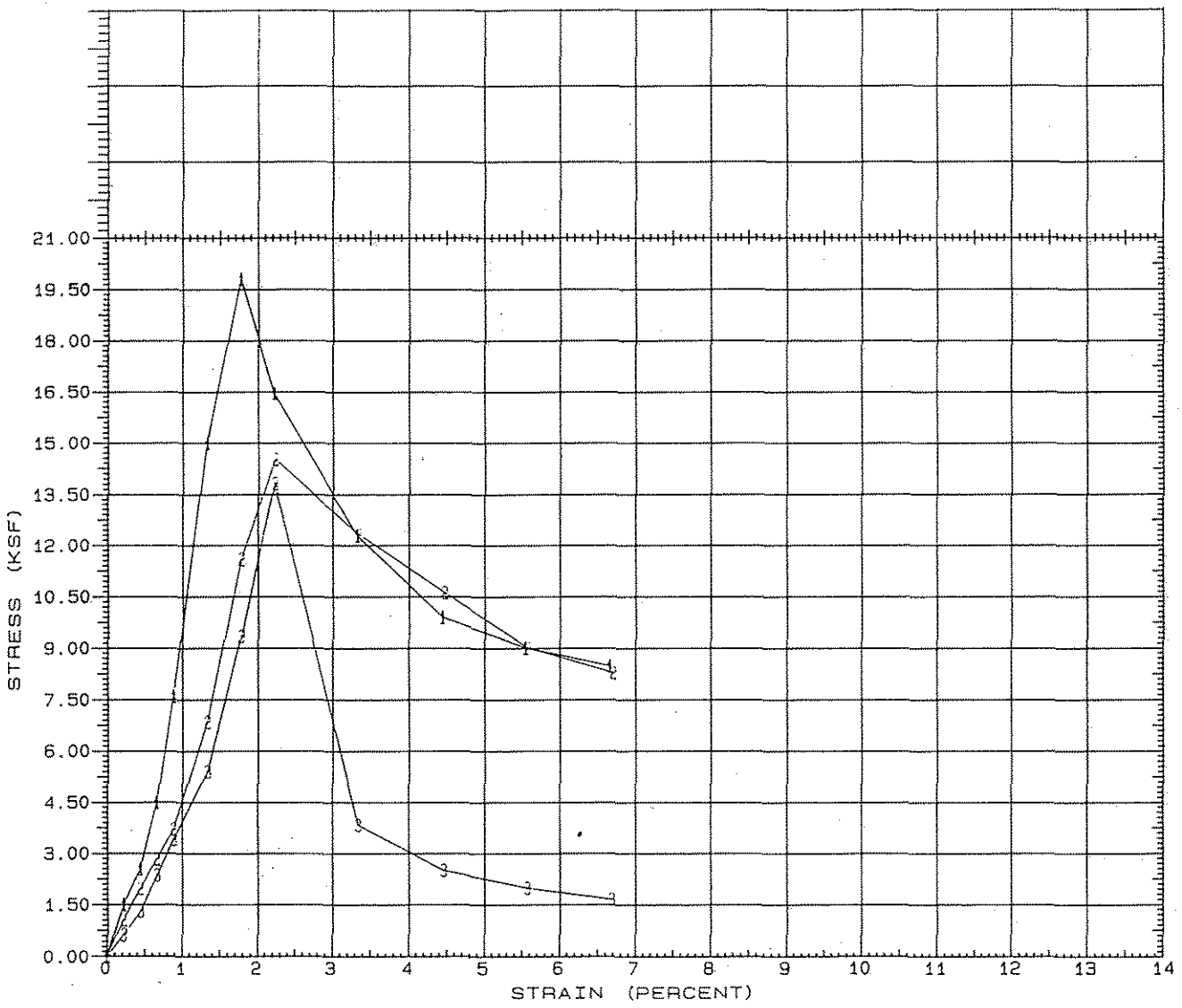
COUNTY	N\A
LAB NO.	AAD7-5
PROJECT	DEPT. INFO.
SENDER'S NO.	MIX #1-3
LOCATION	N\A
LAYER	N\A

Test	Run 1	Run 2	Run 3
Depth			
Wet Density	140.8	142.1	138.3
Dry Density	127.0	128.1	124.8
Before Moist. (%)	10.9	10.9	10.8
After Moist. (%)	11.4	11.2	11.9
AASHTO Class	A-	A-	A-
Class Name			
Preconsol. (KSF)	.72	5.04	2.88
Run (KSF)	.72	5.04	2.88

Run 1

Run 2

Run 3



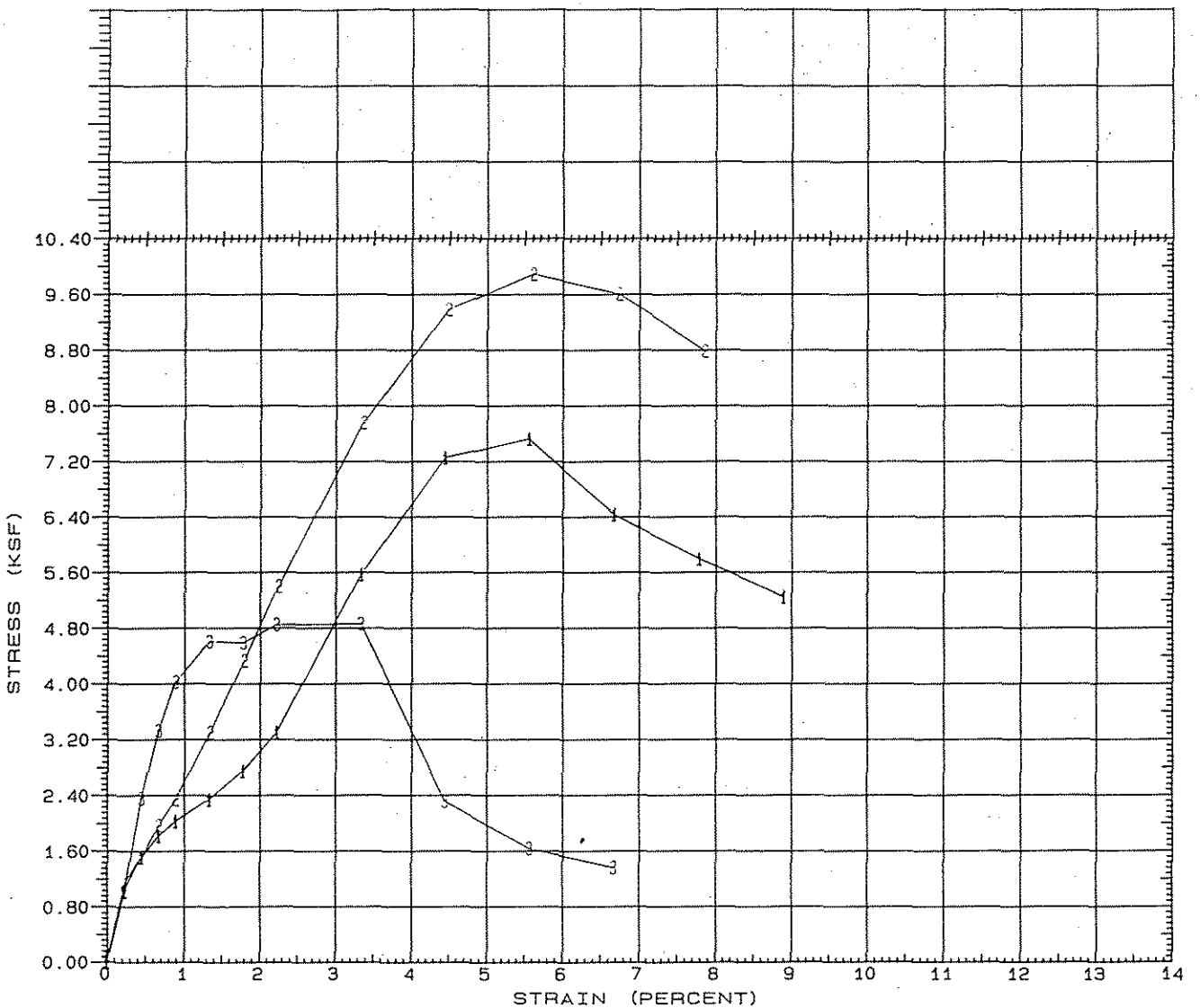
COUNTY	N\A
LAB NO.	AAD7-6
PROJECT	DEPT. INFO.
SENDER'S NO.	MIX #2-2
LOCATION	N\A
LAYER	N\A

