A T L Testing Laboratories

A Division of R & D Engineering Associates, Inc.

Engineers • Geologists

Boyd Smith, P.E. Donald E. Green, P.E.

ATL JOB NO.: F-0385102 JULY 7, 1985

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REPORT
OF
FOUNDATION SOIL INVESTIGATION

FOR

MORRISON - KNUDSEN ENGINEERING, INC.

PROJECT

ELEVEN BRIDGE SITES
FOR
THE
A. C. D. C.

FLOOD CONTROL DISTRICT
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JUL 29 '85

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	ENGR		DISTRICT
	FINANCE		
REMARKS			

Registered Professional Engineer (Civil)
CERTIFICATE NO. 9995
DONALD E. GREEN
Date Signed 7/9/85
ARIZONA, U.S.A.

3130 North 27th Avenue • Phoenix, Arizona 85017 • Telephone (602) 252-3975

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I N D E X

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3.0 DISCUSSION & RECOMMENDATIONS.....2

3.2 Bridge Foundations.....4

LOGS OF BORINGS

Registered Professional Engineer (Civil)
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PROJECT

ELEVEN BRIDGE SITES
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THE
A. C. D. C.

1.0 SCOPE

This investigation was undertaken to define adequate foundation support for the eleven Bridge Sites on the above referenced project.

2.0 FIELD INVESTIGATION

The field investigation consisted of advancing 2 to 3 borings at each bridge site location to a sufficient depth to define adequate founding for each structure. The borings are 4-inches in diameter and were advanced with a Mobil B-50 Rotary Drill Rig. The sub-soils were classified by cuttings received at the collar of the bore holes. Bulk samples were secured to

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verify the field classification by laboratory analyses.

The auger borings were supplemented with both continuous and standard penetration tests. The continuous penetration tests consisted of advancing a 2-inch diameter blunt-nosed penetrometer with repeated blows of a 140-pound drop weight. This resistance is indicated on the attached "Logs of Borings" under the column headed "CONT". The standard penetration tests were conducted with a 2-inch O.D. Split Barrel Sampler, advanced by the same effort as the continuous penetration test. These results are noted on the attached "Logs of Borings" under the column headed "SPT". Both results are expressed in the number of blows from the 140-pound drop weight to advance the penetrometer a distance of 1-foot.

The results of the soil classification, penetration tests and the location of each boring is indicated on the "Logs of Boring", included herewith.

3.0 DISCUSSION AND RECOMMENDATIONS

3.1 Structural Considerations - It is understood each structure will be a single span bridge that will cross the A. C. D. C. The design of the structure is such there will be vertical walls at each abutment. The soil structure will be supported with a diaphragm wall.

The sub-soil conditions will not permit the driving of piling from the surface. Therefore, pre-boring will be required for the installation of pipe pile where sub-soil conditions will even permit the pre-boring. All pile should have closed end sections and be driven with a mandrel At some locations, the only feasible method of providing foundation support will be through the use of spread footings, due to the presence of strata of calichified sand, gravel, cobbles and small boulders. In these conditions, modifications to the diaphragm wall may have to be made to allow for some lateral load contribution from the spread footing.

Due to the extensive pre-boring required at locations where piles may be used, the allowable bearing values more approximates those for drilled-cast-in-place pile than driven piling. Therefore, capacities of greater than 20 tons per pile have not been considered.

The pre-boring should allow for an annular area around the pile of at least 2-inches. This void should be filled with sand slurry to provided, at least, minimal lateral support for the pile.

The bearing values and types of footings recommended herein consider limiting settlements to 1-inch.

3.2 - Bridge Foundations

3.2.1 - Bridge No. 1 - 7th Avenue

Spread footings may rest upon a calichified stratum of sand and gravel at a depth of -15 feet. The allowable bearing capacity for a 10-feet wide footing is 5.6 tons per square foot.

Pipe piling may be set below -25-feet with pre-boring to within 3-feet of anticipated tip elevation. The allowable capacity at this site is 20 tons per pile on a 24-inch diameter pile.

The average modulus of subgrade reaction to a depth of 35-feet at this location is 720 kips per square foot.

3.2.2 - Bridge No. 2 - Dunlap Avenue

Spread footings are not considerable feasible at this site. Therefore, pipe piling should be set at -35-feet, with pre-boring to within 3-feet of tip elevation. The allowable capacity is 20-tons for a 24-inch diameter pipe pile.

The average modulus of subgrade reaction to a depth of 35-feet is 630 kips per square foot.

3.2.3 - Bridge No. 3 - Central Avenue

Spread footings are not considered feasible at this site. Therefore, pipe piling should be installed to a depth of -32-feet or more. Pre-boring should be considered to within 3-feet of the pile tip elevation. The design capacity is 20 tons

for a 24-inch diameter pile.

The average modulus of subgrade reaction to a depth of 35-feet is 770 kips per square foot.

3.2.4 - Bridge No. 4 - 7th Street

Spread footings are not considered to be feasible for this site. Therefore, pipe piles should be installed with tip elevations at a minimum of -30-feet. Pre-boring will be required to within 3-feet of anticipated tip elevation. The 20 ton capacity may be developed with a pipe that has a diameter of 24-inches.

The average modulus of subgrade reaction to a depth of 35-feet is 885 kips per square foot.

3.2.5 - Bridge No. 5 - Northern Avenue

Spread footings may be used at this location that bear upon a highly calichified stratum at -15-feet. The allowable contact pressure for a 10-feet wide footing is 5.6 tons per square foot.

Pipe piles may be installed to bear upon a clayey sand and gravel at depths of -31-feet or more. The design load is 20 tons for a 24-inch diameter pipe pile.

The average modulus of subgrade reaction to a depth of 35-feet is 630 kips per square foot.

3.2.6 - Bridge, No. 6 - 12th Street

Spread footings may be utilized at this site at depths varying from -12-feet at Station to -20-feet at Station 12+28. It is not anticipated sub-soil conditions will permit the pre-boring that will be necessary to install the pipe piling. The allowable bearing value for a 10-feet wide footing is 5.6 tons per square foot.

The average modulus of subgrade reaction to a depth of 30-feet is 720 kips per square foot.

3.2.7 - Bridge No. 7 - 16th Street

Pile installation is not considered feasible at this location. The strongly cemented strata below -10-feet will resist the pre-boring and driving of piling. Therefore, the use of spread footings are recommended. These footings may bear upon the strongly calichified layer at depths below -10-feet. The allowable bearing capacity a 10-feet wide footing is 5.0 tons per square foot.

The average modulus of subgrade reaction to a depth of 35-feet is 720 kips per square foot.

3.2.8 - Bridge No. 8 - Glendale Avenue

The use of pile foundations are not considered feasible at this site due to a shallow calichified stratum. Therefore, the use of spread footings are recommended for use. The footings

should bear at a minimum of -6-feet. The allowable bearing capacity for a 10-feet wide footing is 3.8 tons per square foot.

The average modulus of subgrade reaction to a depth of 35-feet is 930 kips per square foot.

3.2.9 - Bridge No. 9 - Maryland Avenue

Piling are not recommended at this location due to a strongly calichified stratum at -5-feet. Therefore, spread footings should be designed to bear upon this stratum at a minimum depth of -6-feet. The allowable bearing capacity for a 10-feet wide footing is 3.8 tons per square foot.

The average modulus of subgrade reaction to a depth of 35-feet at this location is 930 kips per square foot.

3.2.10 - Bridge No. 10 - 24th Street

Spread footings should be designed at this location to bear upon a calichified stratum at a depth of -6-feet. The allowable bearing capacity for a 10-feet wide footing is 3.8 tons per square foot.

The average modulus of subgrade reaction to a depth of 35-feet at this location is 930 kips per square foot.

3.2.11 - Bridge No. 11 - 32nd Street

Spread footings should be used at this location. They should bear upon a calichified stratum at -6-feet. The allowable bearing capacity for a 10-feet wide footing is 3.8 tons per

square foot.

The average modulus of subgrade reaction to depth of 35 feet at this location is 930 kips per square foot.

Respectfully submitted,
ATL TESTING LABORATORIES

Registered Professional Engineer (Civil)
CERTIFICATE NO. 9995
DONALD E. GREEN
Date Signed 7/9/85
ARIZONA, U.S.A.

Donald E. Green, P.E.

