Geotechnical Engineering Research Laboratory
One University Avenue
Lowell, Massachusetts 01854
Tel: (978) 934-2277 Fax: (978) 934-3046
e-mail: Samuel_Paikowsky@uml.edu
web site: http://www.uml.edu/research_labs/Geotechnical_Engineering/
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Samuel G. Paikowsky, Sc.D
Professor

14.533 ADVANCED FOUNDATION ENGINEERING
HOMEWORK #1
(Lectures 1&2, due 9/22/2010)
Introduction, Classification, Subsurface Investigation

A. As a preparation for the guest lecture on 9/15/2010, **review** Chapters 2 and 3 in Textbook (Bowles). Following the lecture, submit a lecture summary (1-2 pages).
B. Review the following: (1) "Geological Background and Engineering Parameters of Boston Blue Clay" by Peter Connors, (2) "Art and Science in Subsurface Engineering" by Ralph B. Peck, and (3) "Geotechnical Characteristics of the Boston Area" by Edmund G. Johnson (all provided as a handout).

C. **Submit** the solutions for the questions below in two weeks.
   1. Design a Subsurface Investigation Plan (layout of borings, holes type, depth & sampling) for the attached bridge site, where an existing soil map showed a large river delta and additionally wet swamps at the east approach.

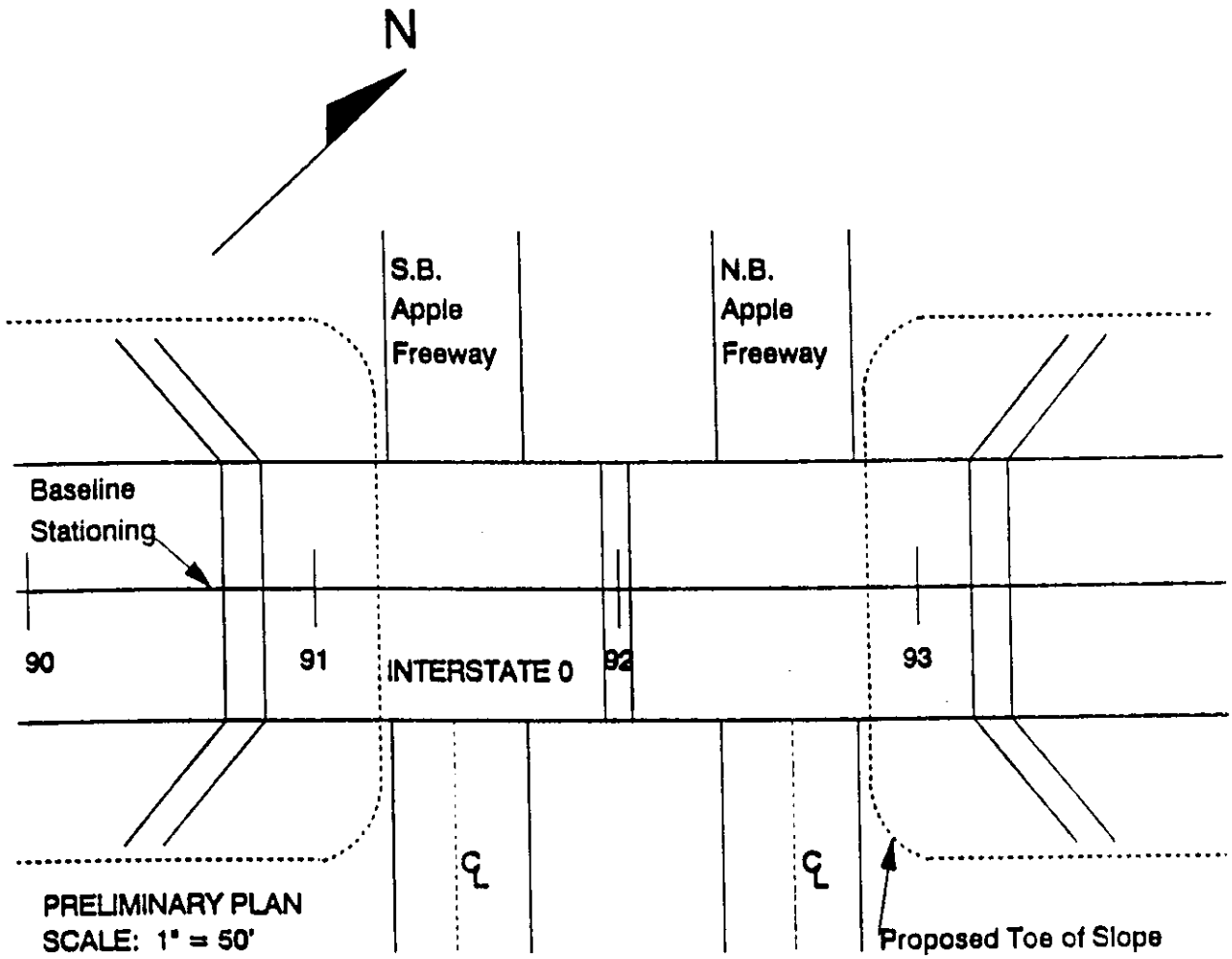
   2. Given the attached 4 boring logs, plot their location on the plan (station & offset) and draw a soil profile, indicating the soil/rock type, blow counts, and water content.