Test	Run 1	Run 2	Run 3
Depth			
Wet Density	122.7	121.1	119.2
Dry Density	103.8	103.1	101.8
Before Moist. (%)	18.2	17.5	17.1
After Moist. (%)	21.8	22.2	22.2
AASHTO Class	A-	A-	A-
Class Name			
Preconsol. (KSF)	.72	5.04	2.88
Run (KSF)	.72	5.04	2.88

Run 1 CRACKS AFTER TEST

Run 2 CRACKED IN 3 PIECES AFTER SOAK

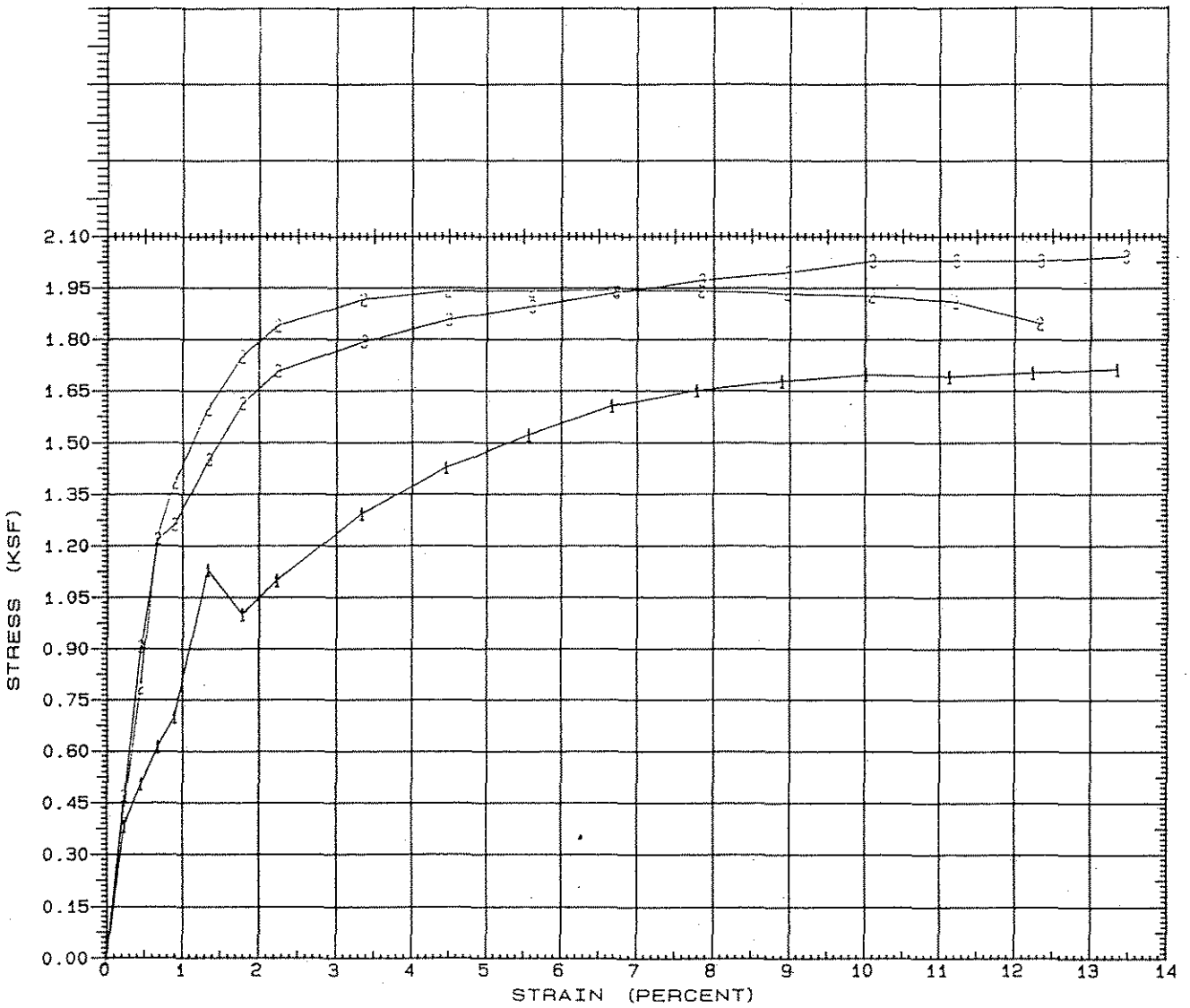
Run 3 CRACKED IN 3 PIECES BEFORE TEST WHEN DRY



COUNTY N\A
LAB NO. AAD7-6
PROJECT DEPT. INFO.
SENDER'S NO. MIX #2-3
LOCATION N\A
LAYER N\A

Test	Run 1	Run 2	Run 3
Depth			
Wet Density	119.0	118.1	121.9
Dry Density	94.7	93.6	96.7
Before Moist. (%)	25.7	26.2	26.1
After Moist. (%)	29.0	28.8	28.2
AASHTO Class	A-	A-	A-
Class Name			
Preconsol. (KSF)	.72	5.04	2.88
Run (KSF)	.72	5.04	2.88

Run 1
Run 2
Run 3



COUNTY N/A
LAB NO. AAD7-6
PROJECT DEPARTMENT INFORMATION
SENDER'S NO. MIX # 2-5
LOCATION Sealed in Cans for Curing
LAYER N/A

Test	Run 1	Run 2	Run 3
Depth	N/A	N/A	N/A
Wet Density	127.3	128.3	126.8
Dry Density	103.7	104.5	103.2
Before Moist. (%)	22.7	22.8	22.9
After Moist. (%)	25.5	25.4	25.6
AASHTO Class	A-	A-	A-
Class Name			
Preconsol. (KSF)	.72	5.04	2.88
Run (KSF)	.72	5.04	2.88

Run 1
Run 2
Run 3

APPENDIX C
FREEZE-THAW TEST RESULTS

BEFORE SOAK

SAMPLE		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1	4.60	4.61	4.61	3.99	4.00	4.00	4.00	4.00	1885.50
0.1%/1.0%	#2	4.60	4.59	4.60	4.00	4.00	3.99	4.01	4.00	1881.60
NOTES:										
CEMENT/FLY ASH+	#1	4.61	4.59	4.60	4.02	4.01	4.01	4.00	4.01	2161.40
SOIL1 5%/15%	#2	4.59	4.61	4.60	4.00	4.01	4.00	4.01	4.01	2159.90
NOTES:										
LIME+SOIL1	#1	4.57	4.59	4.58	4.00	4.01	4.00	4.01	4.01	2087.00
6.5%	#2	4.55	4.56	4.55	4.01	4.01	4.01	4.00	4.01	2076.20
NOTES:										
CONSOLID+SOIL2	#1	4.42	4.45	4.44	3.81	3.80	3.81	3.79	3.80	1578.60
MIX#9 RUN1	#2	4.46	4.43	4.44	3.81	3.78	3.82	3.80	3.80	1574.10
NOTES: SPECIMENS CRACKED DURING OVEN CURING										
CEMENT/FLY ASH+	#1	4.59	4.59	4.59	4.00	3.99	3.99	3.99	3.99	1772.70
SOIL2 5%/15%	#2	4.60	4.60	4.60	4.00	3.99	4.00	3.99	3.99	1750.30
NOTES:										
LIME+SOIL2	#1	4.60	4.60	4.60	4.00	4.00	4.00	4.00	4.00	1768.00
6.5%	#2	4.61	4.61	4.61	4.00	4.00	4.00	4.00	4.00	1764.00
NOTES:										
CONSOLID+SOIL2	#1	4.60	4.61	4.61	3.99	3.99	3.98	3.99	3.99	1836.80
0.1%/1.0% MOD.	#2	4.59	4.59	4.59	3.98	3.98	3.97	3.98	3.97	1831.50
NOTES: SPECIMENS KEPT IN SEALED CANS DURING CURING TO PREVENT CRACKING										

