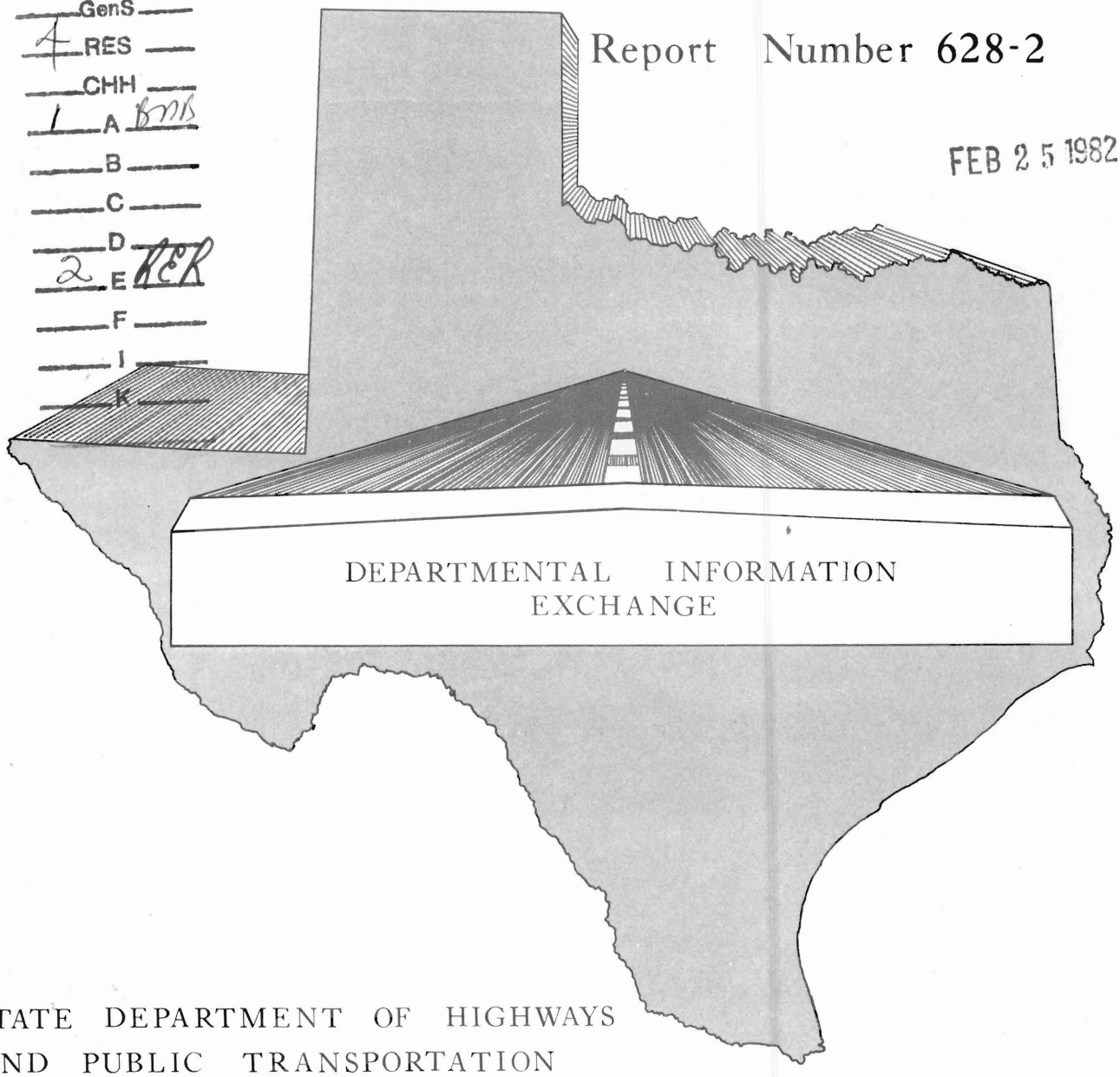
Bill Elmore
D-9

EXPERIMENTAL PROJECTS

CEMENT FLY-ASH STABILIZATION

FM-3188 EXTENSION-TRINITY COUNTY, TEXAS

Report Number 628-2



STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

R

CEMENT/FLY-ASH STABILIZATION
FM 3188 EXTENSION, TRINITY COUNTY
TEXAS

Experimental Project Report Number 628-2

by

Kenneth W. Fults
Senior Laboratory Engineer

Texas State Department of Highways
and Public Transportation

District 11

Lufkin, Texas

November, 1981

TECHNICAL REPORT STANDARD TITLE PAGE

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Cement/Fly-Ash Stabilization FM-3188 Extension, Trinity County, Texas	November, 1981
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9. Performing Organization Name and Address Texas State Department of Highways and Public Transportation P. O. Box 5051 Austin, Texas 78763	10. Work Unit No.
	11. Contract or Grant No.
	13. Type of Report and Period Covered Final September, 1979 to September, 1981
12. Sponsoring Agency Name and Address Texas State Department of Highways and Public Transportation P. O. Box 5051 Austin, Texas 78763	14. Sponsoring Agency Code

15. Supplementary Notes

Work done in cooperation with the Federal Highway Administration

16. Abstract

One of the first attempts in Texas to use fly-ash/cement as a stabilizing agent for in-place field sand to be used as a base course in a pavement structure was performed in 1979 in Trinity County, District 11. The roadway selected was FM 3188, a low volume facility near Lake Livingston. A mixture of 5 1/2 percent cement (weight) and 4 percent fly ash (weight) was selected as the binder. The material was mixed and placed during a two week period. Fly-ash was mixed with the sand from one to five days before the cement. After two years the facility is performing satisfactorily with little or no cracking or other failure mode evident.

17. Key Words	18. Distribution Statement
Fly Ash-Cement Stabilization Sand Stabilized Base Fly Ash-Cement-Sand Base	No Restrictions

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
unclassified	unclassified	27	

Form DOT F 1700.7 (8-69)

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DISCLAIMER STATEMENT

The material in this report is experimental in nature, and is published for informational purposes only. Any discrepancies with official views or policies of the DHT should be discussed with the appropriate Austin Division prior to the implemenation of the procedures or results.

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policies of the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

EXPERIMENTAL PROJECT
CEMENT/FLY-ASH STABILIZATION
FM 3188 EXTENSION, TRINITY COUNTY
TEXAS

Project Location

FM 3188 is located in Trinity County, Texas about 6 miles east of the City of Trinity. The project begins at the end of existing FM 3188, approximately 3.0 miles southeast of SH 94 and extends southeast 2.0 miles to a road intersection. See Figure 1. This project was constructed in the late summer and fall of 1979.