   3. Based on the bridge and subsurface profiles, what type of in-situ and laboratory tests would you request for; (i) stability/strength analysis, and (ii) settlement calculations.

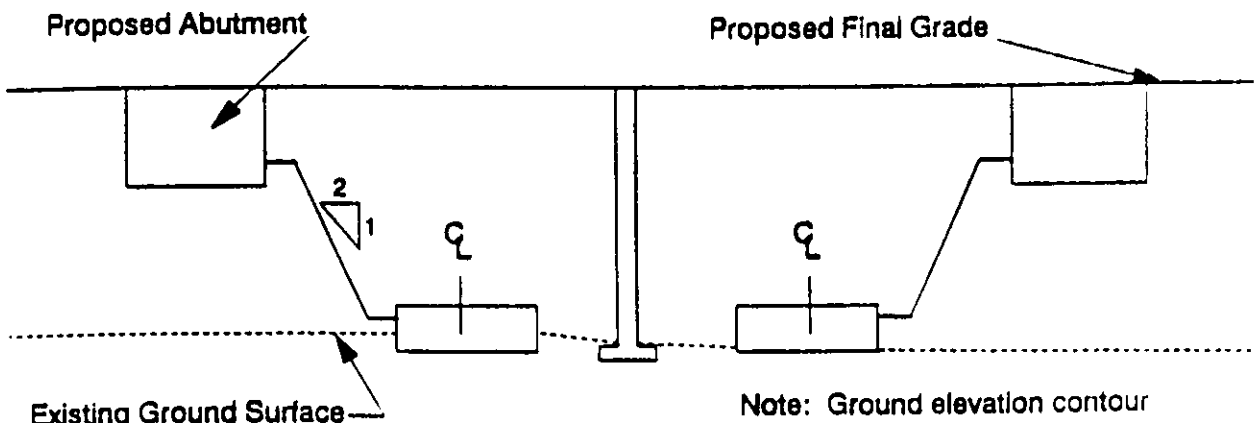
   4. Use boring log BAF-4 to calculate and draw the effective stress diagram p_0 (pressure vs. depth). For this you have to estimate the unit weight values of the soils.

   5. Attached find the profiles of p_0 and p_c. Calculate the Over-Consolidation Ratio (OCR), discuss and explain its trend.

   6. Given are the strength values (UU, CU, Vane) for samples from Boring BAF-4. Plot the strength values vs. depth, discuss the reason for the difference, and select one design value for the clayey layer.



PRELIMINARY PLAN
SCALE: 1" = 50'



PRELIMINARY PROFILE
SCALE: 1" = 50' Horiz.
1" = 20' Vert.