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #5 - NORTHERN AVENUE

BORING TYPE: '4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 42-FEET LEFT OF STATION 20+74

SPT	CONT	DEPTH	DESCRIPTION
		1	SILTY SAND & GRAVEL
	87		LIGHT BROWN
		2	SLIGHTLY MOIST
	100		
		3	----------
	37		CLAYEY SAND & GRAVEL TO 2.5"
		4	WEAK CALCAREOUS CEMENTATION
	28		GRAYISH BROWN
		5	SLIGHTLY MOIST
	53		
		6	
	36		
		7	
	31		
		8	
	40		
		9	
	41		
		10	
103	100/4"		
		11	
		12	
		13	
		14	
		15	
	95		
		16	
	45		
		17	
		18	
		19	
		20	
	78		
		21	
	34		
		22	
		23	
		24	
		25	
	41		
		26	----------
	45		SANDY GRAVELLY CLAY
		27	STONG CALCAREOUS CEMENTATION
			BROWN
		28	SLIGHTLY MOIST
		29	
		30	
	64		
		31	----------
	93		CLAYEY SAND, GRAVEL AND COBBLES
		32	STRONG CALCAREOUS CEMENTATION
			GRAYISH BROWN
		33	SLIGHTLY MOIST
		34	
		35	
	100/10"		
		36	
		37	
		38	
		39	NEAR AUGER REFUSAL AT 40-FEET
			BOTTOM OF BORING
		40	----------

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #5 - NORTHERN AVENUE

BORING TYPE: '4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION 52-FEET RIGHT OF STATION 21+19

SPT	CONT	DEPTH	DESCRIPTION
4			
		1	SILTY SAND & FINE GRAVEL
6			LIGHT BROWN
		2	--SLIGHTLY MOIST----------
14			
		3	CLAYEY SAND, GRAVEL & COBBLES
19			WEAK CALCAREOUS CEMENTATION
		4	GRAYISH BROWN
32			SLIGHTLY MOIST
		5	
90			
		6	
106			
		7	
90/3"			
		8	
		9	
		10	
74			
		11	
68			
		12	
		13	
		14	
		15	
103/6"			
		16	
45			
		17	
		18	
		19	
		20	
110/10"			
		21	
		22	
		23	
		24	
		25	
70			
		26	
79/6"			
		27	
		28	
		29	
		30	
104/8"			
		31	
		32	
		33	
		34	
		35	
108/6"			
		36	
		37	NEAR AUGER REFUSAL AT 38-FEET
			BOTTOM OF BORING
		38	----------
		39	
		40	

ATL

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #5 - NORTHERN AVENUE

DATE JULY 9, 1985

LOCATION NORTHERN AVENUE

MATERIAL SUBGRADE SOIL

DATE OF SAMPLE 5-17-85

SUBMITTED BY ATL/T. SMITH

REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	¼	3/8	3/4	1	1½	
#1		0'-3'	SC	25	7	29	35	44	54	60	72	76	86	98	99	100	681
#1		3'-26'	SC	33	13	24	28	33	39	43	53	57	65	80	86	94	682
#1		29½'-39½'	GW-GM	36	14	8	10	11	12	13	14	16	26	48	62	85	683
#2		0'-2'	SM	23	2	42	50	59	68	73	84	88	93	100			684
#2		2'-38'	GC	31	9	16	19	22	26	30	45	52	63	85	92	100	685

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #1 - 7TH AVENUE

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION: 18-FEET LEFT OF STATION 14+18

SPT CONT	DEPTH	DESCRIPTION
7		
	1	CLAYEY SILT
6		BROWN
	2	SLIGHTLY MOIST
13		
	3	
19		
	4	
29		———
	5	CLAYEY SAND & FINE GRAVEL
28		WEAK CALCAREOUS CEMENTATION
	6	LIGHT BROWN
47		SLIGHTLY MOIST
	7	
57		
	8	
75		
	9	
100/9"		
	10	
49		———
	11	CLAYEY SAND & GRAVEL
139		STONG CALCAREOUS CEMENTATION
	12	TAN
		SLIGHTLY MOIST
	13	
	14	
	15	
117		
	16	
100/11"		
	17	
	18	
	19	
	20	

SPT CONT	DEPTH	DESCRIPTION
144		
	21	
103/6"		
	22	
	23	
	24	GRAVELLY SANDY CLAY
		MODERATE CALCAREOUS CEMENTATION
	25	GRAYISH BROWN
		SLIGHTLY MOIST
	26	
	27	
	28	
	29	
	30	
69		
	31	
100/10"		
	32	
	33	
	34	
	35	
100/6"		
	36	
	37	
	38	
	39	BOTTOM OF BORING AT 40-FEET
	40	———

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #1 - 7TH AVENUE

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION: 6-FEET RIGHT OF STATION 14+65

SPT	CONT	DEPTH	DESCRIPTION
7			
		1	SILTY SAND
6			LIGHT BROWN
		2	SLIGHTLY MOIST
22			
		3	
41			
		4	
29			----------
		5	CLAYEY SAND & FINE GRAVEL
21			WEAK CALCAREOUS CEMENTATION
		6	TAN
25			SLIGHTLY MOIST
		7	
21			
		8	
25			
		9	
27			
		10	
23			----------
		11	CLAYEY SAND & GRAVEL
17			STONG CALCAREOUS CEMENTATION
		12	TAN
32			SLIGHTLY MOIST
		13	
37			
		14	
31			
		15	
25			
		16	
27			
		17	
33			
		18	
26			
		19	
28			
		20	
	39		
		21	
	50		
		22	
	45		
		23	
	54		
		24	----------
	70		CLAYEY SAND WITH GRAVEL TO 1"
		25	WEAK CALCAREOUS CEMENTATION
66	84		GRAYISH BROWN
		26	MOIST
92			
		27	
		28	
		29	
		30	
		31	
155			
		32	
		33	
		34	
		35	
		36	
172			
		37	
		38	
		39	BOTTOM OF BORING AT 40-FEET
		40	----------

A T L

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #1 DATE JULY 9, 1985

LOCATION 7TH STREET

MATERIAL SUBGRADE SOIL DATE OF SAMPLE 5-8-85

SUBMITTED BY ATL/T. SMITH REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		1½'-4½'	CL-ML	23	6	52	61	72	81	85	90	91	94	100			557
#1		4½'-10½'	SC	35	16	32	36	41	53	65	84	89	94	100			558
#1		10½'-24'	SC	40	17	47	54	61	72	80	94	97	100				559
#1		24'-40'	SC	39	13	35	42	48	58	65	75	79	83	86	88	100	560
#2		1½'-4½'	SC	26	11	38	45	57	75	84	94	96	97	100			561
#2		4½'-10½'	SC	36	15	35	41	47	58	67	77	83	89	97	99	100	562
#2		10½'-24'	SC	40	16	25	29	34	41	46	54	57	70	97	99	100	563
#2		24'-40'	SM	26	2	36	47	58	74	83	95	98	99				564

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATIO BRIDGE #2 - DUNLAP AVENUE

BORING TYPE: '4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION CENTERLINE STATION 19+26

SPT	CONT	DEPTH	DESCRIPTION
		1	ASPHALTIC CONCRETE & BASE COURSE
		2	
	6		SILTY SAND AND FINE GRAVEL
		3	BROWN
	6		MOIST
		4	
	9		
		5	
	6		
		6	
	8		
		7	
	14		
		8	CLAYEY SAND WITH SOME FINE GRAVEL
	18		GRANITIC ORIGIN
		9	WEAK CALCAREOUS CEMENTATION
	15		LIGHT BROWN
		10	SLIGHTLY MOIST
18	15		
		11	
14	20		
		12	
	37		
		13	
	38		
		14	
	39		
		15	
58	50		
		16	
111	100/10"		
		17	
			CLAYEY SAND AND GRAVEL
		18	WEAK CALCAREOUS CEMENTATION
			GRAYISH BROWN
		19	SLIGHTLY MOIST
		20	
	41		
		21	
	77		
		22	
		23	
		24	
		25	
	27		
		26	
	33		
		27	
		28	
		29	
		30	
	20		
		31	
	32		
		32	
		33	
		34	
		35	
	81		
		36	CLAYEY GRAVEL
	100		WEATHERED IN-PLACE GRANITE
		37	LIGHT BROWN
			SLIGHTLY MOIST
		38	
		39	BOTTOM OF BORING AT 40-FEET
			IN MATERIAL DESCRIBED ABOVE
		40	

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATIO BRIDGE #2 - DUNLAP AVENUE

BORING TYPE: '4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION CENTERLINE STATION 20+03

SPT	CONT	DEPTH	DESCRIPTION
		1	
		2	
	9		SILTY SAND
		3	BROWN
	6		MOIST
		4	
	10		
		5	
	11		
		6	
	12		
		7	
	28		
		8	CLAYEY SAND WITH SOME FINE GRAVEL
	32		GRANITIC ORIGIN
		9	WEAK CALCAREOUS CEMENTATION
	28		LIGHT BROWN
		10	SLIGHTLY MOIST
17	23		
		11	
37	31		
		12	
	31		
		13	
	45		
		14	
	29		
		15	
36	36		
		16	
55	33		
		17	
	33		
		18	
	40		
		19	
	38	20	
30	39		
		21	
49	50		
		22	
	44		
		23	
	37		
		24	
	37		
		25	
31	60		
		26	
35	46		
		27	
	35		
		28	
	56		
		29	
	100/10"		
		30	
60			
		31	CLAYEY GRAVEL
60			WEATHERED IN-PLACE GRANITE
		32	GRAYISH BROWN
			SLIGHTLY MOIST
		33	
		34	
		35	
50			
		36	
63			
		37	
		38	
		39	BOTTOM OF BORING AT 40-FEET
		40	IN MATERIAL DESCRIBED ABOVE