AFTER SOAK

SAMPLE		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1	4.62	4.61	4.62	4.00	4.00	4.00	4.00	4.00	1945.50
0.1%/1.0%	#2	4.61	4.60	4.61	4.00	3.88	3.99	3.88	3.94	1935.40
NOTES:										
CEMENT/FLY ASH+	#1	4.61	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2177.00
SOIL1 5%/15%	#2	4.59	4.62	4.61	4.01	4.00	4.02	4.02	4.01	2175.70
NOTES:										
LIME+SOIL1	#1	4.58	4.59	4.58	4.00	4.01	3.99	4.01	4.00	2094.60
6.5%	#2	4.55	4.56	4.56	4.01	4.00	4.01	4.00	4.00	2082.00
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES: SPECIMENS FELL APART DURING SOAKING AND NO MEASUREMENTS TAKEN										
CEMENT/FLY ASH+	#1	4.60	4.60	4.60	4.00	4.00	4.00	4.00	4.00	1870.50
SOIL2 5%/15%	#2	4.59	4.61	4.60	4.00	4.00	4.00	4.00	4.00	1848.40
NOTES:										
LIME+SOIL2	#1	4.60	4.60	4.60	4.00	3.99	3.99	4.00	3.99	1807.40
6.5%	#2	4.61	4.62	4.62	4.00	4.00	4.00	4.00	4.00	1810.30
NOTES:										
CONSOLID+SOIL2	#1	4.68	4.67	4.67	4.04	4.03	4.03	4.03	4.03	1899.50
0.1%/1.0% MOD.	#2	4.66	4.67	4.67	4.03	4.03	4.03	4.03	4.03	1902.80
NOTES: MUSHY AND FLAKING THE TOP LIFT OF BOTH SPECIMENS CRACKING OFF										

SAMPLE — AFTER FREEZE CYCLE#1

		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1	4.64	4.65	4.65	3.99	3.99	4.00	3.99	3.99	1933.50
0.1%/1.0%	#2	4.61	4.60	4.61	4.00	3.88	3.88	3.99	3.94	1925.90
NOTES:		#1 BROKEN OFF AT TOP PRIOR TO MEASURE								
CEMENT/FLY ASH+	#1	4.59	4.61	4.60	4.00	4.01	4.01	4.01	4.01	2158.00
SOIL1 5%/15%	#2	4.61	4.59	4.60	4.01	4.00	4.01	4.00	4.01	2155.50
NOTES:										
LIME+SOIL1	#1	4.56	4.58	4.57	3.99	4.00	3.99	4.00	4.00	2068.70
6.5%	#2	4.55	4.54	4.55	4.00	3.99	4.00	4.00	4.00	2055.40
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.61	4.61	4.61	3.99	4.00	4.00	4.00	4.00	1841.30
SOIL2 5%/15%	#2	4.60	4.62	4.61	4.00	4.00	4.01	4.00	4.00	1819.00
NOTES:										
LIME+SOIL2	#1	4.61	4.61	4.61	4.01	4.00	4.00	4.00	4.00	1781.80
6.5%	#2	4.64	4.63	4.64	4.01	4.00	4.00		4.00	1784.80
NOTES:										
CONSOLID+SOIL2	#1	4.70	4.72	4.71	4.04	4.04	4.03	4.04	4.04	1856.50
0.1%/1.0% MOD.	#2	4.70	4.67	4.69	4.04	4.04	4.04	4.03	4.04	1878.70
NOTES:										

SAMPLE — AFTER THAW CYCLE #1

		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1	4.66	4.66	4.66	4.00	4.00	4.00	4.00	4.00	1936.00
0.1%/1.0%	#2	4.60	4.61	4.61	4.00	4.00	4.00	4.00	4.00	1929.90
NOTES:		#1, 12.3 GM PIECE FELL OFF AFTER WEIGHING								
SOIL1+CEMENT+	#1	4.60	4.61	4.60	4.01	4.00	4.01	4.01	4.01	2167.50
FLYASH MIX#6	#2	4.61	4.58	4.60	4.01	4.00	4.01	4.00	4.01	2161.70
NOTES:										
SOIL1+6.5%LIME	#1	4.59	4.57	4.58	3.99	4.01	3.99	4.00	4.00	2077.30
MIX#7	#2	4.56	4.55	4.55	4.01	3.99	4.01	4.00	4.00	2065.80
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.61	4.61	4.61	4.00	4.00	4.01	4.00	4.00	1875.80
SOIL2 5%/15%	#2	4.61	4.62	4.61	4.00	4.01	4.00	4.00	4.00	1853.60
NOTES:										
LIME+SOIL2	#1	4.62	4.62	4.62	4.01	4.01	4.01	4.02	4.01	1812.20
6.5%	#2	4.64	4.64	4.64	4.01	4.01	4.01	4.01	4.01	1817.10
NOTES:										
CONSOLID+SOIL2	#1	4.68	4.67	4.67	4.04	4.03	4.03	4.03	4.03	1899.50
0.1%/1.0% MOD.	#2	4.66	4.67	4.67	4.03	4.03	4.03	4.03	4.03	1902.80
NOTES: MUSHY & FLAKING- TOP LIFT CRACKING OFF										

SAMPLE AFTER FREEZE CYCLE#2

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1	4.66	4.66	4.66	4.00	4.00	4.00	3.99	4.00	1923.00
0.1%/1.0%	#2	4.60	4.61	4.61	3.99	4.00	4.00	4.00	4.00	1929.00
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.59	4.00	4.01	4.01	4.01	4.01	2159.70
SOIL1 5%/15%	#2	4.58	4.61	4.59	4.01	4.00	4.01	4.00	4.00	2158.50
NOTES:										
LIME+SOIL1	#1	4.60	4.58	4.59	4.01	4.00	4.00	4.00	4.00	2077.60
6.5%	#2	4.55	4.56	4.55	4.01	4.00	4.02	3.99	4.00	2067.50
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.62	4.62	4.62	4.01	4.00	4.01	4.01	4.01	1870.40
SOIL2 5%/15%	#2	4.62	4.64	4.63	4.01	4.01	4.01	4.01	4.01	1847.60
NOTES:										
LIME+SOIL2	#1	4.64	4.64	4.64	4.03	4.02	4.02	4.02	4.02	1808.30
6.5%	#2	4.68	4.66	4.67	4.02	4.02	4.02	4.01	4.02	1811.40
NOTES:										
CONSOLID+SOIL2	#1	4.73	4.72	4.73	4.06	4.09	4.07	4.04	4.06	1870.40
0.1%/1.0% MOD.	#2			0.00					0.00	1883.90

NOTES: UNABLE TO MEASURE #2 DUE TO CRUMBLING AND FLAKING

SAMPLE AFTER THAW CYCLE#2

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1	4.66	4.65	4.66	4.00	3.99	4.00	4.00	4.00	1930.40
0.1%/1.0%	#2	4.61	4.60	4.61	4.00	4.00	4.00	4.00	4.00	1934.80
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.01	4.00	4.01	4.01	4.01	2160.30
SOIL1 5%/15%	#2	4.58	4.61	4.60	4.00	4.01	4.01	4.01	4.01	2159.40
NOTES:										
LIME+SOIL1	#1			0.00					0.00	2080.20
6.5%	#2	4.55	4.54	4.54	4.00	4.00	4.01	3.99	4.00	2068.00

NOTES:SPECIMEN #1 FELL APART DURING HANDLING AFTER WEIGHING/ BEFORE MEASURE

CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.62	4.62	4.62	4.00	4.01	4.00	4.01	4.00	1883.10
SOIL2 5%/15%	#2	4.63	4.64	4.63	4.01	4.00	4.01	4.01	4.01	1863.50
NOTES:										
LIME+SOIL2	#1	4.66	4.66	4.66	4.04	4.03	4.05	4.04	4.04	1836.30
6.5%	#2	4.69	4.67	4.68	4.04	4.03	4.04	4.03	4.04	1841.40
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES:PHOTO TAKEN 4/9/87 NO FURTHER MEASUREMENTS TAKEN DUE TO FRAGILITY

SAMPLE AFTER FREEZE CYCLE#3

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	1921.00
0.1%/1.0%	#2			0.00					0.00	1935.90
NOTES:#2 FAILED AT WEIGHING #1 INTACT BUT CRUMBLING NO FURTHER MEASURES										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2158.70
SOIL1 5%/15%	#2	4.61	4.58	4.60	4.01	4.00	4.01	4.00	4.01	2156.00
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.56	4.56	4.56	4.01	4.02	4.03	4.01	4.02	2062.80
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.63	4.64	4.64	4.03	4.01	4.03	4.01	4.02	1875.10
SOIL2 5%/15%	#2	4.64	4.66	4.65	4.02	4.02	4.02	4.01	4.02	1858.00
NOTES:										
LIME+SOIL2	#1	4.67	4.67	4.67	4.04	4.04	4.05	4.04	4.04	1829.10
6.5%	#2	4.68	4.71	4.70	4.04	4.04	4.03	4.06	4.04	1835.90
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION FROM PHOTOGRAPHED STATE										