Note: Ground elevation contour lines are typically included on layout sheets left off for clarity

REGION 3
COUNTY Orange
PROJECT Interstate 0
DATE START 5/2/92
DATE FINISH 5/3/92
CASING O.D. 2-1/2" I.D.
SAMPLER O.D. 2" I.D. 1-3/8"
RIG TYPE Acker B-40
CORE BARREL Double Tube

SUBSURFACE EXPLORATION LOG

HAMMER FALL-CASING 18"
HAMMER FALL-SAMPLER 30"
WEIGHT OF HAMMER-CASING 300 LBS.
WEIGHT OF HAMMER-SAMPLER 140 LBS.

HOLE BAF-1
LINE Baseline
STA. 90+77
OFFSET 50' Rt.
SURF. ELEV. 1001.1

TIME	4 pm	8 am
DATE	5/2/92	5/3/92
DEPTH TO WATER	15'	15'

DEPTH BELOW SURFACE	BLOWS ON CASING	SAMPLE NO.	BLOWS ON SAMPLER 0"/.0	.0/1.0	1.0/1.5	1.5/2.0	Sample Recovery/in	DESCRIPTION OF SOIL AND ROCK	MOIST CONT %
0	4	J1	1	3	5				10
	16								
	25								
	16								
	20								
	30	J2	7	7	8			GR. FINE TO COARSE SAND	7
	21								
	35							MOIST - NON PLASTIC	
	38								
10	51								
	40	J3	10	21	20				6
	35								
	52								
	58								
	61								
	50	J4	10	18	21				6
	42								
	65								
	72								
20	26								20'
	60	J5	3	6	6				31
	51								
	72								
	75							GR SILTY CLAY	
	81								
	80	J6	3	6	7			MOIST - PLASTIC	32
	71								
	90								
	83								
30	84								
	80	J7	2	4	4				36
	77								
	83								
	84								
	86								
35	80	J8	2	3	3				38
	76							GR. SILTY CLAY	
	85							MOIST - PLASTIC	
	87								
	89								40.5'
40	81		3	3	50				
	120								
	140							GR. SANDY GRAVEL	
	156								
	180							MOIST - NON PLASTIC	
	160		35	50					
	195								
	200								
	210								
	230								TOP OF ROCK 51.2'
50								HARD UNWEATHERED BASALT	
								Run 1 - 60"	
								RECOVERY - 48" RQD = 70%	
								9 PIECES	55'
								HARD UNWEATHERED BASALT	
								RUN 2 - 60" RQD - 80%	
								RECOVERY - 54" 8 PIECES	
60									60'
								END OF BORING 60'	

REGION 3
COUNTY ORANGE
PROJECT INTERSTATE 0
DATE START 5/4/92
DATE FINISH 5/6/92
CASING O.D. 2-1/2" I.D.
SAMPLER O.D. 2" I.D. 1-3/8"
RIG TYPE Acker B-40
CORE BARREL Double Tube

SUBSURFACE EXPLORATION LOG

HAMMER FALL-CASING 18"
HAMMER FALL-SAMPLER 30"
WEIGHT OF HAMMER-CASING 300 LBS.
WEIGHT OF HAMMER-SAMPLER 140 LBS.

HOLE BAF-2
LINE Baseline
STA. 92+00
OFFSET 50' Lt.
SURF. ELEV. 996.2

TIME	4 pm	8 am
DATE	5/4/92	5/6/92
DEPTH TO WATER	10'	10'

DEPTH BELOW SURFACE	BLOWS ON CASING	SAMPLE NO.	BLOWS ON SAMPLER 0"/6"	0"/6"-12"/6"	12"/6"-18"/6"	18"/6"-24"/6"	DESCRIPTION OF SOIL AND ROCK	MOIST. CONT. %
0	6	J1	1	2	2			12
	19							
	27	J2	1	3	3		GR. - SILTY SAND	8
	35							
	21	J3	2	5	6		MOIST - NON PLASTIC	10
	30	J4	7	9	12			
	22							6
	25	J5	8	7	15			
	24							7
10	28	J6	14	20	20			
	27	J7	15	18	19			10
	36							7
	34	J8	13	16	17			
	37						14.5'	32
	39	J9	15	10	3			
	31							
	40							
	46							
	46							
20	45							
	41	J10	2	4	4			31
	42						GR. SILTY CLAY	
	56							
	52						MOIST - PLASTIC	
	58							36
	50	J11	2	3	3			
	56							
	52							
	49							
30	58							
	52	J12	1	2	3			37
	56							
	61							
	63							
	65							
35	62	J13	1	2	4			34
	63						GR SILTY CLAY	
	72						MOIST - PLASTIC	
	71						39'	
40	89							
	75		30	20	35		GR SANDY GRAVEL	
	81							
	401						MOIST - NON PLASTIC	
	120						(Cored Boulder 42.5' to 45'. recovered 12"-7 pieces.	
	140						used boulder buster)	
	110		50	60				
	136							
	166							
	191						TOP OF ROCK 50'	
50	482							
							HARD UNWEATHERED BASALT	
							Run 1 - 60"	
							Recovery - 55" - 13 pieces RQD = 80%	
							55'	
							HARD UNWEATHERED BASALT	
							Run 2 - 60"	
							Recovery - 52" 7 pieces RQD = 75%	
							60'	
60								