TABULATION OF TEST RESULTS

JOB NO.: F0385102

A T L

Testing Laboratories

PROJECT: BRIDGE #2 DATE JULY 9, 1985

LOCATION DUNLAP AVENUE-WEST OF 3RD AVENUE

MATERIAL SUBGRADE SOIL DATE OF SAMPLE 5-9-85

SUBMITTED BY ATL/T. SMITH REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		1½-'7'	SM	21	3	44	56	68	81	89	97	98	100				615
#1		7'-19'	SC	37	13	29	34	40	51	60	72	80	89	98	100		616
#1		19'-31'	GW-GM	40	18	12	14	16	21	28	46	59	72	89	94	100	617
#1		31'-35½'	GW=GM	38	20	2	2	2	2	2	8	33	74	99	100		618
#2		1½'-7'	SM	20	2	34	45	57	69	76	84	87	91	99	100		619
#2		7'-28'	SC	42	19	26	31	36	44	52	64	72	83	97	99	100	620
#2		28'-40'	GC	42	19	13	15	16	17	18	29	39	60	95	100		621

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATIOBRIDGE #3 - CENTRAL AVENUE

BORING TYPE: '4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 18-FEET RIGHT OF STATION 18+30

SPT	CONT	DEPTH	DESCRIPTION
	15		ASPHALTIC CONCRETE & BASE COURSE
		1	
	20		SANDY CLAY WITH SOME FINE GRAVEL
		2	WEAK CALCAREOUS CEMENTATION
	22		TAN
		3	MOIST
23	17		
		4	
	14		
		5	
	10		CLAYEY SAND WITH SOME GRAVEL
		6	WEAK CALCAREOUS CEMENTATION
	10		TAN
		7	MOIST
23	10		
		8	
	18		CLAYEY SAND WITH SOME GRAVEL
		9	TAN - DARK GRAY
	25		MOIST
		10	
21	57		
		11	
22	26		
		12	
	52		
		13	
	26		
		14	SILTY CLAY
	29		WEAK CALCAREOUS CEMENTATION
		15	LIGHT TAN
26	33		MOIST
		16	
34	25		
		17	
	45		
		18	CLAYEY SAND WITH SOME FINE GRAVEL
	53		MODERATE CALCAREOUS CEMENTATION
		19	LIGHT TAN
	65		MOIST
		20	

SPT	CONT	DEPTH	DESCRIPTION
30	52		
		21	
49	66		
		22	
	64		
		23	
	79		
		24	
	100/9"		
		25	
35			
		26	
43			
		27	
		28	
		29	
		30	
38			
		31	CLAYEY GRAVEL
110			WEATHERED IN-PLACE GRANITE
		32	GRAYISH BROWN
			SLIGHTLY MOIST
		33	
		34	
		35	
166/10"			
		36	
		37	
		38	
		39	BOTTOM OF BORING AT 40-FEET
		40	IN MATERIAL DESCRIBED ABOVE

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #3 - CENTRAL AVENUE

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION CENTERLINE STATION 19+36

SPT	CONT	DEPTH	DESCRIPTION
			ASPHALTIC CONCRETE & BASE COURSE
		1	
	11		SANDY CLAY WITH SOME FINE GRAVEL
		2	WEAK CALCAREOUS CEMENTATION
	15		TAN
		3	MOIST
	8		
		4	
	8		
		5	
32	9		
		6	
23	12		
		7	
	15		
		8	
	21		
		9	
	23		
		10	
16	21		
		11	
22	30		
		12	
	26		
		13	
	54		
		14	
	56		
		15	
23	39		
		16	
45	41		
		17	
	100/10"		
		18	CLAYEY SAND WITH SOME FINE GRAVEL
			STRONG CALCAREOUS CEMENTATION
		19	LIGHT TAN
		20	MOIST

SPT	CONT	DEPTH	DESCRIPTION
	15		
		21	
	100/4"		
		22	
		23	
		24	
		25	
	10		
		26	
	33		
		27	
		28	
		29	
		30	
	47		
		31	
	53		
		32	
		33	
		34	
	57		
		35	
	146/10"		CLAYEY GRAVEL
		36	WEATHERED IN-PLACE GRANITE
			BROWN
		37	SLIGHTLY MOIST
		38	
		39	BOTTOM OF BORING AT 40-FEET
		40	~~IN MATERIAL DESCRIBED ABOVE~~

TABULATION OF TEST RESULTS

JOB NO.: F0385102

ATL

Testing Laboratories

PROJECT: BRIDGE #3

DATE JULY 9, 1985

LOCATION CENTRAL AVENUE @ RUTH

MATERIAL SUBGRADE SOIL

DATE OF SAMPLE 5-10-85

SUBMITTED BY ATL/R. BOYER

REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		6"-6'	CL	28	8	61	71	78	84	88	94	96	98				626
#1		5"-8'	SC-GC	33	15	19	22	25	29	33	50	60	77	94	100		627
#1		8'-13½'	SC	45	20	37	44	50	57	63	75	81	88	100			628
#1		13½-17½'	CH-CL	50	25	58	66	72	76	79	85	88	92	98	98	100	629
#1		17½'-40'	SC	45	23	31	34	37	41	45	51	57	72	93	93	100	630
#2		6"-3'	CL	37	18	61	69	75	80	83	87	88	90	91	94	100	631
#2		3'-13½'	SC	34	14	42	49	53	58	62	72	77	84	94	94	100	632
#2		13½'-40'	GW-GC	44	20	12	14	17	19	22	39	51	72	96	100		633

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #4 - 7TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION 43-FEET LEFT OF STATION 28+87

SPT	CONT	DEPTH	DESCRIPTION
	16		
		1	SANDY CLAY
	10		BROWN
		2	MOIST
	8		
		3	
	6		
		4	
	7		
		5	
	12		
		6	
	12		
		7	CLAYEY SAND AND GRAVEL
	25		WEAK CALCAREOUS CEMENTATION
		8	LIGHT BROWN
	27		SLIGHTLY MOIST
		9	
	41		
		10	
22	36		
		11	
30	20		
		12	
	51		
		13	
	105		
		14	
		15	
43			
		16	
77			
		17	
		18	
		19	
		20	

SPT	CONT	DEPTH	DESCRIPTION
	23		
		21	
	67		
		22	
		23	
			GRAVEL TO 2" IN DIAMETER IN A SILTY CLAY
		24	MATRIX
			MODERATE CALCAREOUS CEMENTATION
		25	GRAYISH BROWN
	36		SLIGHTLY MOIST
		26	
	44		
		27	
		28	
		29	
		30	
	38		
		31	
	61		
		32	
		33	
		34	
		35	CLAYEY SAND & GRAVEL
	44		MODERATE CALCAREOUS CEMENTATION
		36	BROWN
	99		SLIGHTLY MOIST
		37	
		38	
		39	BOTTOM OF BORING AT 40-FEET
		40	IN MATERIAL DESCRIBED ABOVE

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #4 - 7TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION65-FEET RIGHT OF STATION 28+10

SPT CONT	DEPTH	DESCRIPTION
	1	CLAYEY SAND WITH SOME FINE GRAVEL
13		BROWN
	2	MOIST
9		
	3	
4		
	4	
6		
	5	
8		
	6	
10		
	7	CLAYEY SAND AND GRAVEL
22		WEAK CALCAREOUS CEMENTATION
	8	LIGHT BROWN
22		SLIGHTLY MOIST
	9	
33		
	10	
35		
	11	
36		
	12	
59		
	13	
80		
	14	
62/5"		
	15	
39		CLAYEY SAND & GRAVEL
	16	WEAK CALCAREOUS CEMENTATION
87		GRAYISH BROWN
	17	SLIGHTLY MOIST
	18	
	19	
	20	

SPT CONT	DEPTH	DESCRIPTION
30		
	21	
64		
	22	
	23	
	24	
	25	
28		
	26	
74		
	27	
	28	
	29	
	30	
122		
	31	
	32	
	33	
	34	
	35	
100/9"		
	36	
	37	
	38	
	39	BOTTOM OF BORING AT 40-FEET
	40	IN MATERIAL DESCRIBED ABOVE

A T L

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #4 DATE JULY 9, 1985

LOCATION 7TH STREET & GOSWELD

MATERIAL SUBGRADE SOIL DATE OF SAMPLE 5-13-85

SUBMITTED BY ATL/T. SMITH REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		1'-7'	SM-SC	22	5	40	50	61	71	76	83	90	95	99	100		635
#1		7'-16½'	SC	41	16	30	35	41	48	54	64	71	83	97	98	100	636
#1		16½'-40'	GM-GC	47	22	10	12	14	16	18	26	33	47	73	82	100	637
#2		0'-7'	CL	28	11	59	67	73	78	81	86	88	91	97	100		638
#2		7'-23'	GC	36	18	30	34	38	43	48	59	69	75	88	92	100	639
#2		23'-34'	GW-GP	41	21	2	2	2	2	3	7	13	24	58	73	91	640