SAMPLE AFTER THAW CYCLE#3

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.00	4.01	4.01	4.01	4.01	2158.60
SOIL1 5%/15%	#2	4.58	4.61	4.60	4.00	4.01	4.00	4.01	4.01	2155.10
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.56	4.55	4.56	3.99	4.00	4.01	3.99	4.00	2063.50
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.63	4.64	4.64	4.02	4.01	4.02	4.02	4.02	1889.20
SOIL2 5%/15%	#2	4.63	4.66	4.64	4.02	4.02	4.02	4.02	4.02	1870.40
NOTES:										
LIME+SOIL2	#1	4.68	4.70	4.69	4.02	4.04			4.03	1846.00
6.5%	#2	4.68	4.70	4.69	4.04	4.05	4.07	4.04	4.05	1849.30
NOTES: SPECIMEN #1 FAILED DURING MEASUREMENT										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION FROM PHOTOGRAPHED STATE										

SAMPLE AFTER FREEZE CYCLE#4

		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2154.40
SOIL1 5%/15%	#2	4.61	4.58	4.59	4.01	4.00	4.01	4.00	4.01	2152.00
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.54	4.56	4.55	3.99	4.01	4.00	3.99	4.00	2054.50
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.66	4.66	4.66	4.02	4.01	4.03	4.01	4.02	1886.50
SOIL2 5%/15%	#2	4.66	4.67	4.67	4.02	4.03	4.03	4.01	4.02	1865.60
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2	4.71	4.71	4.71	4.09	4.08	4.08	4.07	4.08	1844.30
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES: NO FURTHER DETERIORATION STILL SOFT AND MUSHY TO THE TOUCH

SAMPLE AFTER THAW CYCLE #4

		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2160.60
SOIL1 5%/15%	#2	4.59	4.61	4.60	4.00	4.01	4.00	4.01	4.01	2159.70
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.55	4.54	4.54	3.99	3.99	3.98	3.99	3.99	2054.50
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.66	4.67	4.66	4.02	4.03	4.03	4.02	4.03	1894.60
SOIL2 5%/15%	#2	4.65	4.67	4.66	4.03	4.03	4.03	4.02	4.02	1874.10
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2	4.75	4.75	4.75	4.07	4.10	4.06	4.07	4.07	1860.30
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES: CRACKS APPEARING ON THE TOP OF BOTH SPECIMENS

SAMPLE — AFTER FREEZE CYCLE#5

		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.01	4.01	4.00	4.01	4.01	2154.70
SOIL1 5%/15%	#2	4.61	4.58	4.60	4.00	4.01	4.00	4.01	4.01	2154.00
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.55	4.56	4.55	4.00	4.00	4.00	3.99	4.00	2043.00
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.66	4.67	4.67	4.02	4.04	4.03	4.03	4.03	1892.00
SOIL2 5%/15%	#2	4.69	4.68	4.68	4.05	4.04	4.02	4.05	4.04	1869.00
NOTES: #2 DETERIORATING ON THE SIDES; SEVERAL PIECES FLAKING OFF										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2	4.72	4.71	4.71	4.05	4.06	4.04	4.07	4.05	1847.80
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE — AFTER THAW CYCLE #5

		LENGHT, (IN.)			DIAMETER, (IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.61	4.60	4.01	4.00	4.01	4.01	4.01	2162.80
SOIL1 5%/15%	#2	4.58	4.61	4.60	4.01	4.01	4.00	4.01	4.01	2161.10
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.54	4.57	4.55	4.00	3.99	3.99	3.99	3.99	2045.20
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.68	4.66	4.67	4.03	4.04	4.03	4.04	4.03	1896.00
SOIL2 5%/15%	#2	4.68	4.68	4.68	4.04	4.04	4.03	4.03	4.04	1865.10
NOTES: FURTHER FLAKING ON #2										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2	4.74	4.73	4.74	4.07	4.06	4.02	4.05	4.05	1854.20
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE — AFTER FREEZE CYCLE#6

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.01	4.01	4.00	4.01	4.01	2162.30
SOIL1 5%/15%	#2	4.58	4.61	4.59	4.00	4.01	4.00	4.01	4.01	2161.90
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.54	4.56	4.55	3.99	3.98	3.99	3.99	3.99	2047.80
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.68	4.68	4.68	4.04	4.05	4.03	4.04	4.04	1901.40
SOIL2 5%/15%	#2	4.69	4.69	4.69	4.02	4.03	4.03	4.04	4.03	1866.60
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES: 2# FAILED AFTER WEIGHING AND BEFORE MEASUREMENT										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE — AFTER THAW CYCLE #6

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2164.90
SOIL1 5%/15%	#2	4.61	4.58	4.60	4.01	4.00	4.01	4.00	4.01	2165.40
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.53	4.55	4.54	4.07	4.10	4.09	4.08	4.08	2037.50
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.69	4.69	4.69	4.01	4.04	4.03	4.03	4.03	1894.30
SOIL2 5%/15%	#2	4.70	4.72	4.71	4.02	4.03	4.06	4.03	4.04	1854.90
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE AFTER FREEZE CYCLE#7

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2159.20
SOIL1 5%/15%	#2	4.61	4.59	4.60	4.01	4.00	4.01	4.00	4.01	2161.20
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.54	4.53	4.54	4.00	4.08	4.09	4.08	4.06	2031.80
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.68	4.70	4.69	4.04	4.05	4.04	4.03	4.04	1891.80
SOIL2 5%/15%	#2	4.68	4.71	4.70	4.03	4.04	4.03	4.02	4.03	1853.70
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES: NO FURTHER DETERIORATION

SAMPLE AFTER THAW CYCLE #7

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2162.70
SOIL1 5%/15%	#2	4.61	4.58	4.59	4.01	4.00	4.01	4.00	4.01	2163.80
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.54	4.55	4.54	4.08	4.09	4.09	4.08	4.08	1987.00
NOTES: LARGE CHUNK SEPARATED FROM BASE BEFORE WEIGHING AND DISCARDED										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.69	4.69	4.69	4.04	4.05	4.04	4.03	4.04	1886.20
SOIL2 5%/15%	#2	4.68	4.71	4.70	4.02	4.05	4.03	4.02	4.03	1844.40
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES: NO FURTHER DETERIORATION

SAMPLE AFTER FREEZE CYCLE#8

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.59	4.01	4.01	4.00	4.01	4.01	2161.20
SOIL1 5%/15%	#2	4.58	4.61	4.59	4.00	4.01	4.00	4.01	4.01	2163.50
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.53	4.54	4.53	3.99	3.98	3.98	3.99	3.98	1984.20
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.70	4.70	4.70	4.04	4.04	4.03	4.03	4.04	1884.30
SOIL2 5%/15%	#2	4.71	4.73	4.72	4.04	4.06	4.04	4.04	4.05	1848.20
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES: NO FURTHER DETERIORATION

SAMPLE AFTER THAW CYCLE #8

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2159.20
SOIL1 5%/15%	#2	4.58	4.61	4.59	4.01	4.00	4.01	4.00	4.01	2159.10
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.51	4.56	4.53	3.97	3.97	3.99	3.97	3.98	1938.40

NOTES: MUCH CRUMBLING ON TOP AND BOTTOM OF SPECIMEN F; SOME LOSS OF MATERIAL

CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.70	4.69	4.70	4.03	4.05	4.03	4.01	4.03	1875.80
SOIL2 5%/15%	#2	4.72	4.72	4.72	4.04	4.01	4.02	4.03	4.03	1833.90
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	

NOTES: NO FURTHER DETERIORATION

SAMPLE — AFTER FREEZE CYCLE#9

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.00	4.01	4.01	4.01	4.01	2152.60
SOIL1 5%/15%	#2	4.61	4.58	4.59	4.00	4.01	4.00	4.01	4.01	2153.50
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2	4.49	4.52	4.51	3.98	3.99	4.00	3.98	3.99	1927.10
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.69	4.71	4.70	4.00	4.00	4.02	4.01	4.01	1865.60
SOIL2 5%/15%	#2	4.62	4.71	4.67	3.95	4.02	3.99	4.06	4.01	1820.20
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE — AFTER THAW CYCLE #9