REGION 3
COUNTY Orange
PROJECT Interstate 0
DATE START 5/8/92
DATE FINISH 5/9/92
CASING O.D. 2-1/2" I.D.
SAMPLER O.D. 2" O.D. 1-1/2"
RIG TYPE Acker B-40
CORE BARREL Double Tube

SUBSURFACE EXPLORATION LOG

HAMMER FALL-CASING 18"
HAMMER FALL-SAMPLER 30"
WEIGHT OF HAMMER-CASING 300 LBS.
WEIGHT OF HAMMER-SAMPLER 140 LBS.

HOLE BAF-3
LINE Baseline
STA. 93+27
OFFSET 50' Rt.
SURF. ELEV. 990.0

	TIME	DATE	DEPTH TO WATER
	4 pm	5/8/92	6'
	8 am	5/9/92	6'

DEPTH BELOW SURFACE	BLOWS ON CASING	SAMPLE NO.	BLOWS ON SAMPLER 0"/.0	0"/1.0	1.0/1.5	1.5/2.0	DESCRIPTION OF SOIL AND ROCK	MOIST. CONT. %
0	0	J1	1	0	1		BLACK MUCK WET - PLASTIC	115
	2							
	11	J2	3	5	7			20
	25							
	31						GR SAND W/ ROOTS AND FIBERS	
	40							
	41	J3	8	8	9		MOIST - NON PLASTIC	8
	56							
	71							
10	83						10'	
	70	J4	6	5	5			29
	91							
	93							
	82						GR-BR CLAYEY SILT	
	93							
	81	J5	2	3	6		MOIST PLASTIC	31
	80							
	87							
	85							
20	90						20'	
	82	J6	4	3	3			34
	86							
	87						GR SILTY CLAY	
	85							
	90						MOIST - PLASTIC	
	73	J7	2	2	3			39
	72							
	83							
	71							
30	61							
	81	J8	2	2	2			40
	83							
	72							
	76							
	83							
	71	J9	2	3	2			36
	79							
	86						GR-SILTY CLAY	
	83							
	85						MOIST - PLASTIC	
40	82	J10	3	4	3			35
	81							
	93							
	91							
	96						45'	
	121	J11	20	21	35			10
	450						GR SILTY GRAVEL	
	391							
	220						MOIST - NON PLASTIC	
50	230							
	200	J12	15	36	40		52' to 53' CORED BOULDER	5
	370						RECOVERY 3"	
	400						MANY FRAGMENTS	
	410							
	380							7
		J13	40	60	80			
							Top of Rock 60.5'	
60								
		J14	100	REFUSAL @ 60.5'			HARD UNWEATHERED BASALT	
							RUN 1 60.5' to 65.5' - 60" - RECOVERY 50", 12 PIECES ROD	70%
							RUN 2 65.5' to 70.5' - 60" - RECOVERY 60", 6 pieces ROD 95%	

REGION 3
COUNTY Orange
PROJECT Interstate 0
DATE START 5/10/92
DATE FINISH 5/12/92
CASING O.D. 4" I.D.
SAMPLER O.D. 2" I.D. 1.38"
RIG TYPE Acker B-40
CORE BARREL Double Tube

