

PROGRESS REPORT NO. 9
FEBRUARY 1978

EVALUATION OF FRENCH PRESSUREMETER

by

CONSTRUCTED FACILITIES DIVISION
DEPARTMENT OF CIVIL ENGINEERING
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

for

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FEDERAL HIGHWAY ADMINISTRATION
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I. INTRODUCTION

This ninth progress report describes the work accomplished during February 1978. Table 1 lists the work tasks and presents the schedule as revised in February 1978. Task A (in Table 1) having been completed, February was devoted to Task B and C as follows:

Task B: Measurement of in situ horizontal stress.

Task C: Interpretation of PAFSOR tests.

1) Establishment of in situ soil parameters.

2) Analysis of pressuremeter (PAFSOR) test data.

3) Literature review on pressuremeter test and methods of interpretation.

2. WORK ACCOMPLISHED AND SUMMARY OF RESULTS

The principal activities during January 1978 are summarized in Table 2 and described more fully below.

Task B: Measurement of In Situ Horizontal Stress

Machining of the three earth pressure cells was completed during February 1978. At the end of the month, deairing, assembly and calibration of the cells were in progress.

As a first estimate, the work of March 27th is set as the starting date for the testing program. Table 3 lists the planned measurements with approximate cell insertion dates and equilibration times. Figure 1 shows the tentative location of the three holes. These may be changed depending upon the stress distribution analyses to check the influence of the embankment. Measurements will be taken at three elevations in each hole (El.-30, -50 and -90 ft.)

Task C: Interpretation and Analysis of Pressuremeter Data

Establishment of In Situ Soil Parameters

MIT summarized CALDOT's results from unconsolidated-undrained (UU) triaxial compression tests on samples from Sta. 246. Figure 2 compares the undrained shear strength obtained in each test to the average field vane strength measured at Sta. 245 before construction.

Values of the coefficient of earth pressure at rest, K_0 , in Boston Blue Clay can be obtained from the following sources:

1. hydraulic fracturing tests run in piezometers at the I-95 site in 1973 and 1974
2. hydraulic fracturing tests in Boston Blue Clay at other sites
3. oedometer tests with lateral stress measurement on Boston Blue Clay samples
4. anisotropically consolidated strength tests on Boston Blue Clay samples (triaxial $\overline{CK_0UC}$ and $\overline{CK_0UE}$ - and plane strain tests)
5. Brooker and Ireland's (1965)* relationship among plasticity index, overconsolidation ratio and K_0 .

Figure 3 partially summarizes the values of K_0 . There are still some difficulties in retrieving the K_0 parameters from hydraulic fracturing tests, mainly because of large uncertainties in the in situ vertical stress and pore pressure at the time of the measurements (especially at the I-95 site). It is hoped that all results will be compiled by the end of March 1978.

Interpretation and Analysis of Pressuremeter Tests

Development of a finite difference model to simulate the in situ pressuremeter test using cylindrical and spherical cavity expansion theories was completed and the computer program is now ready for parametric studies. In particular, results of these analyses should provide some insight into the importance of the cell geometry (length to diameter ratio) on the soil parameters obtained from existing methods of interpretation of the pressuremeter test.

Plotting of the Camkometer tests was completed. Values of initial pressure, P_0 , and limit pressure, P_1 , were obtained from the various pressure curves, as done previously with the PAFSOR results.

*Brooker, E.W. and Ireland, H.O. (1965), "Earth Pressure at Rest Related to Stress History", Canadian Geotechnical Journal, Vol. 2, No. 1, pp. 1-15.

Summary tables and figures, comparing the PAFSOR and Camkometer results are in progress and will be presented in the March 1978 progress report.

In a visit with Professor Michele Jamiolkowski and his co-workers in Italy, who have used the PAFSOR extensively at several sites and who now plan to experiment with the Camkometer, Dr. Lacasse exchanged information on the following topics:

1. PAFSOR test
 - a) test procedures
 - b) interpretation methods and results
 1. undrained shear strength, c_u
 2. limit pressure, P_l
 3. initial pressure, P_0 vs. in situ horizontal total stress, σ_{ho}
 4. Young's modulus
2. Camkometer test
3. Earth pressure cells
4. Recent references on pressuremeter testing

Literature Review

Under this item, only the literature made available by the geotechnical staff of University of Torino was received and summarized.