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.01	4.01	4.01	4.00	4.01	2158.80
SOIL1 5%/15%	#2	4.61	4.58	4.59	4.00	4.01	4.00	4.01	4.01	2157.50
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00	3.98	3.97	3.98	3.97	3.97	1904.60
NOTES: TOP DISINTEGRATING; LOOSING MATERIAL FROM BOTH TOP AND BOTTOM										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.69	4.71	4.70					0.00	1857.00
SOIL2 5%/15%	#2	4.68	4.72	4.70					0.00	1794.50
NOTES: SIDES FLAKING BADLY; UNABLE TO MEASURE DIAMETER										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE AFTER FREEZE CYCLE#10

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.01	4.00	4.01	4.01	4.01	2161.30
SOIL1 5%/15%	#2	4.61	4.58	4.60	4.00	4.01	4.00	4.01	4.00	2160.60
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00	4.00	4.00	3.99	3.99	4.00	1904.30
NOTES: VERY SOFT										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.73	4.75	4.74					0.00	1860.60
SOIL2 5%/15%	#2	4.71	4.71	4.71					0.00	1792.50
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE AFTER THAW CYCLE #10

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.01	4.01	4.00	4.01	4.01	2167.20
SOIL1 5%/15%	#2	4.61	4.58	4.59	4.01	4.00	4.01	4.00	4.01	2166.00
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00	3.98	3.96	3.97	3.95	3.96	1909.20
NOTES:										
CONSOLID+SOIL2	#1	4.73	4.70	4.71					0.00	1856.30
MIX#9 RUN1	#2	4.67	4.73	4.70					0.00	1797.40
NOTES:										
CEMENT/FLY ASH+	#1			0.00					0.00	
SOIL2 5%/15%	#2			0.00					0.00	
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES: NO FURTHER DETERIORATION										

SAMPLE — AFTER FREEZE CYCLE#11

		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.60	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2160.80
SOIL1 5%/15%	#2	4.61	4.58	4.60	4.01	4.00	4.01	4.00	4.01	2160.00
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00	3.96	3.99	3.98	4.00	3.98	1901.00
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.73	4.70	4.71					0.00	1848.60
SOIL2 5%/15%	#2	4.73	4.70	4.71					0.00	1790.50
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES:										

SAMPLE — AFTER THAW CYCLE #11

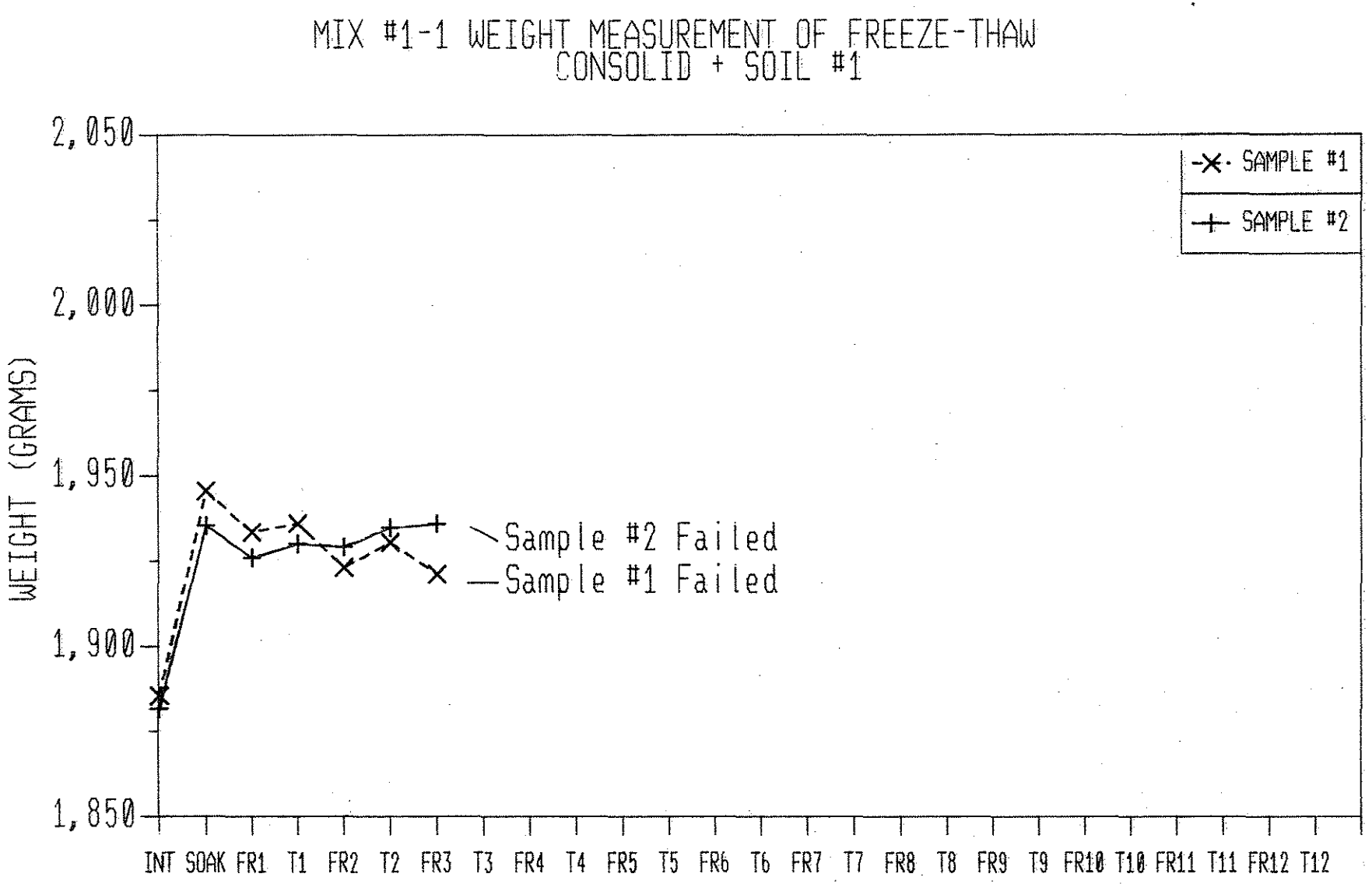
		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.61	4.59	4.60	4.00	4.01	4.01	4.01	4.01	2164.00
SOIL1 5%/15%	#2	4.58	4.61	4.59	4.00	4.01	4.00	4.01	4.01	2162.80
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES: BOTTOM FELL OFF OF SPECIMEN #2; ENTIRE SAMPLE CRUMBLED WHEN HANDLED										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.72	4.69	4.71					0.00	1836.30
SOIL2 5%/15%	#2	4.68	4.70	4.69					0.00	1772.00
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES:										