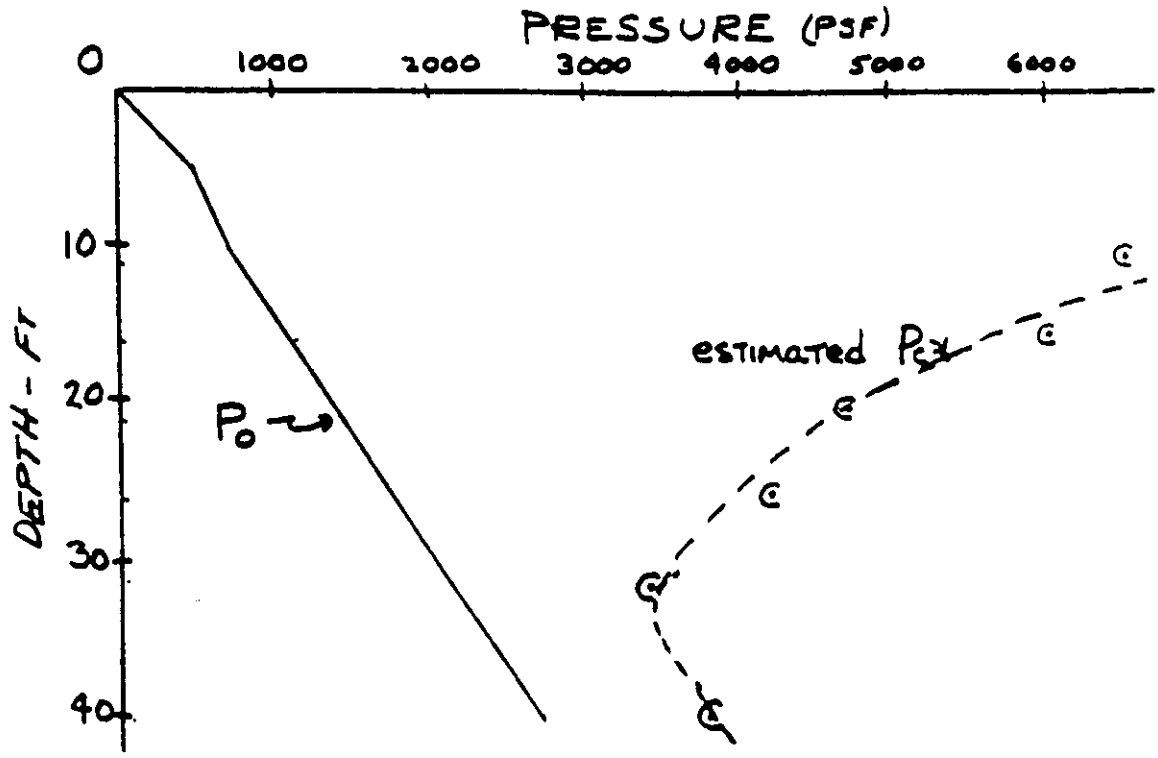
SUBSURFACE EXPLORATION LOG

HAMMER FALL-CASING 18"
HAMMER FALL-SAMPLER 30"
WEIGHT OF HAMMER-CASING 300 LBS.
WEIGHT OF HAMMER-SAMPLER 140 LBS.

HOLE BAF-4
LINE Baseline
STA. 93+27
OFFSET 50' Lt.
SURF. ELEV. 991.0

TIME	4 pm	8 am
DATE	5/10/92	5/12/92
DEPTH TO WATER	5'	5'