Project Geology

The soil profile revealed that the project was located over cohesiveless silty sand with typical soil constants as follows: LL=20, PI=2. Since acceptable base materials are scarce within the project area, the Resident Engineer requested the District Laboratory in Lufkin to evaluate the existing material for cement stabilization.

Lab Analysis - Routine

Soil Samples were taken at three various locations from the roadway and hydrometers, soil constants and strength evaluations were performed with the follow- results:

Station	LL	PI	% Cl	% Silt	% Fn Sd	% Cr Sn	4% Cem	6% Cem	8% Cem
165+00	18	2	4	25	70	1	184	308	509
185+00	22	2	5	30	65	0	91	164	251
215+00	19	1	6	24	63	7	175	264	411

Where:

LL = Liquid Limit (Tex-104-E)
PI = Plasiticity Index (Tex-106-E)
%Cl = Percent Clay (Tex-110-E)
% Silt = Percent Silt (Tex-110-E)
% Fn Sd = Percent Fine Sand (Tex-110-E)
% Cr Sn = Percent Coarse Sand (Tex-110-E)

Values under 4% Cem, 6% Cem and 8% Cem are compressive strength values in psi of specimens tested in zero laterial confinement and a 7 day break (Tex-120-E).

Based on these results, the Resident Engineer elected to Cement Stabilize in place using 7% cement by weight.

Lab Testing - Experimental

The District Laboratory decided to continue analysing the soil using a cement/fly-ash combination because the use of high cement contents have in the past given severe cracking and maintenance problems. Also using the PCA evaluation procedure it appeared that from between 8% to 11% cement would be needed to pass durability testing. The results of the cement/fly-ash test evaluations were as follows:

Strength PSI @ 0 Lateral Pressure (Tex-120-E)
(Cement % by weight/Fly-Ash % by weight)

Station	4/6	6/4	6/6	6/8	6/10	6/12
165+00	295	472		629		869
185+00			426			
215+00		539	547			

These specimens were observed for shrinkage/swell characteristics and there was zero swell and no shrinkage or shrinkage cracks observed. The fly-ash being used in this experimentation was obtained from Lufkin Redi-Mix where it was being used to extend the cement in concrete. This material was produced at the Fairfield Big Brown Plant and was being marketed by Trinity Division of Portland Cement as processed fly-ash trademarked TPA. A spokesman for the marketing agent explained that the major difference in the processed and non-processed fly-ash was gradation and cost. The processed material has all the waste and oversize (+200) material removed and was priced at $20/ton. The non-processed was priced at $5/ton. The spokesman said there would be no problem in roadway shipments for the project as it would be handled the same as cement.

Other experimental laboratory testing may be found in Appendix A. These tests include a comparison of compressive strength of raw fly-ash-cement mixtures and processed fly-ash-cement mixtures along with studies of lime-fly-ash mixtures.

Contract Field-Change

Based on the above results, it was decided that with the concurrence of the Resident Engineer and the Contractor, Pit Construction Company of Lufkin, Texas that a field change request with a supplemental agreement allowing the use of the cement/fly-ash blend would be desirable. In order to keep the total contract price approximately the same, a combination of 5 1/2% cement and 4% fly-ash was recommended. See attached field change request in Appendix B.

Preconstruction Data

The fly-ash proposed for use was the TPA or processed fly-ash with fineness determination of 94.2% passing the #200 mesh and 84.9% passing the #325 mesh. The calcium content was 13.0% by weight with 18.2% calcium oxide. Since it

was planned to spread the fly-ash in advance of the cement during construction operations a decision was made to evaluate possible construction mixing problems that might be encountered. Some 4% fly-ash and soil were mixed at just below optimum moisture one day, then the next day 6% cement was added and molded at optimum moisture. Second, 4% fly-ash and soil were mixed at just below optimum moisture, allowed to stand four days before adding 6% cement and molding at optimum moisture. Finally, 4% fly-ash and 6% cement were mixed at optimum moisture and molded the same day. After 7 days of curing the specimens were tested and there was essentially no loss or gain of strength due to the delayed mixing operations. The maximum variance from the average (237 psi) was 10 psi. The test results are shown in Appendix C.

During this phase of operation we drafted a schedule of testing requirements for the experimental project as follows:

I Raw Materials
- A. Soil (Example: Appendix D-1)
  1. Soil Constants
  2. Gradation
- B. Cement - Sample each truck (Example: Appendix D-2)
- C. Fly-Ash (Example: Appendix D-3)
  1. Percent passing #200 and #325
  2. Pozzolanic Activity Index (PAI)

II Mixture
- A. Moisture Content
- B. Field density with 11 specimens molded for strength (3 specimens to be broken at 7 days; others to remain in curing and broken at 6 mo. intervals)
- C. Determination of Optimum Moisture and Density
- D. Determination of Roadway Density

III Pavement
- A. Dynaflect measurements immediately after construction
- B. Dynaflect measurements each 6 mo. for a period of two years
- C. Pavement coring and strength evaluation 6 months after construction and each 6 months thereafter for a period of two years. (To be monitored by breakage of two specimens from curing room during each coring sequence.)
- D. Visual observation for cracking each 6 months

Project Cross-Section and Traffic

The pavement design required the roadway width to be 24-feet and the base depth to be 6". A one coarse surface treatment was used to seal the base.

(See Figure 2). The average daily traffic was expected to be about 250 vehicles per day.

Construction Operations

As soon as the contractor established his grade line throughout the project the District Laboratory obtained soil samples at approximately 500 foot intervals for soil constant and hydrometer analysis (See Figure 3).

Prior to the addition of the fly-ash the base was scarified and loosened and bladed back in. When the fly-ash was delivered to the project the road bed was further prepared by undercutting and windrowing to each side as well as scarifing the bed. During spreading of the fly-ash there was excessive dusting even on still, humid days. The dusing occurred immediately behind the transport and once it settled it did not "puff" up readily. The transports discharged the fly-ash at 15 pounds tank pressure and 15 pounds line pressure. It was felt that the line pressure caused most of the dusting but the drivers were reluctant to cut line pressure for fear of clogging. It was noted that many of the particles tended to chain together during descent with chains up to 24 inches long observed along ditch lines. This chaining could have been formed from particle charge or the high humidity.

Once the fly-ash was spread it was bedded into the base by blading and then scratched up and rebedded. It was not pulvermixed. During the late evening after the first two fly-ash transports had been spread and bedded, a heavy rain hit the job and super saturated the admixture. Traffic had great difficulty in traveling over the treated area and spun through the base to the tight subgrade before gaining traction. Some of the contractor's employees on the job noted that the admixture was excessively slick when wet.