3. WORK PLANNED FOR NEXT THREE MONTHS

The work items planned for the coming months are:

- 1) Measure horizontal stress with new earth pressure cells inserted in three holes at Sta. 246, in Saugus, MA (I-95 site where PAFSOR tests were run).
- 2) Continue summary internal report of all laboratory test results on 1977 specimens of Boston Blue Clay.
- 3) Estimate the in situ horizontal stress at Sta. 246 and 263, in the vicinity of the PAFSOR tests (to be compared with in situ measurements).
- 4) Continue evaluation of the pressuremeter test data and literature review:
 - a) try curve-fitting methods of interpretation.
 - b) investigate alternate (improved?) methods of interpretation.

- 5) Compare PAFSOR and Camkometer test results and investigate the influence of geometry (length-diameter ratio of inflating cell) via spherical versus cylindrical cavity expansion theory.
- 6) Prepare outline of final research report.

4. COSTS INCURRED

The incurred costs progressed as predicted in Table 5 of Progress Report No. 2. At the end of January 1978, total expenditures amounted to approximately \$51,100.

Table 2: Principal Activities During February 1978

Task B: Measurement of In Situ Horizontal Stress

- 1) Complete machining of three earth pressure cells.
- 2) Start calibration, assembly and deairing of cells.
- 3) Plan testing program and make logistical arrangements with drilling contractor and MDPW.

Task C: Interpretation of PAFSOR Tests

Establishment of In Situ Parameters

- 1) CALDOT Testing Program:
 - a) Summarize CALDOT's UU triaxial test data.
- 2) Stress History at Sta. 246 and 263:
 - a) Start summary report of laboratory tests results on 1977 BBC samples.
 - b) Continue summary of existing measurements of K_0 in I-95 Boston Blue clay.
 - c) Continue estimates of in situ horizontal stress at both stations.

Interpretation and Analysis of Pressuremeter Data

- 1) Complete write-up of finite differences simulation of in situ pressuremeter test. Parametric studies are now underway using cylindrical and spherical cavity expansion theory.
- 2) Complete plots of stress-strain curves for all 1973 Camkometer tests at Sta. 263.
- 3) Obtain P_0 and P_1 values from Camkometer tests and compare to PAFSOR results.
- 4) Discuss pressuremeter test experience and methods of interpretation with Professor Michele Jamiolkowski and his co-workers of University of Torino, Italy, who have used the PAFSOR device extensively.

Literature Review

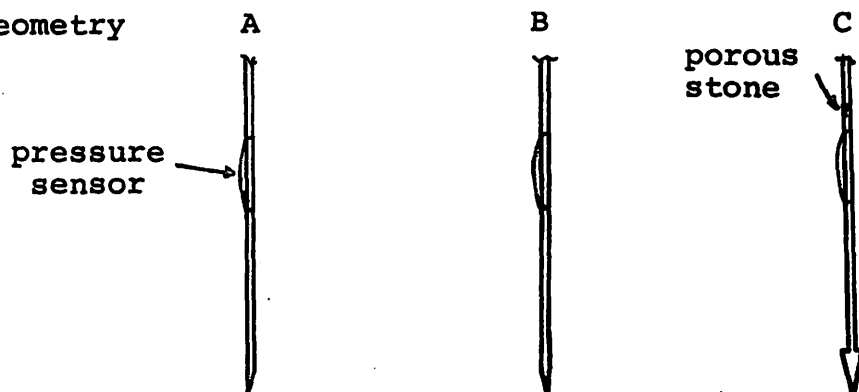
- 1) Review literature on pressuremeter testing made available by geotechnical staff at University of Torino.

Table 3. Proposed Field Program Using MIT-DOT Earth Pressure Cells.