DEPTH BELOW SURFACE	BLOWS ON CASING	SAMPLE NO.	BLOWS ON SAMPLER 0"/.5"	.5"/1.0"	1.0"/1.5"	1.5"/2.0"	DESCRIPTION OF SOIL AND ROCK	MOIST. CONT %
0	0	J1	1	1	1		BLACK ORGANIC SILT	120
	2						WET - PLASTIC	
	11						3'	
	25							
	31							
	40	J2	4	8	9		GR. SAND	12
	41							
	56							
	71						MOIST - NON PLASTIC	
10	83						10'	
	70	T3					(10' - 12' PUSHED TUBE 20")	33
	91							
	93							
	82		VANE				(13' VANE SHEAR TEST	
	93							
	81	T4					(15' - 17' PUSHED TUBE 20")	35
	80							
	87						GR CLAYEY SILT	
	85		VANE				(18' VANE SHEAR TEST	
20	90						MOIST - PLASTIC	
	82	T5					(20' - 22' PUSHED TUBE 20")	31
	86							
	87							
	85		VANE				(23' VANE SHEAR TEST	
	75							
	73	T6					(25' - 27' PUSHED TUBE 20")	36
	72							
	83							
	71		VANE				(28' VANE SHEAR TEST)	
30	61							
	81	T7					(30' - 32' PUSHED TUBE 20")	38
	83							
	72							
	76							
	83							
	71	J8	2	2	4			38
	79						GR CLAYEY SILT	
	86	VANE					(37' VANE SHEAR TEST) MOIST - PLASTIC	
	83							
40	85							
	82	T9					(40' - 42' PUSHED TUBE 18")	37
	81							
	93							
	91							
	96						45'	
	121	J10	7	8	15			
	450							
	391						GR SANDY GRAVEL	
	220							
50	230						MOIST - NON PLASTIC	
	200	J11	40	100				
	370							
	400							
	410							
	380						TOP OF ROCK — 55'	
							HARD UNWEATHERED BASALT	
							Run 1 - 55' - 60' (60") RECOVERY - 58", 21 PIECES. RQD 90%	
							60'	
60								
							Run 2 - 60' - 65' (60") RECOVERY - 60", 5 PIECES. RQD 95%	
							HARD UNWEATHERED BASALT	



HOLE UDH BAF-4

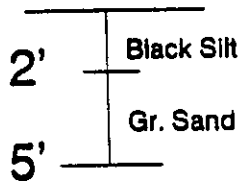
DEPTH, FT.	TUBE No.	w %	UNDRAINED STRENGTH - PSF UU ⊙	CU@P_o ⊙	VANE ⊻
13		34			1150
16	T4	34	1050	1150	
18		36			1100
21	T5	35	950	1250	
23		38			1050
26	T6	39	975	1200	
28		37			1125
31	T7	40	1000	1250	
37		35			1250
40	T9	38	800	1300	(VANE AVG 1135)

East Abutment Area

HAND AUGER HOLE LOGS

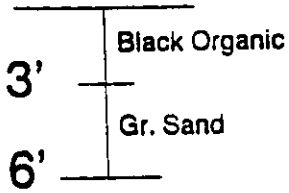
Baseline
Sta, 93+10
50' Rt.

EA1



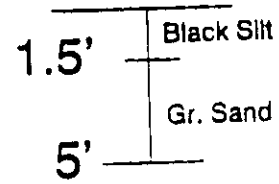
Baseline
Sta, 93+10
BL

EA2



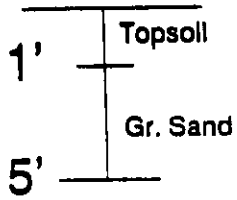
Baseline
Sta, 93+10
50' Lt.

EA3



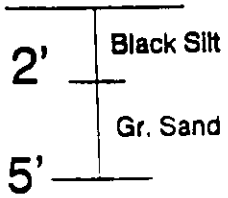
Baseline
Sta, 93+50
50' Rt.

EA4



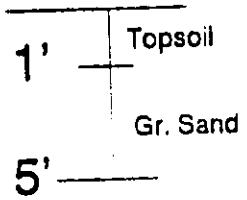
Baseline
Sta, 93+50
BL

EA5



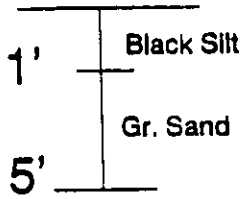
Baseline
Sta, 93+50
50' Lt.

EA6



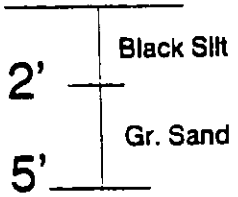
Baseline
Sta, 92+90
50' Rt.

EA7



Baseline
Sta, 92+90
BL

EA8



Baseline
Sta, 92+90
50' Lt.

EA9