As anticipated it was 4 days before cement was added to the first fly-ash section. In fact the addition of cement to the fly-ash soil mixture varied from 1 day to 5 days throughout the length of the project. (See Figure 4).

The addition of the cement and other construction techniques were the same as for any soil cement job. However, since some difficulties had been anticipated, a microwave oven and Toledo Scales had been placed on the project for rapid moisture tests and field density determination. It is worthy to note that once optimum moisture was obtained, optimum density was achieved with minimal rolling. In fact the contractor obtained 95% of laboratory density with as few as 3 passes of a 50 ton pneumatic tired roller, which by the way was the only roller used on the project. It was theorized that the ball-bearing shape of the fly-ash allowed the mixture to assume its most dense particle alignment with the least compactive effort.

Immediately after construction of the last 1000 foot section of roadway, the project was hit by an approximate 9" rain storm. Since none of the previously constructed sections had been primed, the entire job was supersaturated and some rutting by traffic was evident. After the project dried for a few days, it was patched out with hot sand, primed and sealed.

Post Construction Evaluation

Visually, the pavement appears to be performing satisfactorily after 2 years of use. Cracks are not visible on the surface of the pavement. No rutting, deformation or other failure type is evident. It is possible that the lack of cracking is a typical of cement stabilized material and merits further study.

Figures 5 and 6 show the results of compressive strength tests performed at five time intervals throughout a two year period. Even though some variance may be noted, strength gains with increased time is evident.

Figure 7 indicates the results of the deflection tests obtained with a Dynaflect. Note the results are given in terms of stiffness coefficients. The left side of Figure 7 has been devoted to "typical" comparison values obtained statewide on various material types. The right side of the figure shows the periodic tests performed on the project. One test was performed on a "six-inch" soil asphalt with six-inch lime treated subgrade section that was constructed on the same highway about seven years prior to the subject "six-inch cement-fly-ash" section. The subgrade stiffnesses remained relatively constant in the "fair" subgrade range throughout the two year period. The cement-fly-ash material appears to be in a stiffness range between a good crushed rock base and the treated base materials. Considering the variance in results, the cement-fly-ash could be gaining in stiffness with increasing age.

At this time, the results of observations and tests indicate the cement-fly-ash as used on the subject project is performing adequately and will be relatively maintenance free for several years. Similar construction could be used on other low volume highways. The cement-fly-ash binder could be used with a higher class base material on higher volume roads.

Further, work with experimental sections is recommended.

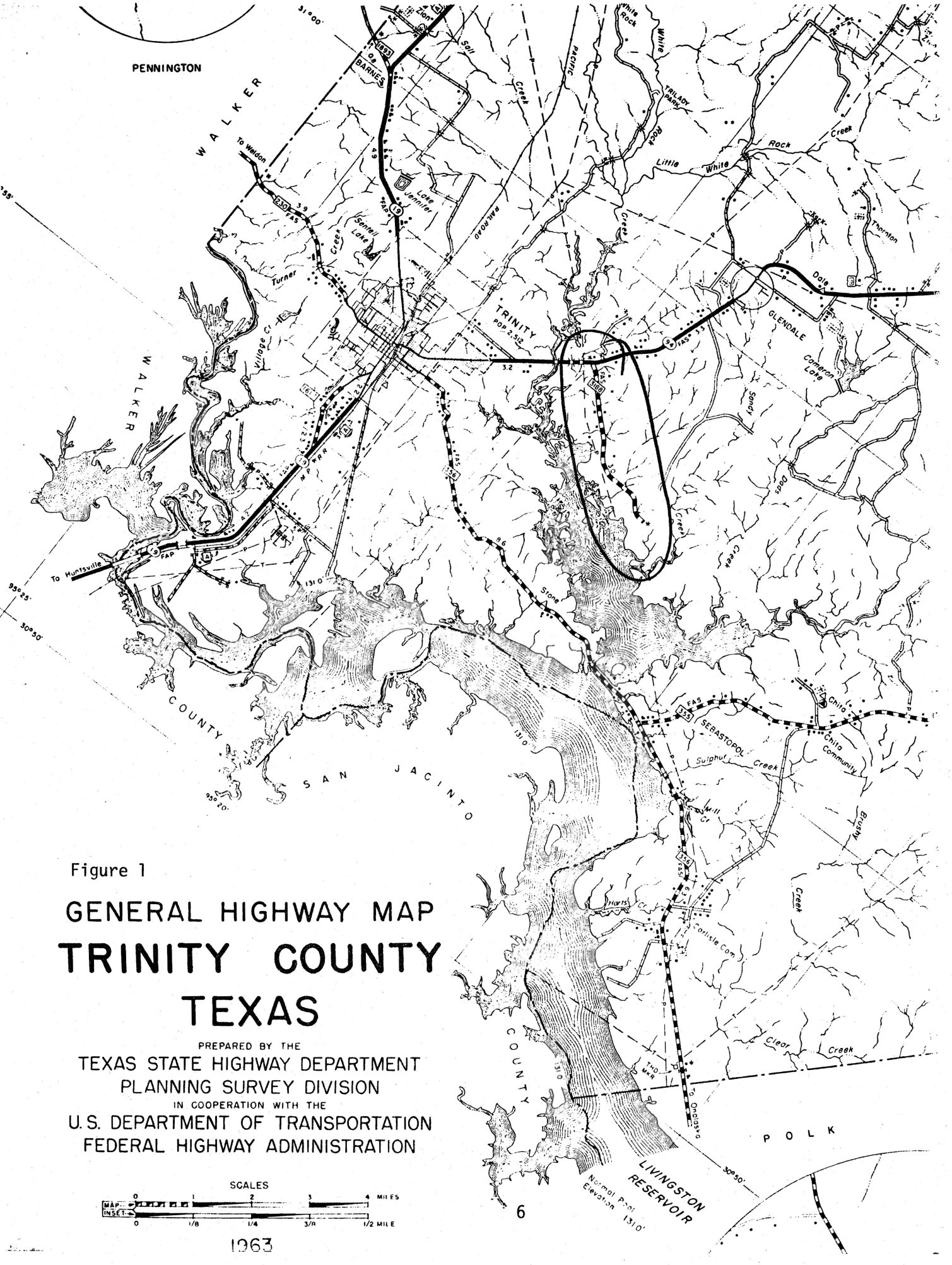


Figure 1

GENERAL HIGHWAY MAP
TRINITY COUNTY
TEXAS

PREPARED BY THE
TEXAS STATE HIGHWAY DEPARTMENT
PLANNING SURVEY DIVISION
IN COOPERATION WITH THE
U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