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #6 - 12TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION 4-FEET RIGHT OF STATION 11+76

SPT	CONT	DEPTH	DESCRIPTION
		1	ASPHALTIC CONCRETE & BASE COURSE
		2	SAND AND GRAVEL
22			BROWN
		3	MOIST
18			
		4	
81			CLAYEY SAND & GRAVEL
		5	WEAK CALCAREOUS CEMENTATION
42			LIGHT BROWN
		6	SLIGHTLY MOIST
37			
		7	
41			
		8	
25			
		9	
60			
		10	CLAYEY SAND & GRAVEL
71	100/11"		STRONG CALCAREOUS CEMENTATION
		11	GRAYISH BROWN
45/4			SLIGHTLY MOIST
		12	
		13	
		14	
		15	
104			
		16	
		17	
		18	
		19	
		20	

SPT	CONT	DEPTH	DESCRIPTION
103			
		21	CLAYEY SAND AND GRAVEL
			STRONG CALCAREOUS CEMENTATION
		22	GRAYISH BROWN
			SLIGHTLY MOIST
		23	
		24	
		25	
109/8"			
		26	
		27	
		28	
		29	
		30	
102/4"			
		31	
		32	
		33	
		34	
		35	
78			
		36	
81			
		37	
		38	
		39	
		40	
106/7"			

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #6 - 12TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 17-FEET LEFT OF STATION 12+28

SPT CONT	DEPTH	DESCRIPTION
	1	ASPHALTIC CONCRETE & BASE COURSE
	2	SAND AND GRAVEL
31		BROWN
	3	MOIST
42		
	4	
27		
	5	
18		
	6	
15		
	7	
12		
	8	
21		
	9	
81		
	10	
80		
	11	
39		CLAYEY SAND AND GRAVEL
	12	LIGHT BROWN
38		SLIGHTLY MOIST
	13	
35		
	14	
28		
	15	
22		
	16	
40		
	17	
31		
	18	
25		
	19	
34	20	

SPT CONT	DEPTH	DESCRIPTION
100 91		
	21	CLAYEY SAND AND GRAVEL
100/3"		STRONG CALCAREOUS CEMENTATION
	22	GRAYISH BROWN
		SLIGHTLY MOIST
	23	
	24	
	25	
100/6"		
	26	
	27	
	28	
	29	
	30	
100/6"		
	31	
	32	
	33	
	34	
	35	CLAYEY SAND & GRAVEL
34		MODERATE CALCAREOUS CEMENTATION
	36	BROWN
71/3"		SLIGHTLY MOIST
	37	
	38	
		CLAYEY SAND, GRAVEL & COBBLES
	39	STRONG CALCAREOUS CEMENTATION
134	40	SLIGHTLY MOIST

ATL

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #6 DATE JULY 9, 1985

LOCATION 12TH STREET

MATERIAL SUBGRADE SOIL DATE OF SAMPLE 5-20-85

SUBMITTED BY ATL/T. SMITH REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		1½'-11'	GW-GM	20	1	11	13	18	24	28	39	44	55	81	92	100	703
#1		11'-20½'	SW-SM	23	6	12	15	20	30	38	57	68	82	96	98	100	704
#1		25'-38'	SM-SC	26	6	20	23	30	41	52	74	80	87	96	99	100	705
#2		9½'-40'	SC	35	11	21	25	31	41	50	66	72	81	97	99	100	706

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #7 - 16TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 45-FEET LEFT OF STATION 19+12

SPT CONT	DEPTH	DESCRIPTION
22		
	1	SILTY SAND & GRAVEL
15		BROWN
	2	MOIST
15		
	3	
25		
	4	
15		
	5	
44		
	6	
100		
	7	CLAYEY SAND & GRAVEL WITH
82		INFREQUENT COBBLES
	8	MODERATE CALCAREOUS CEMENTATION
100/6"		BROWN
	9	SLIGHTLY MOIST
	10	CLAYEY SAND & GRAVEL
100/ 4"		STRONG CALCAREOUS CEMENTATION
	11	GRAYISH BROWN
		SLIGHTLY MOIST
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	
	21	CLAYEY SAND AND GRAVEL
		STRONG CALCAREOUS CEMENTATION
	22	GRAYISH BROWN
		SLIGHTLY MOIST
	23	
	24	
	25	
	26	
	27	
	28	
	29	
	30	
100/4"		WEATHERED IN-PLACE GRANITE
	31	
	32	
	33	
	34	
	35	
100/1"		BOTTOM OF BORING AT 35-FEET
	36	
	37	
	38	
	39	
	40	

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #7 - 16TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION CENTERLINE STATION17+95

SPT CONT	DEPTH	DESCRIPTION
	1	ASPHALTIC CONCRETE & BASE COURSE
	2	CLAYEY SAND & GRAVEL TO 1.5" BROWN
	3	MOIST
	4	SILTY SAND GRAVEL & COBBLES
	5	STRONG CALCAREOUS CEMENTATION GRAYISH BROWN
	6	SLIGHTLY MOIST
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	AUGER REFUSAL ON COBBLES & SMALL BOULDER
	15	
	16	
	17	
	18	
	19	
	20	

SPT CONT	DEPTH	DESCRIPTION
	21	
	22	
	23	
	24	
	25	
	26	
	27	
	28	
	29	
	30	
	31	
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	
	40	

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #7 - 16TH STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 3

BORING LOCATION 60-FEET RIGHT OF STATION 16+85

SPT CONT	DEPTH	DESCRIPTION
44		
	1	SILTY SAND & GRAVEL TO 2"
68		BROWN
	2	MOIST
19		
	3	
15		
	4	
33		
	5	
100/10"		
	6	CLAYEY SAND & GRAVEL WITH
		INFREQUENT COBBLES
	7	MODERATE CALCAREOUS CEMENTATION
		GRAYISH BROWN
	8	SLIGHTLY MOIST
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	16	
	17	
	18	
	19	
	20	

SPT CONT	DEPTH	DESCRIPTION
	21	
	22	
	23	
	24	
	25	
	26	
	27	
	28	
	29	
	30	
	31	
	32	
	33	
	34	
	35	BOTTOM OF BORING AT 35-FEET
	36	
	37	
	38	
	39	
	40	

ATL

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #7 DATE JULY 9, 1985

LOCATION 16TH STREET

MATERIAL SUBGRADE SOIL DATE OF SAMPLE 5-21-85

SUBMITTED BY ATL/T. SMITH REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		0'-6½'	GM	25	3	20	24	29	35	39	48	53	62	85	91	97	789
#1		6½'-21	SC	28	9	19	23	29	39	47	65	73	84	99	100		790
#1		21'-31'	SC	36	16	44	51	60	72	80	90	93	97	100			791

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATIO BRIDGE #8 - GLENDALE AVENUE

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 25-FEET LEFT OF STATION 15+80

SPT	CONT	DEPTH	DESCRIPTION
		1	ASPHALTIC CONCRETE & BASE COURSE
		2	CLAYEY SAND WITH SOME GRAVEL & COBBLES
30			WEAK CALCAREOUS CEMENTATION
		3	GRAYISH BROWN
30			MOIST
		4	
80/1"			CLAYEY SAND GRAVEL & COBBLES
		5	STONG CALCAREOUS CEMENTATION
100/ 6"			TAN
		6	MOIST
		7	
		8	
		9	
		10	SILTY SAND, GRAVEL & COBBLES
140			STRATIFIED CALCAREOUS CEMENTATION
		11	TAN
140/11"			MOIST
		12	
		13	
		14	
		15	CLAYEY SAND GRAVEL COBBLES AND
100/1"			SMALL BOULDERS
		16	STRONG CALCAREOUS CEMENTATION
			TAN
		17	MOIST
		18	AUGER REFUSAL AT 17-FEET
			ON MATERIAL DESCRIBED ABOVE
		19	
		20	

BORING NO: 2

BORING LOCATION 46-FEET RIGHT OF STATION 16+45

SPT	CONT	DEPTH	DESCRIPTION
		1	SILTY SAND AND GRAVEL
47			WEAK CALCAREOUS CEMENTATION
		2	TAN
58			SLIGHTLY MOIST
		3	
100/10"			
		4	
			CLAYEY SAND GRAVEL AND COBBLES
		5	STRONG CALCAREOUS CEMENTATION
			TAN
		6	SLIGHTLY MOIST
		7	
		8	
		9	
100/1"		10	
		11	
		12	
		13	
		14	
100/1"		15	
		16	
		17	
			AUGER NEAR REFUSAL AT 17-FEET
		18	ON MATERIAL DESCRIBED ABOVE
		19	
		20	

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATIO BRIDGE #8 - GLENDALE AVENUE

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 25-FEET LEFT OF STATION 15+80