Cell Geometry*	Hole No.	Elevation of Measurement		Proposed date for Cell Insertion
		σ_{ho}	u	
A	EPC-1	-30 ft	-	Week of March 27, 1978
B	EPC-2	-30 ft	-	"
C	EPC-3	-30 ft	-30 ft	"
A	EPC-1	-50 ft	-	Week of April 24, 1978
B	EPC-2	-50 ft	-	"
C	EPC-3	-50 ft	-50 ft	"
A	EPC-1	-90 ft	-	Week of May 22, 1978
B	EPC-2	-90 ft	-	"
C	EPC-3	-90 ft	-90 ft	"

Notes: σ_{ho} = in situ horizontal total stress
u = equilibrium pore pressure

*Cell Geometry



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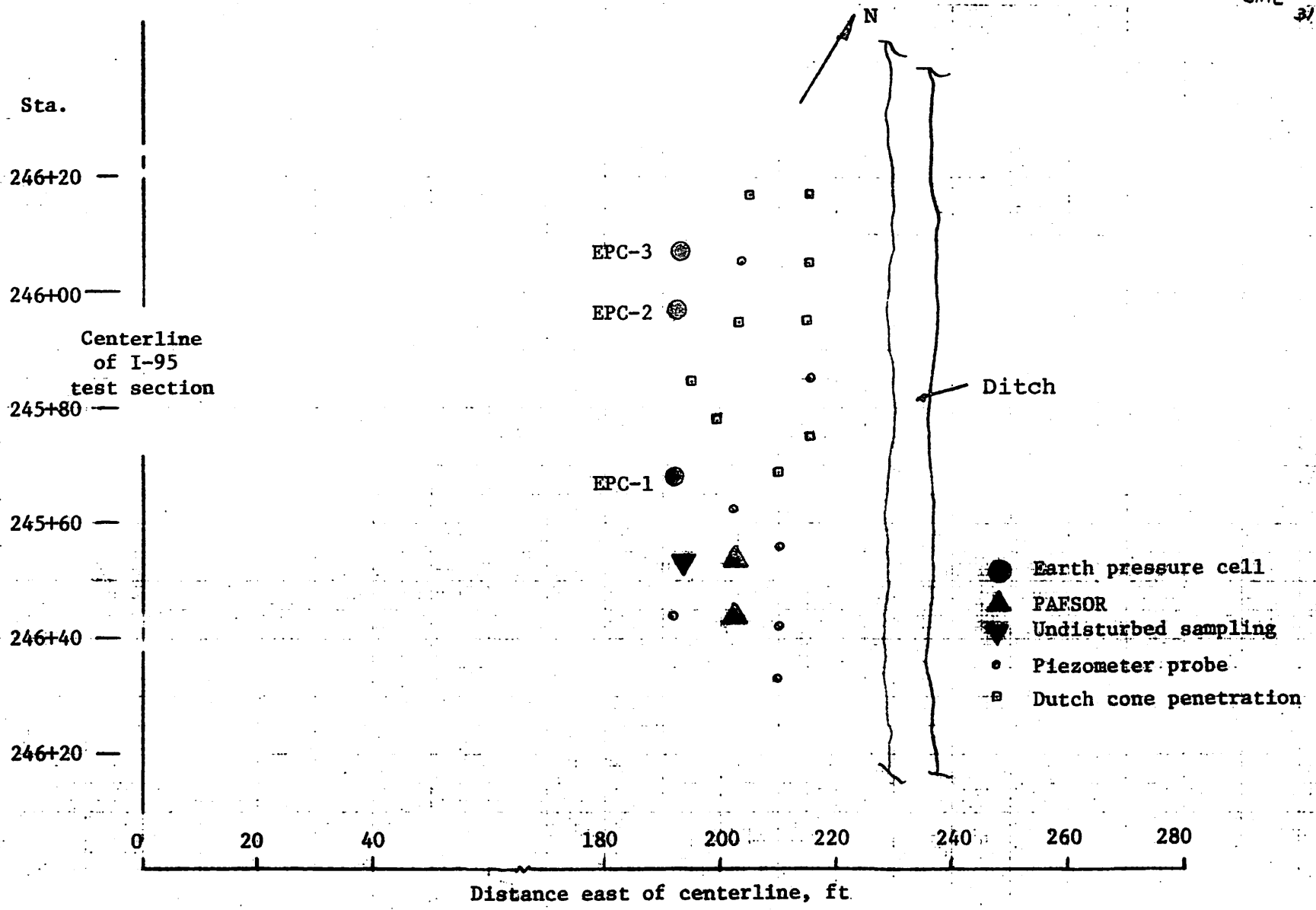
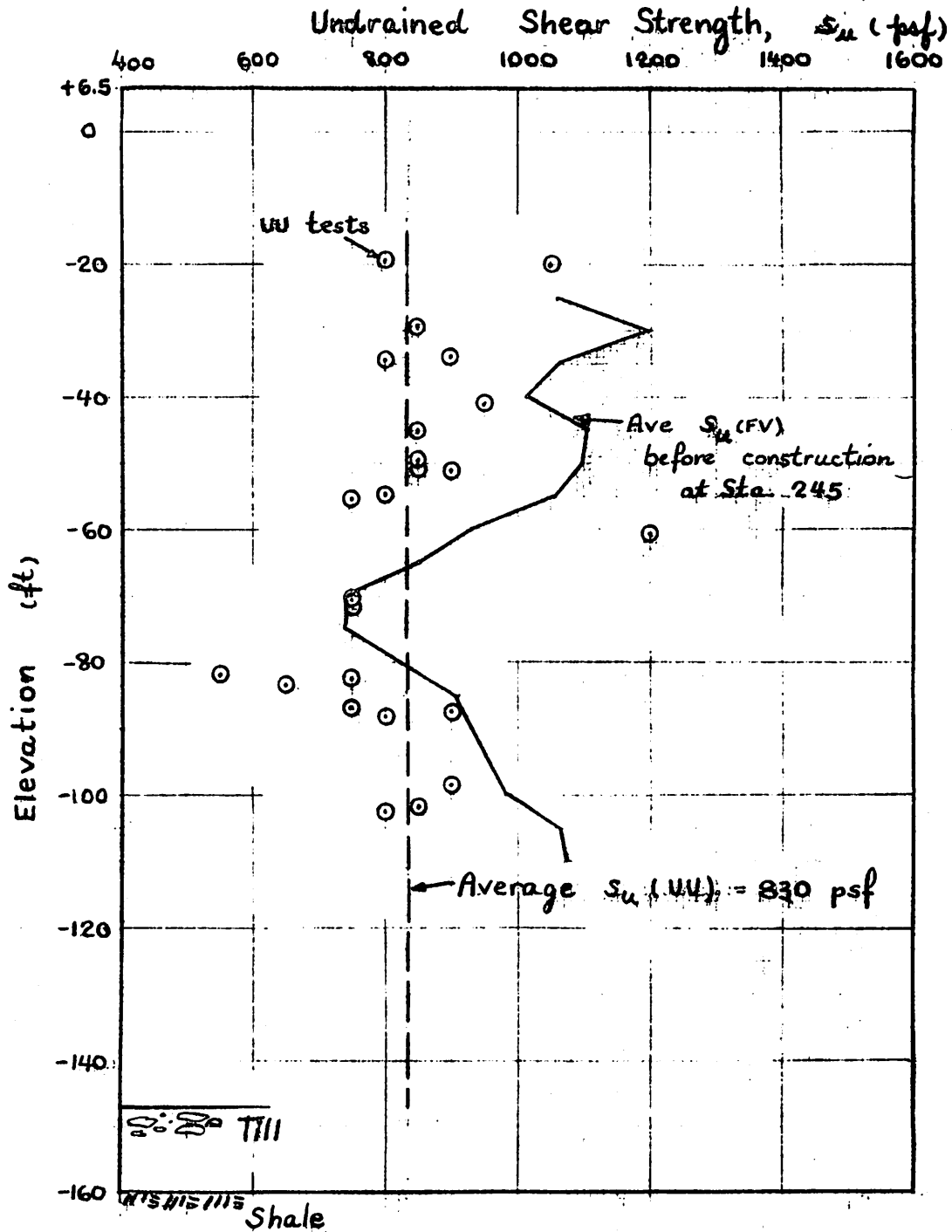