MAP 0 1 2 3 4 MILES

INSET 0 1/8 1/4 3/8 1/2 MILE

1963

STATE DEPARTMENT OF
HIGHWAYS AND PUBLIC TRANSPORTATION

GENERAL TEST REPORT

Contract/Reqn. No. _____ Control 3269-1-3 No. PD 2047
Engineer _____ Project _____ Hwy. FM 31
Contractor Pit Construction Company District 11 County Trinity

****

Laboratory No. 79-1240-1254
Date Sampled 9-4-79 Date Received 9-4-79 Date Reported 10-1-79
Material Soil Profile Code _____
Producer _____ Code _____
Identification Marks _____ Spec. Item _____
Sampled From _____ Quantity _____ Units _____

****

DETERMINATIONS

Lab No.	Station No.	Location	Field Moist	L.L.	P.I.
79-1240	161+00	C.L.	10.5	21	2
1241	166+00	5' Rt. C.L.	10.9	21	3
1242	170+00	5' Lt. C.L.	8.1	19	2
1243	174+00	C.L.	11.2	19	2
1244	180+00	3' Rt. C.L.	10.3	19	2
1245	185+00	3' Lt. C.L.	12.1	22	2
1246	190+00	C.L.	9.6	20	2
1247	196+00	4' Rt. C.L.	10.4	18	2
1248	200+00	4' Lt. C.L.	9.0	19	2
1249	206+00	C.L.	9.4	19	2
1250	211+00	6' Lt. C.L.	10.1	19	2
1251	220+00	9' Lt. C.L.	11.2	20	4
1252	225+00	9' Rt. C.L.	9.1	18	2
1253	234+00	C.L.	12.2	23	7
1254	245+00	5' Rt. C.L.	9.1	20	6

Figure 3 - Soil Profile

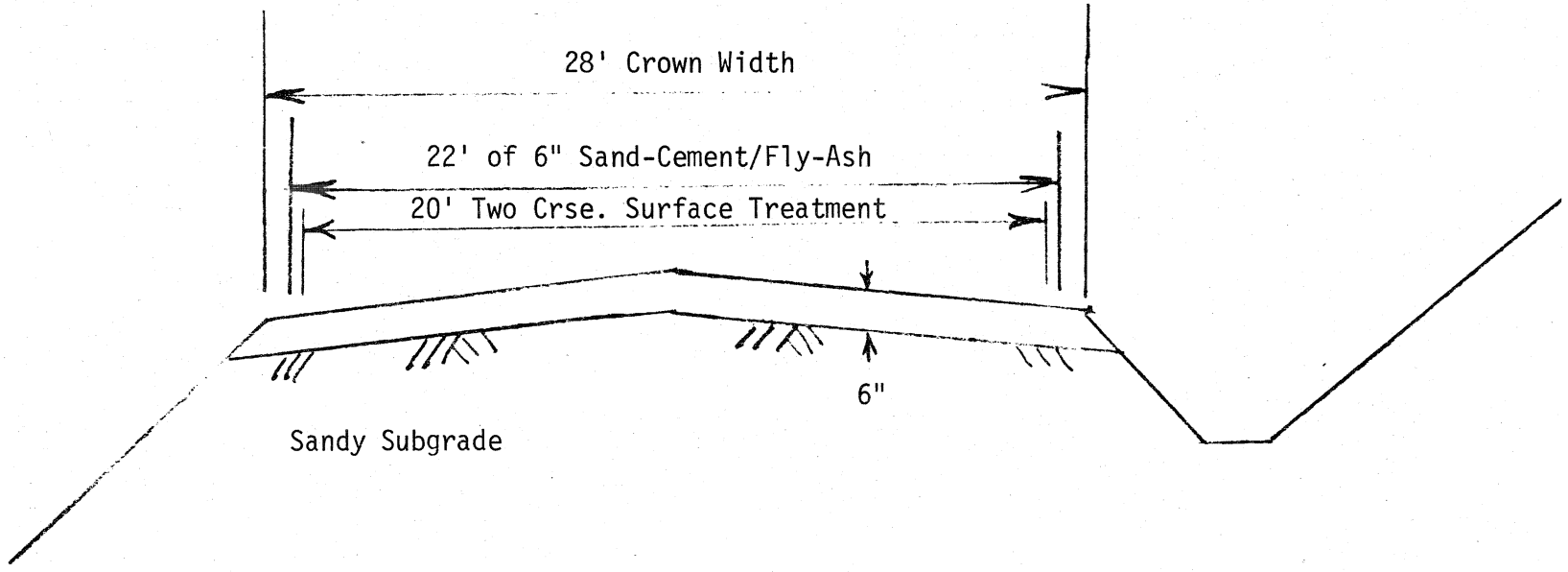
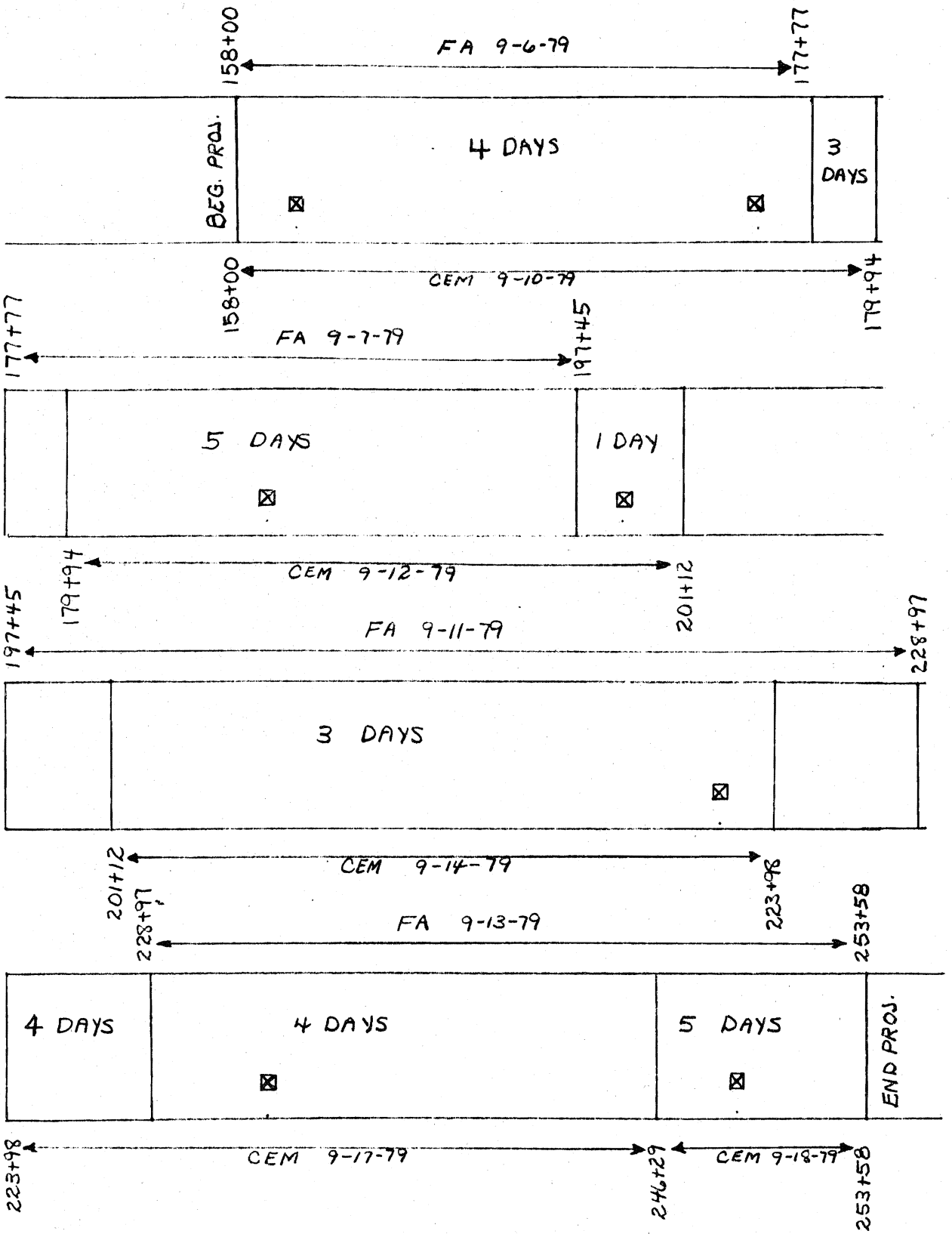