SPT CONT	DEPTH	DESCRIPTION
	1	ASPHALTIC CONCRETE & BASE COURSE
	2	CLAYEY SAND WITH SOME GRAVEL & COBBLES
30		WEAK CALCAREOUS CEMENTATION
	3	GRAYISH BROWN
30		MOIST
	4	
80/1"		CLAYEY SAND GRAVEL & COBBLES
	5	STONG CALCAREOUS CEMENTATION
100/ 6"		TAN
	6	MOIST
	7	
	8	
	9	
	10	SILTY SAND, GRAVEL & COBBLES
140		STRATIFIED CALCAREOUS CEMENTATION
	11	TAN
140/11"		MOIST
	12	
	13	
	14	
	15	CLAYEY SAND GRAVEL COBBLES AND
100/1"		SMALL BOULDERS
	16	STRONG CALCAREOUS CEMENTATION
		TAN
	17	MOIST
	18	AUGER REFUSAL AT 17-FEET
		ON MATERIAL DESCRIBED ABOVE
	19	
	20	

BORING NO: 2

BORING LOCATION 46-FEET RIGHT OF STATION 16+45

SPT CONT	DEPTH	DESCRIPTION
	1	SILTY SAND AND GRAVEL
47		WEAK CALCAREOUS CEMENTATION
	2	TAN
58		SLIGHTLY MOIST
	3	
100/10"		
	4	
		CLAYEY SAND GRAVEL AND COBBLES
	5	STRONG CALCAREOUS CEMENTATION
		TAN
	6	SLIGHTLY MOIST
	7	
	8	
	9	
100/1"	10	
	11	
	12	
	13	
	14	
100/1"	15	
	16	
	17	
		AUGER NEAR REFUSAL AT 17-FEET
	18	ON MATERIAL DESCRIBED ABOVE
	19	
	20	

ATL

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #8

DATE JULY 9, 1985

LOCATION

MATERIAL SUBGRADE SOIL

DATE OF SAMPLE 5-28-85

SUBMITTED BY ATL/T. SMITH

REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		1½'-4'	SC	24	8	16	20	26	33	39	51	59	73	94	97	97	820
#1		¼'-9½'	SM-SC	24	6	24	29	37	48	57	72	80	90	100			821
#1		9½'-17'	SM	22	4	19	23	30	41	50	70	79	96	100			822

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #9 - MARYLAND AVENUE

BORING TYPE: 6-INCH HOLLOW STEMED FLIGHT AUGER

BORING NO: 1

BORING LOCATION 20 FEET LEFT OF STATION 12+00

SPT	CONT	DEPTH	DESCRIPTION
		1	ASPHALTIC CONCRETE & BASE COURSE
		2	CLAYEY SAND AND GRAVEL
10			LIGHT CALCAREOUS CEMENTATION
		3	BROWN
20			SLIGHTLY MOIST
		4	
59			
		5	
111	100/1"		
		6	SILTY SAND AND GRAVEL
			WITH SOME COBBLES & SMALL BOULDERS
		7	STRONG CALCAREOUS CEMENTATION
			GRAYISH BROWN
		8	SLIGHTLY MOIST
		9	
		10	
100/.5"			
		11	
		12	
		13	
		14	
		15	
100/1"			
		16	
		17	
		18	
		19	AUGER NEAR REFUSAL AT -31' IN MATERIAL
			DESCRIBED ABOVE
		20	

BORING NO: 2

BORING LOCATION 12-FEET RIGHT OF STATION 12+65

SPT	CONT	DEPTH	DESCRIPTION
		1	SILTY SAND AND GRAVEL
			WEAK CALCAREOUS CEMENTATION
		2	BROWN - GRAY
40			SLIGHTLY MOIST
		3	
54			
		4	
100/11"			
		5	
			SILTY SAND AND GRAVEL
		6	WITH SOME COBBLES & SMALL BOULDERSS
			STRONG CALCAREOUS CEMENTATION
		7	GRAYISH TAN
			SLIGHTLY MOIST
		8	
		9	
		10	
		11	
		12	
		13	AUGER NEAR REFUSAL AT 12-FEET
			ON MATERIAL DESCRIBED ABOVE
		14	
		15	
		16	
		17	
		18	
		19	
		20	

ATL

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #9

DATE JULY 9, 1985

LOCATION MARYLAND

MATERIAL SUBGRADE SOIL

DATE OF SAMPLE 5-24-85

SUBMITTED BY ATL/T. SMITH

REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		1½'-4½'	SC	31	14	27	30	33	38	44	61	70	84	99	100		806
#1		4½'-31'	SM	22	4	20	23	28	38	46	62	69	81	97	09	100	807
#2		0'-4'	GC	23	13	15	18	23	30	35	48	57	71	96	99	100	808
#2		4'-12'	SC	44	25	23	27	34	45	55	76	84	92	100			809

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #10 - 24TH STREET

BORING TYPE: 6-INCH HOLLOW STEMED FLIGHT AUGER

BORING NO: 3

BORING NO:

BORING LOCATION 107' RIGHT OF MON LINE STATION 12+40

BORING LOCATION

SPT CONT	DEPTH	DESCRIPTION	SPT CONT	DEPTH	DESCRIPTION
	1	CLAYEY SAND AND GRAVEL		1	
66		WEAK CALCAREOUS CEMENTATION			
	2	LIGHT BROWN		2	
60		SLIGHTLY MOIST			
	3			3	
57					
	4			4	
100/8"		----------			
	5			5	
100/11"		SILTY SAND AND GRAVEL			
	6	STRONG CALCAREOUS CEMENTATION		6	
		GRAYISH TAN			
	7	SLIGHTLY MOIST		7	
	8			8	
	9	----------		9	
		AUGER NEAR REFUSAL AT 9-FEET			
	10	ON MATERIAL DESCRIBED ABOVE		10	
	11			11	
	12			12	
	13			13	
	14			14	
	15			15	
	16			16	
	17			17	
	18			18	
	19			19	
	20			20	

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #10 - 24TH STREET

BORING TYPE: 6-INCH HOLLOW STEMED FLIGHT AUGER

BORING NO: 1

BORING LOCATION10' RIGHT OF MON LINE STA 16+64

SPT	CONT	DEPTH	DESCRIPTION
	89		
		1	CLAYEY SAND AND GRAVEL
	100/1"		MODERATE CALCAREOUS CEMENTATION
		2	LIGHT BROWN
			SLIGHTLY MOIST
		3	
		4	
			_____
		5	
			SILTY SAND AND GRAVEL
		6	STRONG CALCAREOUS CEMENTATION
			TAN
		7	SLIGHTLY MOIST
		8	
			_____
		9	
			SILTY CLAY WITH SOME GRAVEL
		10	WEAK CALCAREOUS CEMENTATION
			BROWN
		11	MOIST
		12	
		13	
		14	
		15	
	75		_____
		16	SILTY CLAY
	100/1"		VERY STRONG CALCAREOUS CEMENTATION
		17	TAN - GRAY
			SLIGHTLY MOIST
		18	
		19	
		20	AUGER NEAR REFUSAL AT 19.5'

BORING NO: 2

BORING LOCATION 10' RIGHT OF MON LINE STATION 14+80

SPT	CONT	DEPTH	DESCRIPTION
	89		
		1	CLAYEY SAND AND GRAVEL
	100/8"		WEAK CALCAREOUS CEMENTATION
		2	BROWN
			SLIGHTLY MOIST
		3	
		4	
			_____
		5	
	100/1"		CLAYEY SAND AND GRAVEL
		6	
			STRONG CALCAREOUS CEMENTATION
		7	GRAYISH TAN
			SLIGHTLY MOIST
		8	
		9	
		10	
	100/3"		
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	
			AUGER REFUSAL AT 22-FEET
		19	ON MATERIAL DESCRIBED ABOVE
		20	

ATL

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #10 DATE JULY 9, 1985

LOCATION

MATERIAL SUBGRADE SOIL DATE OF SAMPLE 5-28-85

SUBMITTED BY ATL/T. SMITH REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#1		0'-4½'	SM-SC	27	6	28	34	40	47	52	64	70	82	99	100		823
#1		4½'-8½'	GC	28	9	17	21	25	30	34	46	56	75	99	100		824
#1		8½'-15½'	CL	40	23	63	73	77	80	81	88	92	97	100			825

ATL

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #11 - 32ND STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 1

BORING LOCATION 59-FEET LEFT MON. LINE STATION 15+39

SPT CONT	DEPTH	DESCRIPTION
28		
	1	CLAYEY SAND AND GRAVEL
49		WEAK CALCAREOUS CEMENTATION
	2	BROWN
100/11"		SLIGHTLY MOIST
	3	
	4	CLAYEY SAND, GRAVEL & COBBLES
		STONG CALCAREOUS CEMENTATION
	5	GRAYISH BROWN
		SLIGHTLY MOIST
	6	
	7	
	8	
	9	
100/2"	10	
	11	
	12	
	13	
	14	
100/2"	15	
	16	
	17	
	18	— PERCHED WATER TABLE —
	19	
100/2"	20	