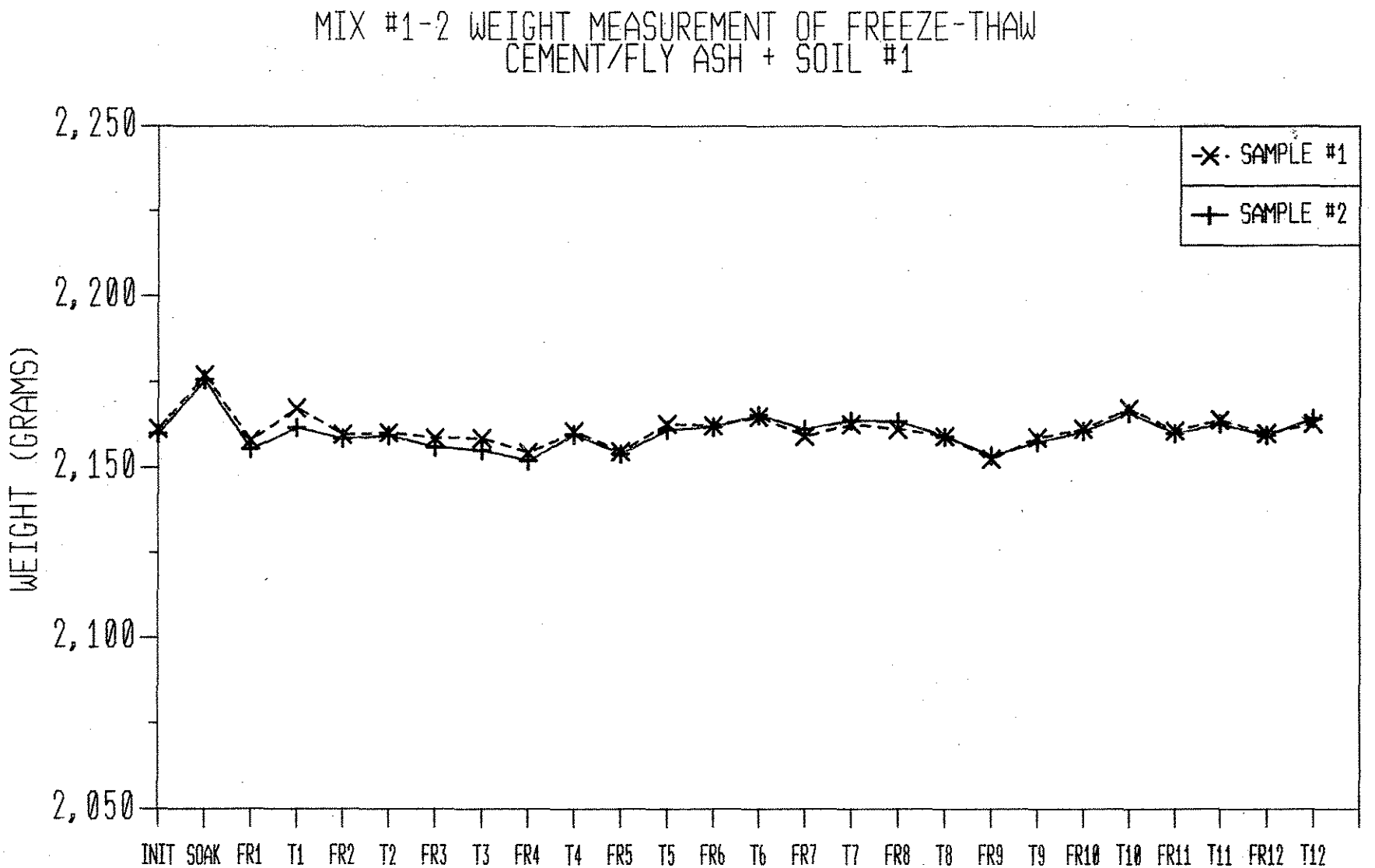
SAMPLE AFTER FREEZE CYCLE#12

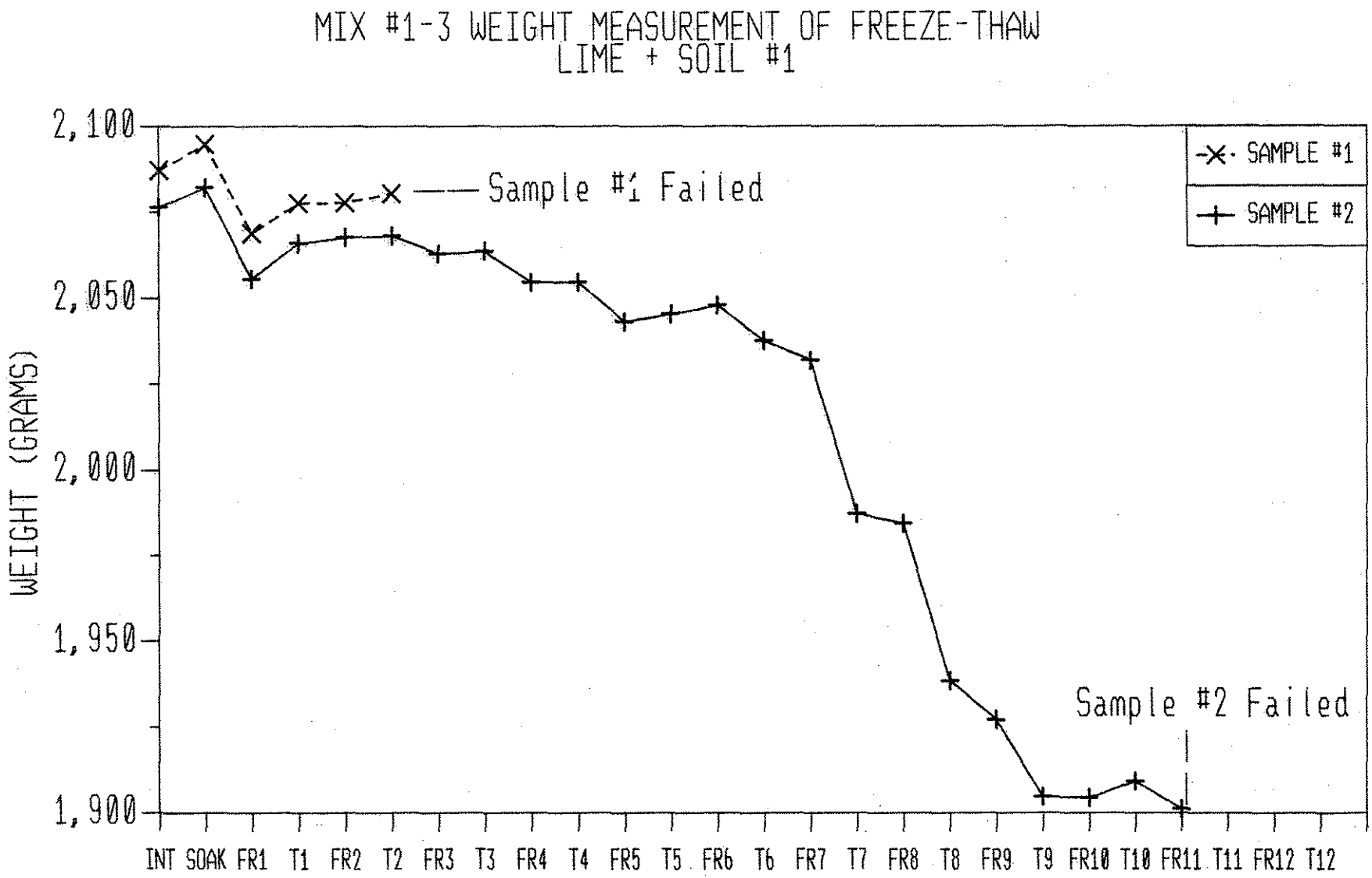
		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
SOIL1 5%/15%	#2	4.61	4.58	4.60	4.00	4.01	4.00	4.01	4.01	2159.50
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.72	4.70	4.71					0.00	1830.10
SOIL2 5%/15%	#2	4.66	4.69	4.68					0.00	1764.50
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES:										