Figure 2 - Typical Cross-Section

Figure 4 Fly-Ash/Cement Placement



Experimental Cement / Fly-Ash
FM 3188 - Trinity County

⊠ Rdwy Sample

Form 231 - Rev. 6-79

STATE DEPARTMENT OF
HIGHWAYS AND PUBLIC TRANSPORTATION

GENERAL TEST REPORT

Contract/Reqn. No. _____ Control 3269-1-3 No. _____
Engineer _____ Project _____ Hwy. FM 3188
Contractor _____ District 11 County Trinity

****

Laboratory No. _____
Date Sampled _____ Date Received 9-79 Date Reported 9-80
Material Cement/Fly-Ash Code _____
Producer _____ Code _____
Identification Marks _____ Spec. Item _____
Sampled From _____ Quantity _____ Units _____

****

DETERMINATIONS

Cement/fly-ash specimens were molded in September or 1979 from roadway material mixed and processed on FM 3188 in Trinity County, After molding the specimens were placed in the damp curing room of the District 11 Laboratory. The following results are a record of the compressive strengths obtained to date.

Date	Station	Molded Density	Molding Moisture	Compressive Strength
9-79	160+00	108	12	40 psi
3-80				80 psi
9-80				20 psi
3-81				29 psi
9-81				25 psi
9-79	176+00	109	13	36 psi
3-80				50 psi
9-80				78 psi
3-81				63 psi
9-81				103 psi
9-79	185+00	107	12	108 psi
3-80				216 psi
9-80				300 psi
3-81				191 psi
9-81				346 psi
9-79	199+00	107	12	105 psi

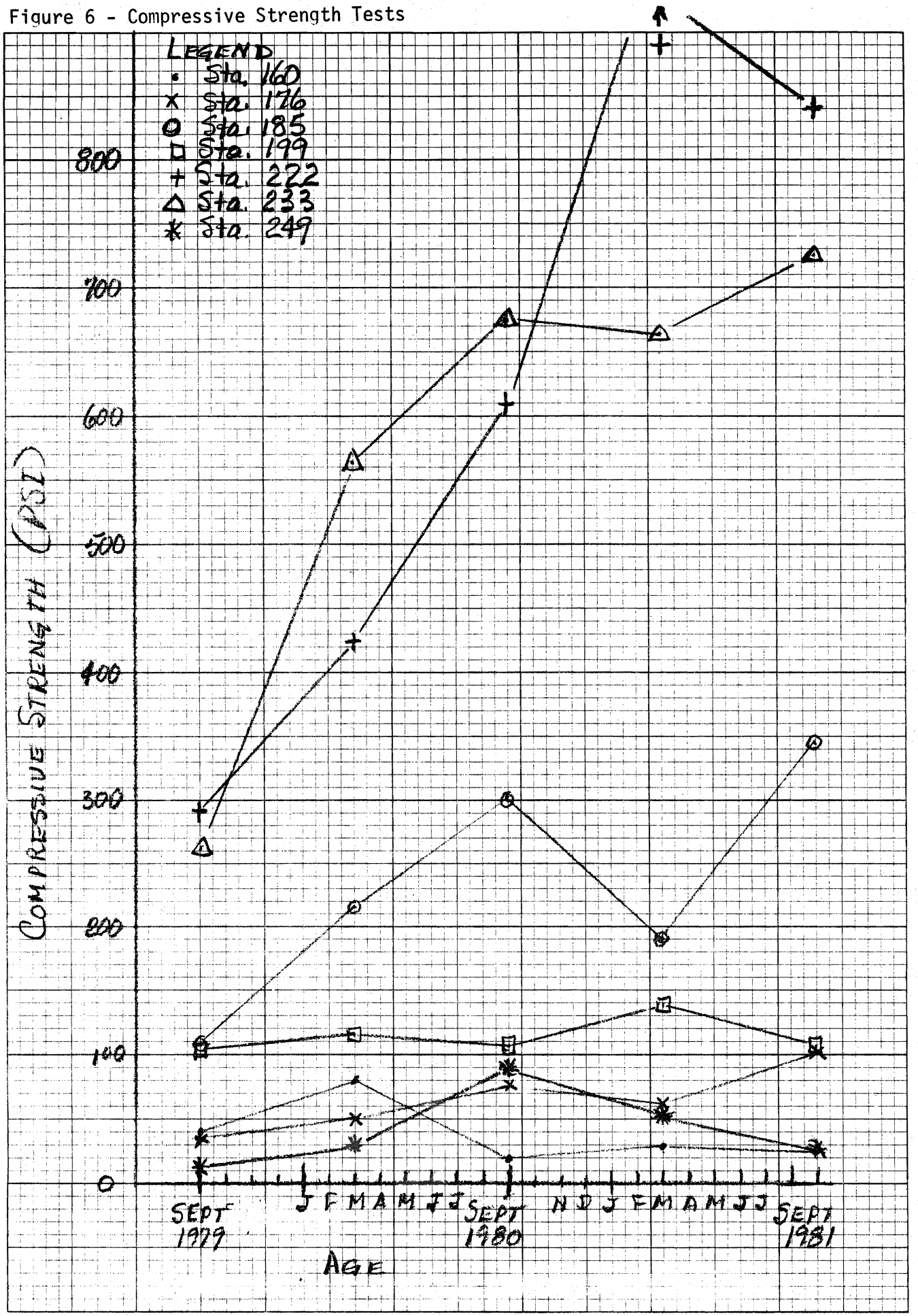
(more)