SPT CONT	DEPTH	DESCRIPTION
	21	
	22	
	23	
	24	
	25	
		AUGER REFUSAL UPON
	26	COBBLES & SMALL BOULDERS
	27	
	28	
	29	
	30	
	31	
	32	
	33	
	34	
	35	
	36	
	37	
	38	
	39	
	40	

A T L

LOG OF BORING

CLIENT: MORRISON - KNUDSEN ENGINEERS

DATE: 07/06/85

PROJECT: BRIDGES FOR THE ACDC

ATL JOB NO: F-0385102

PROJECT LOCATION: BRIDGE #11 - 32ND STREET

BORING TYPE: 4-INCH CONTINUOUS FLIGHT AUGER

BORING NO: 2

BORING LOCATION 49-FEET RIGHT MON. LINE STATION 14+27

SPT	CONT	DEPTH	DESCRIPTION
	29		
		1	CLAYEY SAND AND GRAVEL
	12		WEAK CALCAREOUS CEMENTATION
		2	BROWN
	8		SLIGHTLY MOIST
		3	
	26		
		4	
	"100/5"		
		5	CLAYEY SAND, GRAVEL & COBBLES
			STONG CALCAREOUS CEMENTATION
		6	GRAYISH BROWN
			MOIST
		7	
		8	
		9	
100/1"		10	
		11	
		12	
		13	
		14	
100/1"		15	
		16	
		17	
		18	— PERCHED WATER TABLE —
		19	
100/2"		20	
		21	
		22	
		23	
		24	CLAYEY SAND, GRAVEL, COBBLES & SMALL BOULDERS
100/4"		25	GRAYISH BROWN
			MOIST
		26	
		27	
		28	
		29	
		30	
		31	
		32	
		33	
		34	
		35	BOTTOM OF BORING AT 35-FEET
		36	
		37	
		38	
		39	
		40	

A T L

Testing Laboratories

TABULATION OF TEST RESULTS

JOB NO.: F0385102

PROJECT: BRIDGE #11

DATE JULY 9, 1985

LOCATION 32ND STREET

MATERIAL SUBGRADE SOIL

DATE OF SAMPLE 5-29-85

SUBMITTED BY ATL/T. SMITH

REQUESTED BY

Hole No.	Station	Depth	Classi-fication	LL	PI	SIEVE ANALYSIS-ACCUM. % PASSING											Lab No.
						200	100	40	16	10	4	½	3/8	3/4	1	1½	
#2		4½'-23½'	SG-GC	36	14	20	24	29	35	40	53	61	77	98	100		829
#2		0'-4½'	SM-SC	22	5	27	33	39	47	54	68	76	88	98	100		830

A T L Testing Laboratories

A Division of R & D Engineering Associates, Inc.

Engineers • Geologists

Boyd Smith, P.E. Donald E. Green, P.E.

DVH

ATL JOB NO.: F0385102

July 11, 1985

RECEIVED
Morrison Knudsen
Engineers, Inc.
JUL 26 1985
Southwest District Office
File

REPORT OF

FOUNDATION SOIL INVESTIGATION

FOR

MORRISON-KNUDSEN ENGINEERING, INC.

PROJECT

ELEVEN BRIDGE SITES
FOR THE A.C.D.C.

ADDENDUM NO. 1

Registered Professional Engineer (Civil)
CERTIFICATE NO. 9095
DONALD E. GREEN
Date Signed 7/11/85
ARIZONA, U.S.A.

3130 North 27th Avenue • Phoenix, Arizona 85017 • Telephone (602) 252-3975

A T L Testing Laboratories
A Division of R & D Engineering Associates, Inc.
Engineers • Geologists

Boyd Smith, P.E. Donald E. Green, P.E.

ATL JOB NO.: F0385102 July 11, 1985

REPORT OF

FOUNDATION SOIL INVESTIGATION

FOR

MORRISON-KNUDSEN ENGINEERING, INC.

PROJECT

ELEVEN BRIDGE SITES
FOR THE A.C.D.C

ADDEMDUN NO. 1

Bridge No. 6 - 12th Street

The allowable bearing value for a footing between two (2) to four (4) feet wide at a depth of thirty-five (35) feet, may be taken as 6.4 tons per square foot.

Bridge No. 7 - 16th Street

The bearing value for a footing between two (2) to four (4) feet wide at a depth of thirty (30) feet, may be taken as 6.4 tons per square foot.

3130 North 27th Avenue • Phoenix, Arizona 85017 • Telephone (602) 252-3975

A T L

The following recommendations are for:

Bridge No. 8 - Glendale Avenue

Bridge No. 9 - Maryland Avenue

Bridge No. 10 - on 24th Street

Bridge No. 11 - on 32nd Street

The allowable bearing value for a footing between two (2) to four (4) feet wide at a depth of thirty (30) feet, can be taken as 7.5 tons per square foot.

Should any questions arise, please, do not hesitate to contact the undersigned.

Respectfully submitted,
ATL TESTING LABORATORIES

Registered Professional Engineer (Civil)
CERTIFICATE NO. 9995
DONALD E. GREEN
Date Signed 7/4/85
ARIZONA, U.S.A.

Donald E. Green, P.E.

RECEIVED JUN 1 9 1985

A T L Testing Laboratories

A Division of R & D Engineering Associates, Inc.

Engineers • Geologists

JUN 14 1985

Boyd Smith, P.E.

Donald E. Green, P.E.

MGR - ELP RSP

TRANSMITTAL LETTER

Project: (Name & Address) Eleven Bridge sites across the AC-DC

M. K. Engineering Co. Inc.
10240 N. 31st. Avenue
Suite 213, Phoenix, AZ 85021-1357

ATL Project No. F-0385102

Date: 6.14 85

If enclosures are not as noted, please inform us immdiately.

If checked below, please:
( ) Acknowledge receipt of enclosure.
( ) Return enclosures to us.

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WE TRANSMIT
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THE FOLLOWING:
( ) drawings
( ) reports
( ) soil data sheets
( ) invoice
( ) test reports
(✓) Preliminary Design Calculations & Data,
( ) samples
( ) product literature

Copies	Date	Drwg. No.	Description	Code

Action Code: A - Action indicated on item transmitted
B - No action required
C - Approved as noted
D - Rejected, revise and resubmit

REMARKS:

Addressee
Architect
File
Field

ATL TESTING LABORATORIES

By: [signature]

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F-0385102

Bridge Site #1 - 7th. Avenue.

Summary

Data. Soil at. 35 ft depth as (SM)

Silty Sand with Gravel.

N = 70

$\bar{N}$ corrected for overburden taking $\gamma_d = 130$ pcf

as = 50

All. Bearing Pressure for Spread (MAT) Foundations

= 9.5 TSf

All. Bearing Pressure for soil for 1" settlement

= 6.4 TSf.

Pile capacity for Pile load of 100 kips with

Factor of safety as 4

Use Drilled Pile

Concrete cast in place

Pile length 35 ft

Pile Dia 3 ft.

Pile Capacity 120 Tons.

ρ_{Total} for (100 kips) 0.2 inches - 0.33 inches

Contact Pressure (100 kips) 6.4 TSf

Modulus of Sub-grade Reaction

k_s = 720-1185 ksf

assumed $\mu = 0.3$

& $E_c = 3600$ ksi

& $E_s = 1800 + 753 N$

Note: Skin friction not considered because of Bored Piles and since it is preliminary design.

F-0325102

Bridge Site # 1 – 7th Avenue

DATA

		As per Log of Boring	Soil classification as per S.A.P.I. (I) / (II)	Blow count (I) / (II)
1½′ - 4½′	–	Sandy silty clay	(CL-ML) / (SC)	3′ – 7 / 22
4½′ - 10½′	–	clayey silty sand	(SC) / (SC)	4′ – 6 / 41
10½′ - 24′	–	— do — (with fine gravel)	(SC) / (SC)	5′ – 13 / 29
24′ — 40′	–	Silty sand with Gravel	(SM) / (SM)	6′ – 19 / 21
		↓ continued below upto 35 ft.		7′ – 29
				8′ – 28 / 25
				9′ – 47 / 21
				10 – 57 / 25
				11 – 75 / 20
				12 – 100/9″ / 25
				15′ – 100/11″ / 31
				21′ – 100/0″ / 39
				27′ – 93/0″ / 39
				32′ – 100/10″ / 30/0″
				35′ – 100/0″ / 102/0″

N value at 35 ft is taken as 70 (lower value at 32′ is 72)

Corrected value $\bar{N} = C_N \times N$

$C_N = 0.77 \log \frac{20}{p}$

$p = 35′ (130)$ ksf $= 2.1$ TSf

$= 0.77 \log \frac{20}{2.1}$

$C_N = 0.759$

$\therefore \bar{N} = .759 \times 70$
$= 53.13$

Let us take $\boxed{\bar{N} = 50}$ for design purposes.