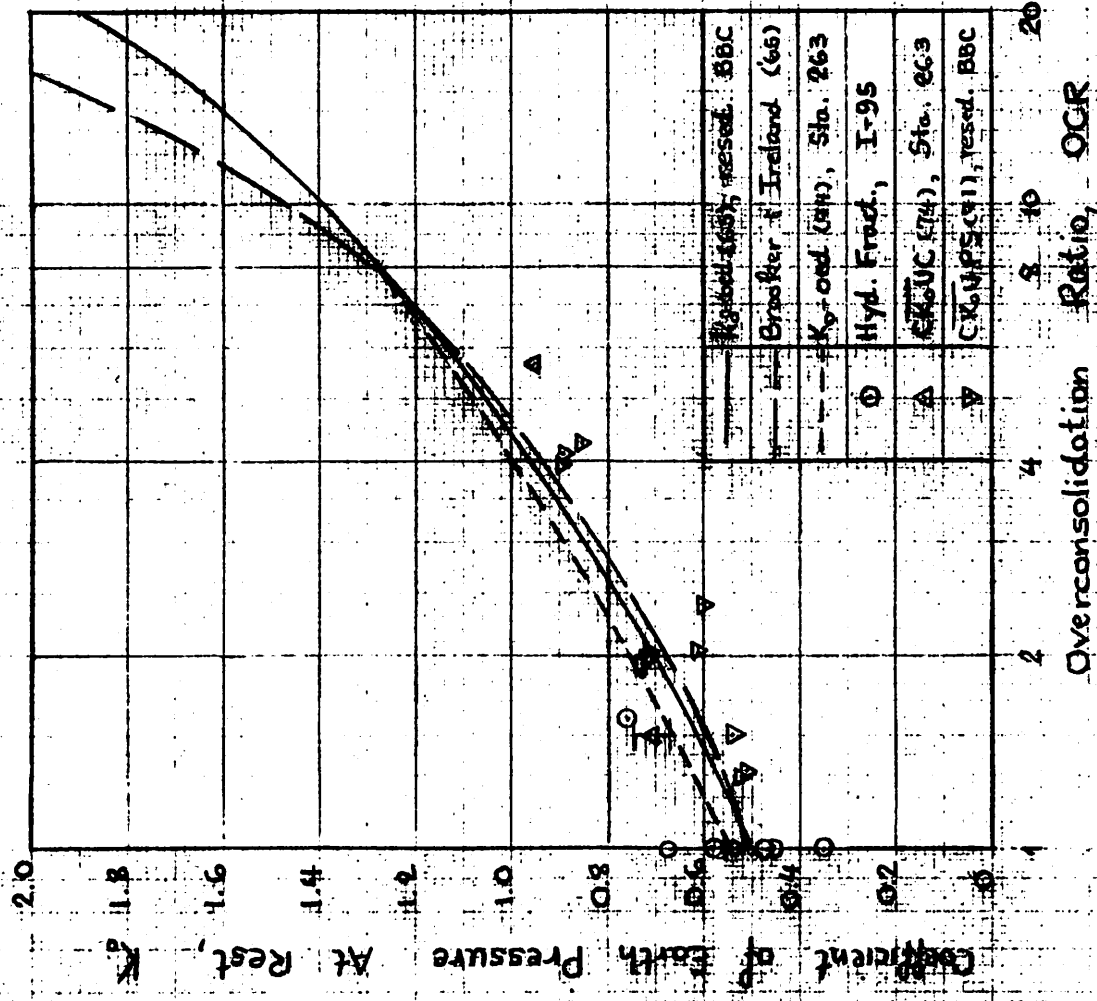
Figure 1

APPROXIMATE LOCATION PLAN OF EARTH PRESSURE CELL TEST HOLES (SPRING 1978)



CALDOT UU TEST RESULTS ON 1977 BBC SAMPLES
FROM STA. 246

Figure 2



K₀ VALUE FOR BOSTON BLUE CLAY