Figure 5 - Compressive Strengths of Periodic Tests

Figure 5
GENERAL TEST REPORT CON'T

Date	Station	Molded Density	Molding Moisture	Compressive Strength
3-80				115 psi
9-80				107 psi
3-81				138 psi
9-81				106 psi
9-79	222+00	112	10	291 psi
3-80				426 psi
9-80				609 psi
3-81				970 psi
9-81				840 psi
9-79	233+00	112	10	261 psi
3-80				593 psi
9-80				675 psi
3-81				665 psi
9-81				728 psi
9-79	249+00	106	14	13 psi
3-80				30 psi
9-80				90 psi
3-81				53 psi
9-81				26 psi

Figure 6 - Compressive Strength Tests



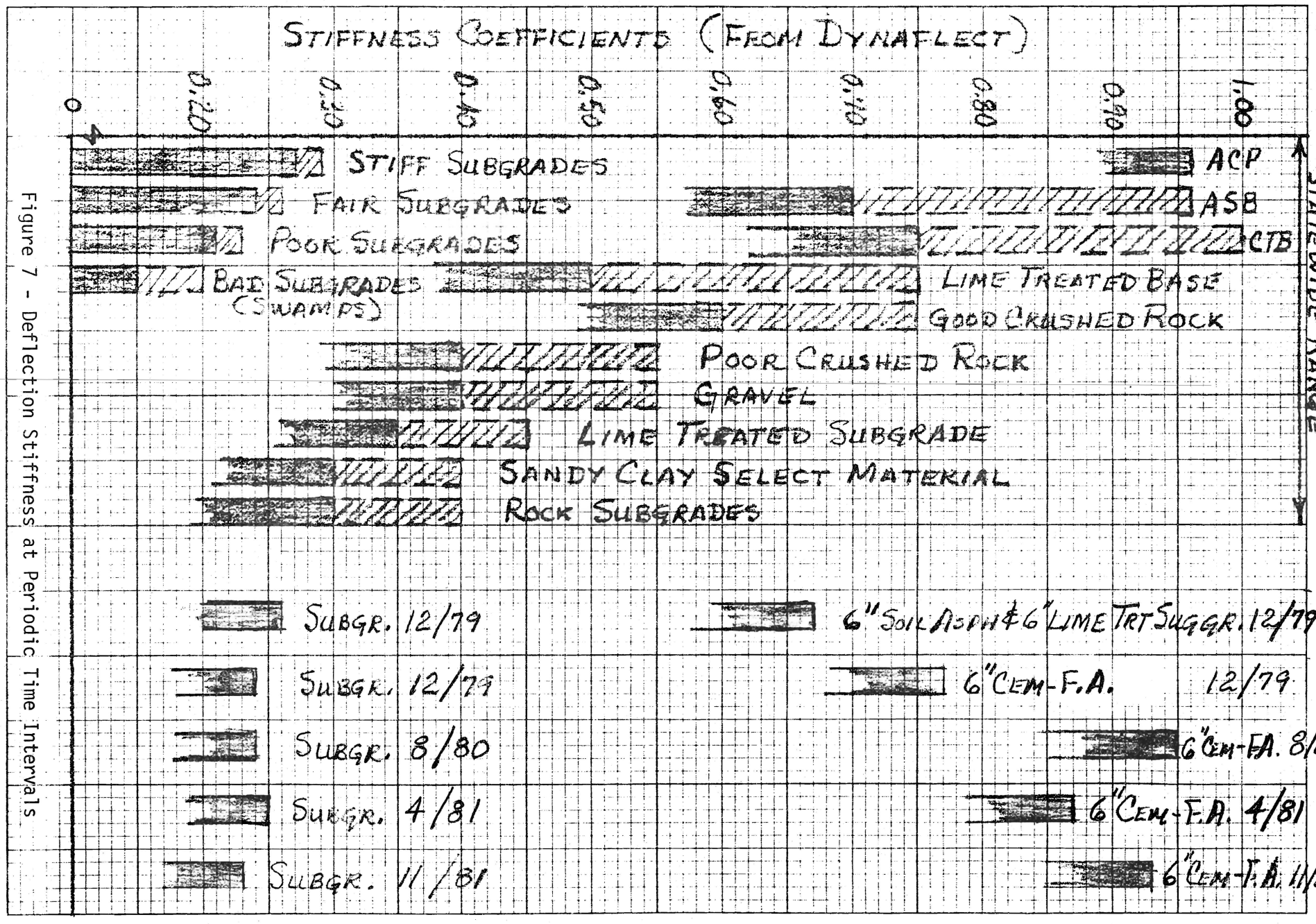


Figure 7 - Deflection Stiffness at Periodic Time Intervals

Appendix A

Experimental Laboratory Testing

Comparison of Raw and Processed Fly-Ash/Cement Mixtures

Processed Fly-Ash

Material from Station 165+00
4% Cement and 6% Processed Fly-Ash

Compressive Strengths (psi) for:

7 Day Break	14 Day Break	21 Day Break
285	345	456

Raw Fly-Ash

4% Raw Fly-Ash and 6% Cement

Compressive Strengths (psi) for:

Material from Station	7 Day Break	14 Day Break	21 Day Break	7 Day(8% Cem.)
164+00	111	130	139	146
183+00	164	226	217	181
249+00	235	291	290	277

Studies of Lime-Fly-Ash Mixtures

Material from Station 165+00

Compressive Strengths at 7 Days (psi) for:

3% Lime	5% Lime	7% Lime	5% Lime & 5% Fly-Ash
10	13	20	74

Appendix B

Field Change Information

B-1

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

P. O. Box 280
Lufkin, Texas 75901
March 27, 1979

Project A 3269-1-3
Control 3269-1-3
F.M. Highway 3188
Trinity County

Austin Office, File D-6

We are submitting herewith Field Change Request No. 1 for the above captioned project. Project plans specify Item 270, Portland Cement at a rate of 35 lbs/SY, which is equivalent to 7% by weight. Further laboratory testing of the material to be cement treated has indicated that higher strengths can be obtained by using a combination of cement and processed fly ash. The proposed combination of 5-1/2% cement and 4% fly ash can be substituted for the plan rate of 7% cement for approximately the same cost. The end result will be a higher strength base while substituting fly ash, which is in abundant supply, for a portion of the required cement, which is in short supply, all for no significant increase in cost.