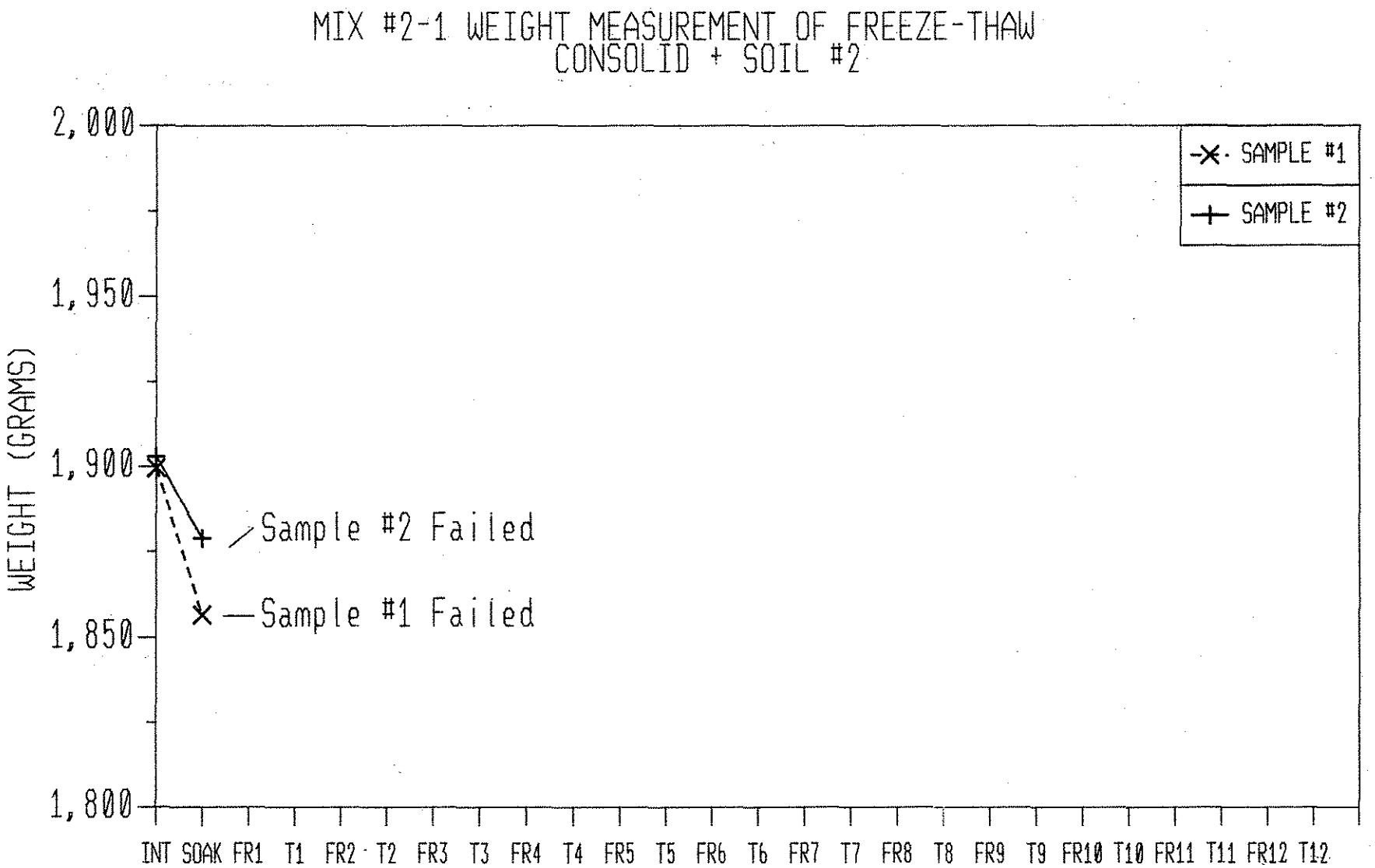
SAMPLE AFTER THAW CYCLE #12

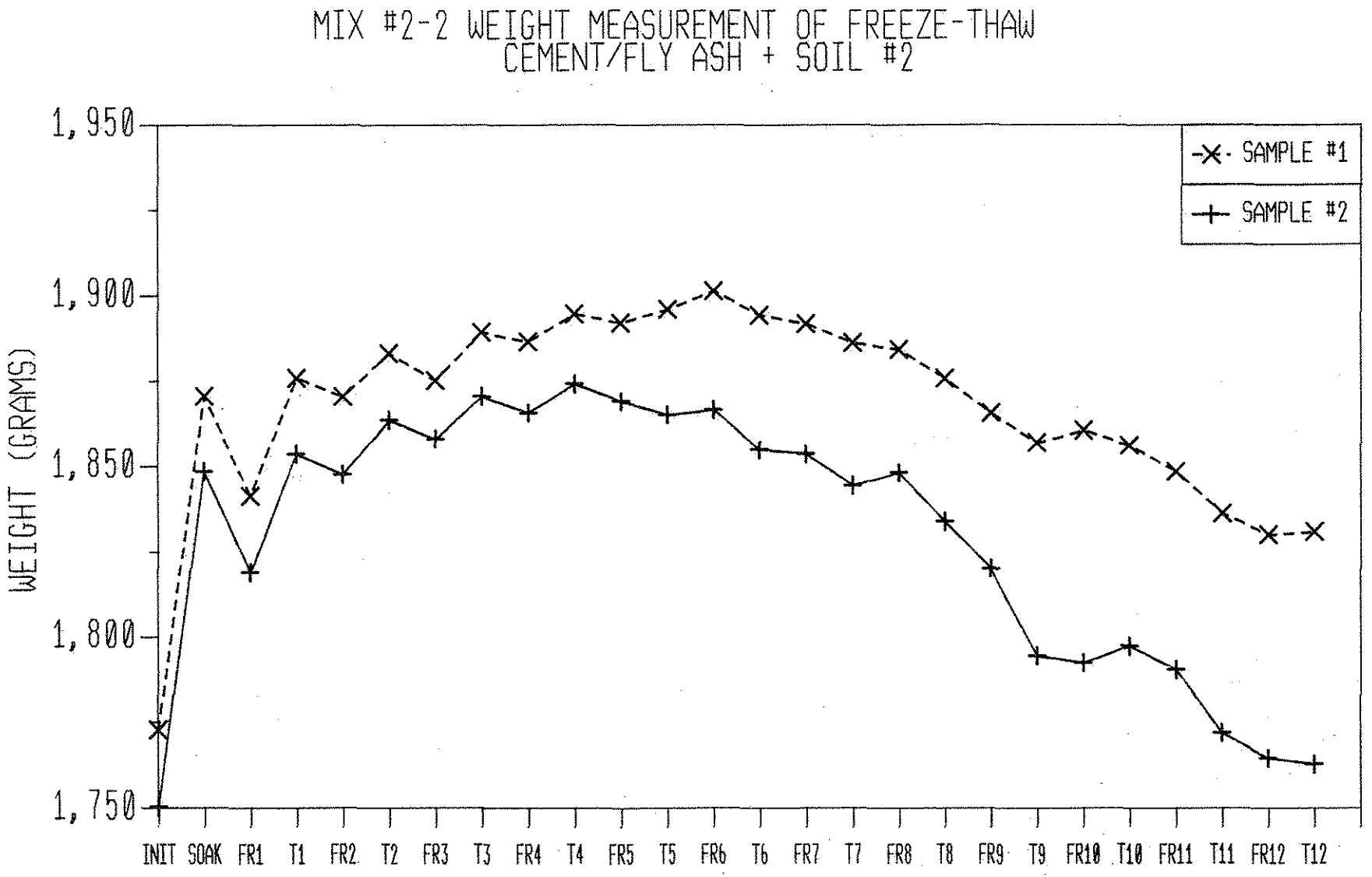
		LENGHT,(IN.)			DIAMETER,(IN.)					
		L1	L2	AVG.	D1	D2	D3	D4	AVG.	WEIGHT
CONSOLID+SOIL1	#1			0.00					0.00	
0.1%/1.0%	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.59	4.60	4.60	4.01	4.01	4.00	4.01	4.01	2163.00
SOIL1 5%/15%	#2	4.58	4.61	4.59	4.00	4.01	4.00	4.01	4.01	2164.40
NOTES:										
LIME+SOIL1	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
MIX#9 RUN1	#2			0.00					0.00	
NOTES:										
CEMENT/FLY ASH+	#1	4.67	4.72	4.70					0.00	1831.00
SOIL2 5%/15%	#2	4.66	4.67	4.67					0.00	1762.80
NOTES:										
LIME+SOIL2	#1			0.00					0.00	
6.5%	#2			0.00					0.00	
NOTES:										
CONSOLID+SOIL2	#1			0.00					0.00	
0.1%/1.0% MOD.	#2			0.00					0.00	
NOTES:										