For 10 ft wide footing and corresponding to N = 50 and for 1″ limiting settlement (Refer Chart 5-9 page 125 of Book by JOHNSON and KAVANAGH) (J&K)

All. Bearing Pressure of Soils = $\boxed{5 \text{ TSf}}$

For Mat foundations the value can be taken twice of above say = $\boxed{10 \text{ TSf}}$

$\sim (N-3)/5$ TSf (Refer page 163 of J&K)

$= (50-3)/5 = \boxed{9.4 \text{ TSf.}}$

Let us take Bearing value for Spread Footing at 35 ft depth as $\boxed{9.5 \text{ TSf}}$

Pile capacity for 100 kips Load.

$P = 100$ kips / 45.0 Tons

$FS = 4$

$P_{ult} = 400$ kips / 180 Tons

Corrected N value taken as 50

$q_p = 0.4 N \frac{D_b}{d}$ $\qquad D_b = 35$ ft

$d = 5$ ft (assumed)

$= 0.4 \times 50 \times \frac{35}{5}$

$= 140$ TSf.

limiting value as for Meyerhof 50 TSf.

$\therefore Q_p = 50 \times A_p$

$= 50 \times (.7854) \times 25$

$= 981.5$ Tons. > 180 Tons

Let us take $d = 3$ ft.

limiting $q_p = 70$ TSf.

$\therefore Q_p = 70 \times .7854 \times 9$

$= \boxed{495 \text{ Tons} > 180 \text{ Tons}}$ o.k.

Contact pressure $= \frac{45}{.7854 \times 9} = \boxed{6.4 \text{ TSf}}$

$\therefore$ all. Pile capacity $= \frac{495}{4} = 124$ say 120 Tons

Size 3 ft. Dia. (Drilled Pile)

Length 35 ft

Settlement.

Pile settlement $= \dfrac{PL}{AE}$ assumed $E_c = 3600$ ksi

For $P = 100$ kips.

$$= \frac{100 \times 35 \times 12}{.7854 \times (36)^2 \times 3600}$$

$$= \boxed{.01''}$$

Taking $E_s = 18000 + 750\,N$

$$= \frac{18000 + 750 \times 50}{50} \text{ ksf}$$

$$= \underline{\underline{1110 \text{ ksf}}}$$

For silty sand
$E_s = 300(N+6)$
$= \underline{\underline{316}}$ ksf.
For clayey sand
$E_s = 320(N+15)$
$= \underline{\underline{416}}$ ksf.
Gravelly sand $= \frac{12 \times 24}{50}(55) = 13.1$

$$\Delta_H = qB\,\frac{(1-\mu^2)}{E_s}\,I_w\,F_3 \times 12 \text{ inch}$$

assumed $\mu = 0.3$
I_w for rigid footing $= 0.88$
$F_3 = 0.5$ for $L/B > 5$
$(L/B = 75/3 > 5)$

$$= \frac{100}{.7854(3)^2} \times (3)\,\frac{(1-.3^2)}{1110} \times .88 \times .50 \times 12$$

$$= 0.184''$$

$$\therefore \text{Total } \rho_T = .184 + .1$$

$$= 0.194$$

$$\boxed{\rho_T = 0.2''}$$

using $\underbrace{E_s = 675 \text{ ksf}}$

$\rho_T = \underbrace{(0.33 \text{ inches})}$

(Refer Page 627 of Bowl's Book)

① As per Glick.

$$k_s = \frac{22.4\ E_s(1-\mu)}{(1+\mu)(3-4\mu)\left[2\ln(2L/B) - .443\right]}$$

$\mu = .3$

$E_s = 1110$ ksf.

$$= \frac{22.4\ (1-.3)\ E_s}{(1.3)(1.8)\left[2\ln(70/3) - .443\right]}$$

$$= \boxed{1.144\ E_s}$$

② As per CHM for cohesionless soils

$$k_s = \frac{3E_s}{B}$$

$$= \frac{3}{3}E_s = \boxed{1.0E_s}$$

Take k_s as average of these as $1.07\ E_s$

$\therefore\ k_s = 1.07 \times 1110$ ksf

$= 1187.7$ ksf

say $\boxed{k_s = 1185 \text{ ksf}}$ modulus of Subgrade Reaction.

using $E_s = 675$

$k_s = 722$ say $\boxed{k_s = 720 \text{ ksf}}$

③ Also as per Yoshinaka

$E_s = 13.5\ N$

$= 13.5 \times 50$

$= 675$ ksf taking error as 1w %

$E_s = 1350$ ksf. used $E_s = 1110$ ksf. Seems ok.

F-0385102

Bridge Site #2 - Dunlap Ave west of 3rd Avenue

Summary

Data

Soil at 35 ft depth as (GC)

Sandy, silty, clayey Gravel Soil

N = 40

$\bar{N}$ Corrected for overburden taking γ_d = 130 pcf.

as = 30

Allowable Bearing Pressure for Spread (Mat) Footings

= 6.5 TSf.

Allowable Bearing Pressure for Soil for 1" settlement as per Meyerhof = 3.75 TSf.

Pile Capacity.

Pile load of 100 kips with Factor of safety as 4

Drilled Pile

Pile length = 35 ft

Pile Dia = 4'.

Allow. Pile Capacity = 110 Tons

q_{Total} for (100 kips load) = 0.2 inches. - 0.26"

contact Pressure (— " —) = 3.6 TSf.

Modulus of Sub-Grade Reaction at 35 ft depth at pile Tip

k_s = 630 - 800 ksf.

F-0385102

Bridge Site #2 - Dunlop West of 3rd. Avenue

			I / II
1½′ - 7′	-	Silty sand + fine gravel	- (SM) / SM
7′ - 19′	-	Silty clayey Sand + gravel	- (SC) / SC (7′-28′)
19′ - 31′	-	Sandy silty gravel/clayey	- (GW-GM) ~~(GW-SM)~~ / (GC) (28′-35½′)
31′ - 35½′	-	— do —	- (GW-GM)

3′	6	9
4′	6	6
5′	9	10
6′	6	11
7	8	12
8	14	20
9	18	32
10	15	28
11	20	23
	37	31
12	38	31
13	39	4
14		
15′	50	28
16′	100/10″	19
21′	63	34
25′	27	3
31′	22	6
35′	95.	8

N value at 35 ft is taken as 40

Soil is Sandy silty clayey Gravel

Corrected Value $\bar{N} = C_N \times N$

$= .759 \times 40$

$= 30.4$

$C_N = 0.77 \times \log \frac{20}{p}$. $p = 35$ (...) $= 2.9$

$= 0.759$

Let us take $\bar{N} = 30$

All B.V. of soils = 3 Tsf For 10′ wide ftg & corresp. mating to 1″ limiting settlement

For MAT Found = $(N-3)/5 = 27/5 = 5.4$ Tsf.

or Double of 3 i.e. 6 Tsf.

Let us take BV for spread footings at 35′ depth

as 6.5 Tsf

Pile Capacity

$P = 100$ kips/45 T F.S = 4 Pull = 400 kips / 180 Tons

Corrected N value = 30

$q_p = 0.4 \times 30 \times \frac{35}{4}$ $D_b = 35$ ft, $d = 4'$

$= 105$ TSf.

q_p limiting value as per Meyerhof charts 35 TSf.

$\therefore Q_p = 35 \cdot A_p$

$= 35 \times .7854 \times (4.0)^2$

$= \underline{\underline{440 \text{ Tons}}} > 180$ Tons.

All. Pile Capacity = 110 say $\boxed{110 \text{ Tons}}$

Contact pressure for 45 Tons load

$= \frac{45}{.7854 \times (4)^2} = \underbrace{3.58 \text{ TSf}}$ < 3.8 TSf allowable

o.k. (as per Meyerhof)

Allowable Pile Capacity = 110 Tons
Dia of pile = 4 ft
Length = 35 ft

Drilled Pile.

Settlement

$$\rho_T = \frac{PL}{AE_c} + \frac{qB(1-\mu^2)}{E_s} I_w F_3 \times 12 \text{ inches.}$$

Taking $E_s = 18000 + 750N$

$= \frac{18000 + 750(30)}{50}$ ksf

$E_s = 810$ ksf.

$E_s = 320(30+15)/50 = 288$ ksf
$E_s = 200(30+6)/50 = 216$ ksf
$E_s = 1200(30+6)/50 = 864$ ksf
Avg = 456 ksf.

assumed $E_c = 3600$ ksi
$P = 100$ kips
$\mu = 0.3$
$I_w = 0.88$
$F_3 = 0.5$

Also As per Yoshinaka $E_s = 13.5 \times N = 13.5 \times 30 = 405$ Taking 100% Error
$E_s = 810$ ksf.

Taking $E_s = 810$ ksf.

$$\therefore \rho_{Total} = \frac{100 \times 35 \times 12}{.7854\,(48)^2 \times 3600} + \frac{100}{.7854\,(4)^2} \times 4 \cdot \frac{(1-.3^2)}{810} \times .88 \times .5 \times 12$$

$= 0.1965$ using $E_s = 625$ (average)

$\rho_T = 0.26''$

say $\boxed{\rho_T = 0.2 \text{ inches.}}$

.1965

Sub Grade Modulus at Tip of Pile

① As per Glick

$$k_s = \frac{22.4\, E_s\,(1-\mu)}{(1+\mu)(3-4\mu)\left[2\ln 2L/B - .443\right]}$$

$= 1.268\, E_s$

$= 1028$ ksf.