A Supplemental Agreement provides for the addition of a Special Item, Fly Ash (Processed) and the establishment of prices thereof. The price of Fly Ash (Processed) will be $30.00 per ton. This compares favorably with the contract price of $15.00 per Bbl.(which converts to approximately $80.00 per ton) for Item 270, Portland Cement. The Supplemental Agreement will be forwarded when received from the Contractor.

B-2

Cost of work will be increased by $15.00. Mr. Jose Hernandez of your office is familiar with this proposed change.

We trust that this request is in order and meets with your approval.

Very truly yours,

J. L. Beaird
District Engineer
District Eleven

Attachment

cc: A. W. Cockrel,Jr., Supv.Res.Engr.

Texas Department of Highways and Public Transportation
Form 112

B-3

APPROVAL OF CHANGE IN PLANS

F. C. Request No. 1 Accompanied by Sketches or F. C. Plan-Sheets Numbered - Hwy. No. FM 31

Trinity County, Federal Proj. No. A-3269-1-3 PD 2047 , Control 3269-1-3

TO THE STATE HIGHWAY ENGINEER ENGINEER-DIRECTOR

Approval of the following changes in plans and/or specifications is requested.

Limits: Sta. 158+00 to Sta. 253+57.75

Description: Substitute 4% Processed Fly Ash for 1½% Portland Cement to make the CEM TREAT (EXIST MATL) (6 IN) consist of 5½% Portland Cement and 4% Processed Fly Ash.

This field change is requested for the following reasons: The Plan rate of Cement for the CEM TREAT (EXIST MATL) (6 IN) on this project is 7%. It has been determined by Laboratory Test that the use of Fly Ash with Cement in the above ratio will give increased strength of the Cement Stabilized Base. This is desirable for this project.

Contractor: Pit Construction Co., P. O. Box 1685, Lufkin, Texas 75901

Item No.	DESCRIPTION	Unit	FIELD CHANGE QUANTITIES			ORIGINAL PLAN QUANTITIES		
			Quantity	Contract Price	Amount	Quantity	Contract Price	Amo
	Ptlnd Cem	Bbl	1,760	15.00	26,400.00	2,239	15.00	33,585.
	Cem Treat(Exist Matl)(6 In)	SY	24,058	1.50	36,087.00	24,058	1.50	36,087.
	Fly Ash (Processed)	Ton	240	30.00	7,200.00	0	0	0
	Total				$69,687.00	Total		$69,672.00
	Net Underrun				$	Net Overrun		$ 15.00

Respectfully requested by:

Supv. Resident Engineer — Date 3-22-79

District Engineer — Date 3-21-79

Engineer Manager — Date

Verified by — Initials — Date

Recommended for Approval by:

Chief Engineer of Highway Design — Date

Engineer, Secondary Roads — Date

Bridge Engineer — Date

Approved

Construction Engineer — Date

Approved

ENGINEER-DIRECTOR — Date

NOTE: Eight copies of this form must be submitted to the S. H. D. Main office through the office of the District Engineer for each federal project requested on Federal Aid Primary and Interstate Projects and five copies for [illegible]

FM 3188

Plan Quant. & Bid Prices

		Est. Quant.	Price	Amount
Item 270-502 Portland Cement	Bbl	2,239	$15.00	$33,585
Item 270-506 Cement Treated (Existing Material)	SY	24,058	1.50	36,087
		Total		$69,672

Conversion of Cement Price from Bbl to Ton

Plan Quantity Tons = (2,239 Bbl) ÷ 5.32 Bbl/ton = 420.86 Ton Cement

$\frac{2,000 \text{ lb/Ton}}{376 \text{ lb/Bbl}}$ = 5.52 Bbl/Ton @$15.00/Bbl = $79.80 per Ton

---

Estimated Cost of Fly Ash = $25.00 per Ton

3/4 Plan Quant. Cement = (3/4)(2,239 Bbl) = 1,679 Bbl Actually Used

1/4 Plan Quant. Cement = (1/4)(2,239 Bbl) = 560 Bbl Replaced

wt. of Cement Replaced = (560 Bbl)(376 lb/Bbl) ÷ 2,000 lb/Ton = 105.28 Tons Replaced

---

(35 lb/SY Plan Rate) ÷ (4.5 CF/SY) ÷ (110 lb/CF) x (100) = 7% Cement

(3/4)(7%) = 5.26% Cement by Wt.

(1/4)(7%)(2) = 3.5% Fly-Ash by Wt.

Lab Tests Using 6% Cement & 4% Fly-Ash

$(\frac{6.0}{5.26})$ = 1.14 Add'l

$(\frac{4.0}{3.5})$ = 1.14 Add'l

Appendix C

Laboratory Tests of Variation in Cement/Fly-Ash Mixing Methods

Study of Mixing Methods of Fly-Ash and Cement

Material from Station 249+00

4% Fly-Ash and 6% Cement

Compressive Strengths at 7 Days

Mix Fly-Ash One Day Cement Next Day	Mix Fly-Ash One Day Cement after 4 Days	Mix Fly-Ash One Day Cement the Same Day
247	234	230