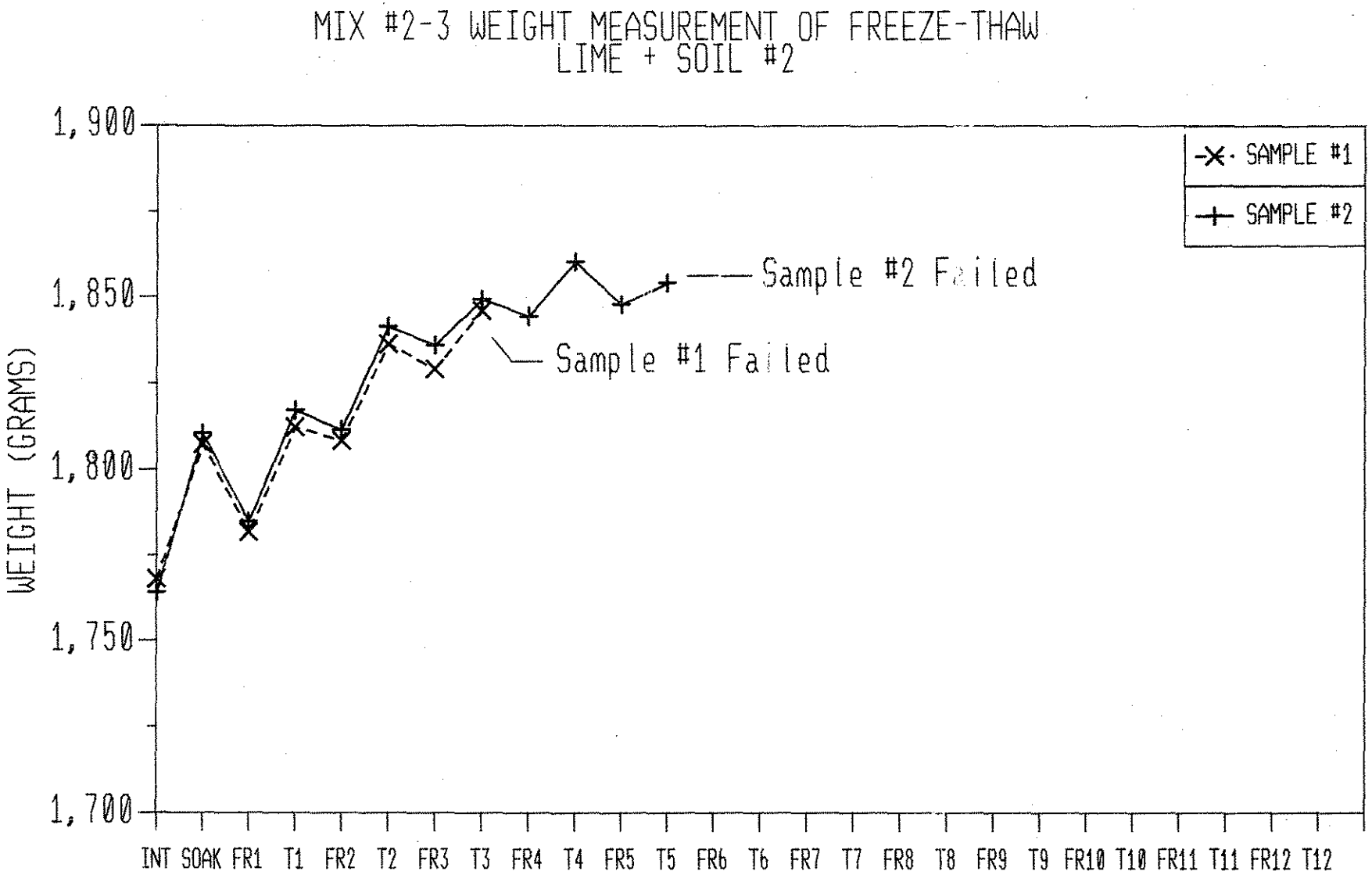

MIX #1-1 WEIGHT MEASUREMENT OF FREEZE-THAW
CONSOLID + SOIL #1
WEIGHT (GRAMS)
2,050
2,000
1,950
1,900
1,850
SAMPLE #1
SAMPLE #2
Sample #2 Failed
Sample #1 Failed
INT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12

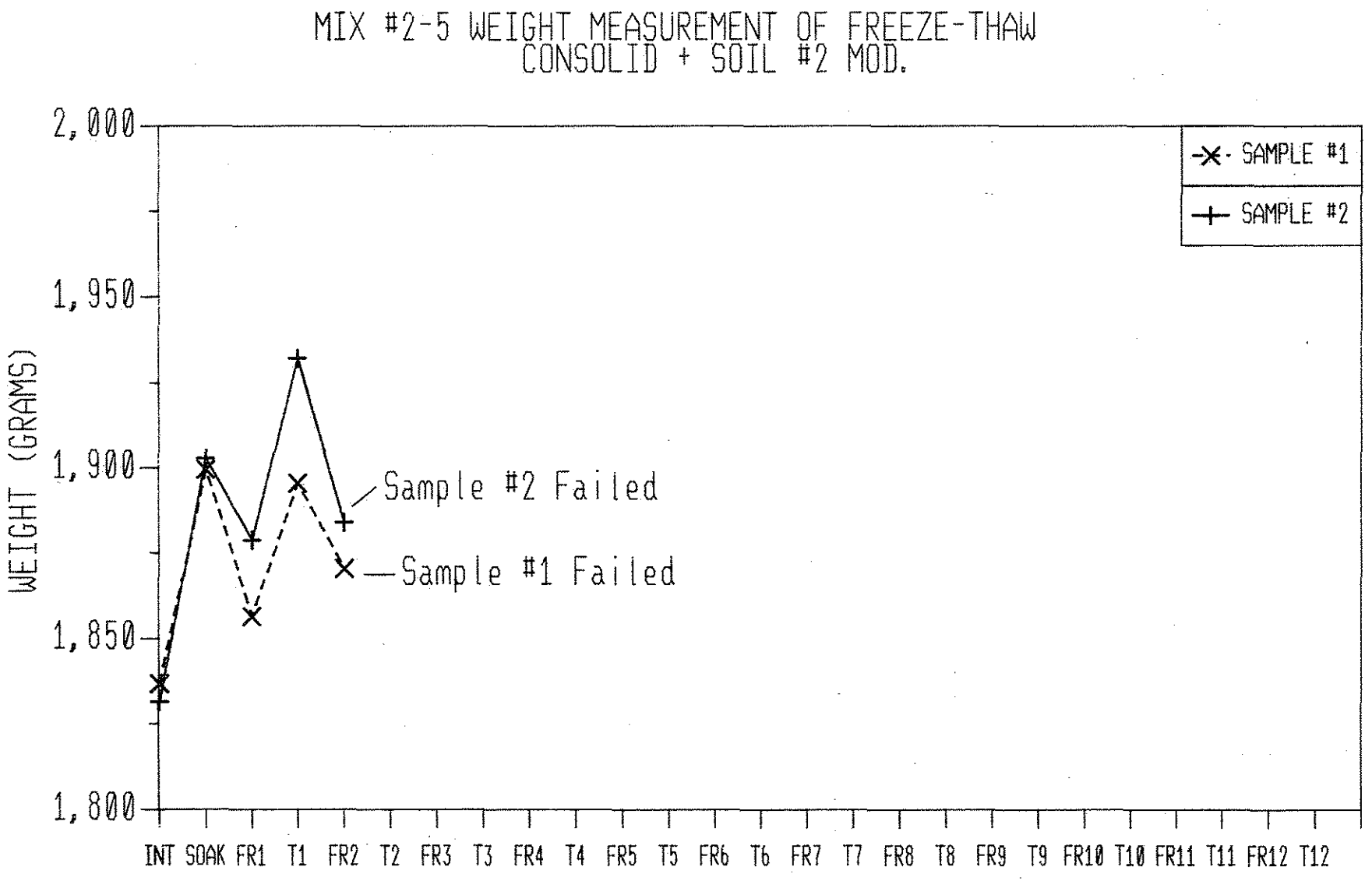

MIX #1-2 WEIGHT MEASUREMENT OF FREEZE-THAW
CEMENT/FLY ASH + SOIL #1
WEIGHT (GRAMS)
2,250
2,200
2,150
2,100
2,050
SAMPLE #1
SAMPLE #2
INIT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12


MIX #1-3 WEIGHT MEASUREMENT OF FREEZE-THAW
LIME + SOIL #1
WEIGHT (GRAMS)
2,100
2,050
2,000
1,950
1,900
SAMPLE #1
SAMPLE #2
Sample #1 Failed
Sample #2 Failed
INT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12


MIX #2-1 WEIGHT MEASUREMENT OF FREEZE-THAW
CONSOLID + SOIL #2
WEIGHT (GRAMS)
2,000
1,950
1,900
1,850
1,800
SAMPLE #1
SAMPLE #2
Sample #2 Failed
Sample #1 Failed
INT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12


MIX #2-2 WEIGHT MEASUREMENT OF FREEZE-THAW
CEMENT/FLY ASH + SOIL #2
WEIGHT (GRAMS)
1,950
1,900
1,850
1,800
1,750
SAMPLE #1
SAMPLE #2
INIT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12


MIX #2-3 WEIGHT MEASUREMENT OF FREEZE-THAW
LIME + SOIL #2
WEIGHT (GRAMS)
1,900
1,850
1,800
1,750
1,700
SAMPLE #1
SAMPLE #2
Sample #2 Failed
Sample #1 Failed
INT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12


MIX #2-5 WEIGHT MEASUREMENT OF FREEZE-THAW
CONSOLID + SOIL #2 MOD.
WEIGHT (GRAMS)
2,000
1,950
1,900
1,850
1,800
SAMPLE #1
SAMPLE #2
Sample #2 Failed
Sample #1 Failed
INT SOAK FR1 T1 FR2 T2 FR3 T3 FR4 T4 FR5 T5 FR6 T6 FR7 T7 FR8 T8 FR9 T9 FR10 T10 FR11 T11 FR12 T12