Appendix D

Examples from Schedule of Testing Requirements

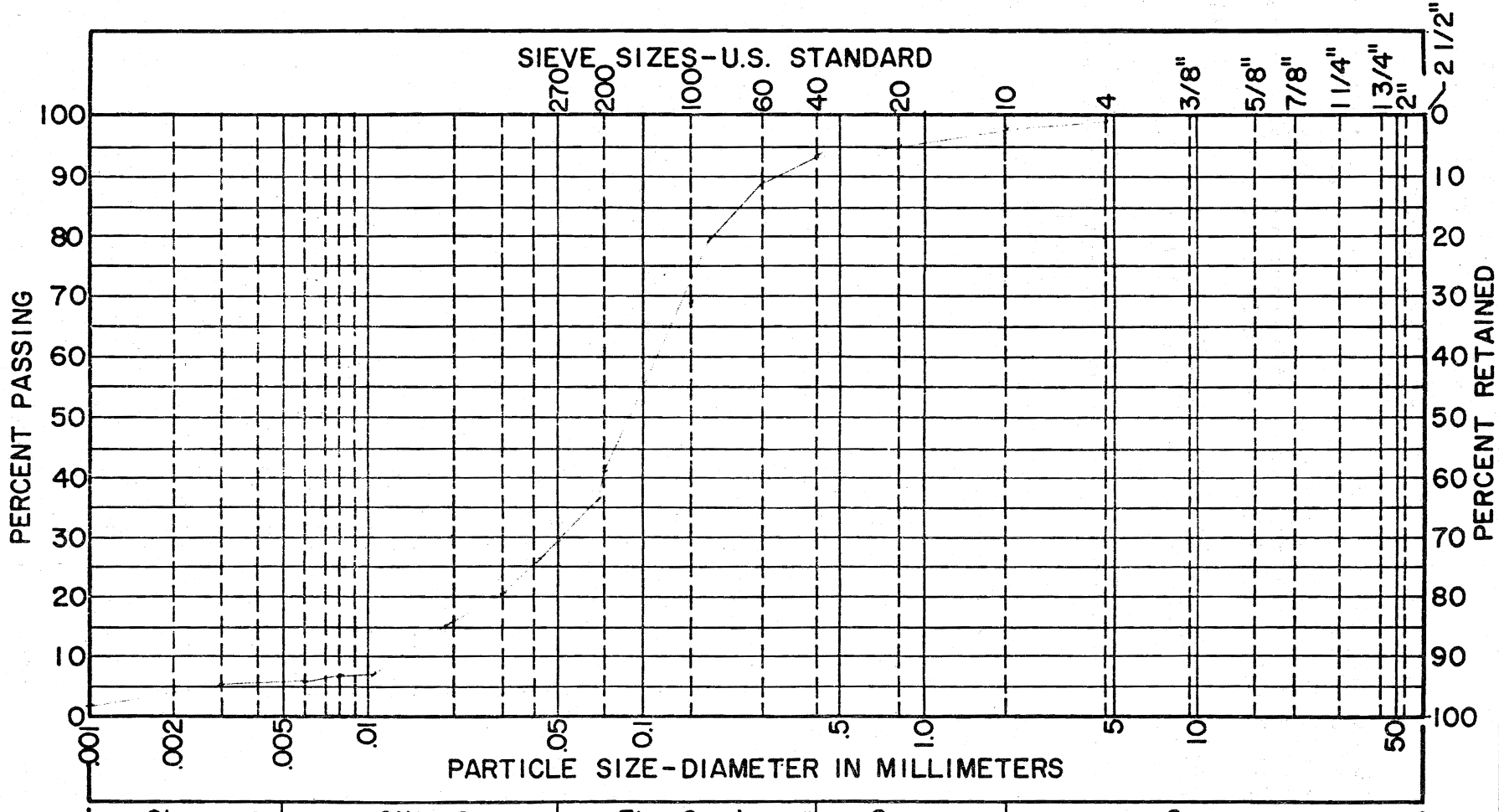
Texas State Highway Department
Form 481

24266-1064-10m

CUMULATIVE MECHANICAL ANALYSIS

Sample No. 229-3-78 County Tarrant Project _____ Highway _____

LL = 19
PI = 1



Clay = 6%	Silt = 24%	Fine Sand = 63.3%	Coarse Sand = 6.7%	Coarse Aggregate
Soil		Binder = 93.3%		

D-1

STATE DEPARTMENT OF
HIGHWAYS AND PUBLIC TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
AUSTIN, TEXAS 78703

D-2 PAGE

MCS.TST.08 CEMENT TEST REPORT D-9 CHARGES 25.00

CONTRACT NO. 07780028 REQ NO. CONTROL 3269-01-003 PD 2047
ENGINEER A. W. COCKRELL, JR. PROJECT A 3269-1-3
CONTRACTOR PIT CONSTRUCTION CO. DIST 11 CO TRINITY HWY FM

LABORATORY NO. D79303254 DATE RECD 09/12/79 DATE REPTD 09/25/79
DATE SAMPLED 09/10/79

MATERIAL CEMENT FOR BASE OR BACKFILL TY-I CODE 0000000331
PRODUCER GIFFORD HILL CEMENT CO.-MIDLOTHIAN,TX CODE 308
IDENTIFICATION MARKS C-1 SPEC. ITEM 0270
SAMPLED FROM TR. #2 QUANTITY 138.300 UNIT BBL

	TENSILE STRENGTH (PSI)	COMPRESSIVE STRENGTH (PSI)
3 DAY		2893
7 DAY		3913
NORMAL CONSISTENCY (%)		24.5

DIVISION OF MATERIALS AND TESTS
MEETS
SPECIFICATIONS

Form 231-Rev. 3-76

D-3

Charge: $73.80

STATE DEPARTMENT OF
HIGHWAYS AND PUBLIC TRANSPORTATION
DIVISION OF MATERIALS AND TESTS
AUSTIN, TEXAS 78701

GENERAL TEST REPORT

CONTRACT NO. _____ CONTROL A-3269-1-3 PD 2047

ENGINEER Mr. A. W. Cockrell PROJECT NO. _____

ADDRESS Lufkin, Texas COUNTY Trinity HWY FM 3188

CONTRACTOR Pit Construction Co. DISTRICT 11 REQ. NO. _____

LABORATORY NO. A79320663 MATERIAL Fly Ash

DATE RECEIVED 9-18-79 PRODUCER Trinity Portland, Big Brown, Fairfiel

SAMPLED FROM Truck, Tank No. 2729, Seal No. 4049 IDENTIFICATION MARKS FA-6

QUANTITY 26 tons SPECIFICATION ITEM Research Class C

Physical Tests (Section D)

Pozzolanic Activity Index (28 day with Portland Cement)	91.2%
Water Requirement	88.6%
Fineness - Retained on 325 Mesh Sieve	14.8%
Soundness - Autoclave Expansion/Contraction	Not Run
Specific Gravity	2.52

Tests By Section E

Retained #30 Sieve	0.0%
Retained #200 Sieve	5.5%
CaO Content (by UVAC method)	13.0%