$\mu = .3$

$E_s = 810$ ksf

$L = 35'$

$B = 4$

② As per Chen for Cohesionless Soils

$$k_s = \frac{3}{B} E_s$$

$= .75\, E_s.$

Average $k_s = 1.009 E_s$ say E_s

$k_s = 810$ ksf.

using $E_s = 625$ ksf

$k_s = 630$ ksf.

Let us take $\boxed{k_s = 800 \text{ ksf}}$

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Bridge Site #3 – Central Ave @ Ruth.

Summary

Data. Soil at 24-35 ft depth as GC/SC

Sandy Silty clayey Gravel

N at 24 ft depth = 35 & $\bar{N}$ at 24 ft depth = 29

N at 35 ft depth = 55 & $\bar{N}$ at 35 ft depth = 41

Allowable Bearing Pressure for spread (Mat) Footing at 24 ft depth = 5.5 TSf.

All. Bearing Pressure at 35 ft-depth for 1" settlement as per Meyerhof = 5.1 TSf

Drilled Pile

Pile length = 35 ft

Dia of Pile = 3.5 ft.

Allow. Pile Capacity = 120 Tons.

ρ_T (for 100 k load): 0.2 inches. – 0.26 inches

Contact pressure = 4.7 TSf.

Modulus of Sub Grade Reaction at 35 ft depth at Pile Tip

$k_s = 770 - 1000$ ksf

Bridge Site #3 – Central Angoa Ruiti

Depth	As per logs of Borings	Soil classification (I)	Soil classification (II)
6"–5'	Sandy silty clay with fine gravel	CL	CL
5'–8'	Sandy clayey gravel	SC / GC	SC
8'–13½'	— Do —	SC	SC
13½'–17½'	Sandy clay with gravel	CH / CL	GW-GM / GC
17½'–40'	Sandy clayey gravel.	SC	SC

Blow Count

	I	II
1	15	
2	20	11
3	22	15
4	17	8
5	14	8
6	10	9
7	10	12
8	10	15
9	18	21
10	25	23
1	57	24
2	26	30
3	52	26
4	26	54
15	29	56
6	33	39
7	25	41
8	45	100/10"
9	53	
20	65	15
21	52	100/4"
22	66	
23	64	
24	69	
25	100/9"	
26	35 =	10 ?
27	43	33
31	38	47
32	110	53
36	100/10"	57
37		146/10½"

N value at 24 ft depth is taken as 35

and N value at 35 ft is taken as 55

$\therefore \bar{N}$ at 24 ft $= C_N \times 35$
$= .829 \times 35 = 29$

& $\bar{N}$ at 35 ft $= C_N \times 55$
$= .759 \times 55 = 41.75$ say 41

$C_{N_{24}} = 0.7 \log \frac{20}{p}$
$= 0.7 \log \frac{20}{1.31}$
$= 0.829$

$p_{24'} = 24(120)$
$= 1.31$ T

$C_{N_{35}} = .759$

$p_{35'} = 2.1$ Tons
taking 130 pcf

For 10 ft. wide footing and for $\bar{N} = 29$
all. Bearing value = 2.9 TSf.

For Mat Footing the value can be taken twice of 2.9 = 5.8 TSf.

or $(N-3)/5 = 26/5 = 5.2$ TSf. Take Bearing value for Spread Footing at 24 ft depth as 5.5 TSf

Pile Capacity

$P = 100$ kips / 45 T F.S = 4 $P_{ult} = 400$ kips / 180 Tons.

Corrected N value = 41

$q_p = 0.4 \times 41 \times \frac{35}{3.5}$ $D_b = 35$ ft, $d = 3.5$ ft.

$= 164$ TSf.

q_p limiting value = 50 TSf

$\therefore Q_p = 50 \times (.7854) \times (3.5)^2$

$= \underbrace{481 \text{ Tons} > 180 \text{ Tons}}$

All. pile capacity = $\underbrace{120 \text{ Tons}}$.

Contact pressure $= \frac{45}{.7854 \times (3.5)^2} = \underbrace{4.7 \text{ TSf} > 5.1 \text{ TSf}}_{\text{O.K.}}$ allowed as per Meyerhof's.

Settlement

$$\rho_T = \frac{PL}{AE_c} + \frac{qB(1-\mu^2)}{E_s} I_\omega \cdot F_3 \times 12 \text{ inches.}$$

$E_s = 18000 + 750\,N$

$= \frac{18000 + 750(41)}{50} = \underline{\underline{975}}$ ksf.

clayey sand $E_s = 320(41+15) = \underbrace{358}$ ksf.

Gravelly sand $E_s = 1200(41+6) = \underbrace{1128}$

Avg = $\underbrace{743 \text{ ksf}}$

also

$E_s = 13.5 \times N$

$= 13.5 \times 40 = 540$ taking 100% error $\underbrace{E_s = 1080.}$

Let us use $E_s = 975$ ksf

$$\therefore \rho_T = \frac{100 \times 35 \times 12}{.7854(42)^2 \times 3600} + \frac{100}{.7854(3.5)^2} \times 3.5 \frac{(1-.3^2)}{975} \times .88 \times .5 \times 12 \text{ inches}$$

$= .008'' + 0.18 = 0.19''$ say $\boxed{\rho_T = 0.2''}$

using $E_s = 745$ ksf ($\rho_T = 0.26$ inches)

Sub Grade Modulus at 35 ft. depth:

① As per Glick

$$k_s = \frac{22.4\ E_s\ (1-\mu)}{(1+\mu)(3-4\mu)\left[2\ln\frac{2L}{B} - .443\right]}$$

$$= 1.21\ E_s = 1177.5\ \text{ksf}$$

② $$k_s = \frac{3}{B} E_s$$

$$= 0.857\ E_s = 835.7\ \text{ksf.}$$

Avg $k_s = 1.0336\ E_s$

$= 1007.76$ ksf.

using $E_s = 745$

$k_s = 770$ ksf.

Take $\boxed{k_s = 1000\ \text{ksf}}$

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Bridge site # 4 — 7th Street.

Summary.

Soil at 24 ft - 35 ft (GW-GM)

clayey, sandy, silty Gravel.

N at 24 ft depth = 28 } $\bar{N}$ = 23 }
N " 35 ft " = 45 } $\bar{N}$ = 34 }

Allowable Bearing Pressure for Spread (Mat) Footings at 24 ft depth = 4.5 TSf

All. Bearing Pressure at 35 ft depth for 1" limiting settlement = 4.15 TSf (as per Meyerhof)

Drilled Pile

Pile length = 35 ft
Pile Dia = 3.75 ft.
All. Pile Capacity = 110 Tons
Q_T (for 100 kips) = 0.2 inches.
Contact pressure (for 100 k) = 4.1 TSf.

modulus of Sub Grade Reaction at 35 ft depth

k_s = 885 ksf

Bridge Site #4 — 7th Street

	Blow Count I	Blow Count II
1		16
2	13	10
3	9	8
4	4	6
5	6	7
6	8	12
7	10	12
8	22	25
9		27
10	22	41
11	33	36
12	35	20
13	36	51
14	59	105
15	80	
16	62/5"	43
17	39	77
21	87	23
21.5	30	36
22	49	67
25	64	36
25½	28	43
27	49	44
31	44	38 } 31
36	122	61 } 31½
	100/9"	44 } 32
		65 } 36
		99 } 36½
		37

clayey, sandy, silty Gravel (GW-GM)

N value at 24 ft depth is taken as 28

& N " " 35 ft " " " " 45

$\bar{N}_{(24)} = .829 \times 28 = 23$

$\bar{N}_{(35)} = .759 \times 45 = 34$

For 10 ft. wide footing & for $\bar{N} = 23$
all. Bearing Value = 2.4 TSf
For mat Foundations the value is taken twice = 4.8 TSf

or $(N-3)/5 = 4$ TSf.

Take Bearing Value for Spread Footings at 24 ft. depth = 4.5 TS

Pile capacity

N = 34

$q_p = 0.4 \times 34 \times \frac{35}{3.75}$

$= 127$ TSf

q_p limiting = 40 TSf.

$\therefore Q_p = 40 \times (.7854) \times (3.75)^2$

$= 442$ Tons

$\therefore$ All. capacity = 110 Tons

Contact Pressure = 4.1 TSf ≃ 4.15 TSf allowable

Settlement.

$$E_s = \frac{18000 + 750\,(34)}{50}$$

$$= \underline{870} \text{ ksf}$$

$E_s = 1200\,(N+6)/50$
$= 24 \times 40 = \underline{960}$ ksf

also $E_s = 13.5 \times 34$
$= 459$ and twice of this $= \underline{918}$ ksf.

Take $E_s = \underline{870 \text{ ksf}}$.

$$\rho_T = \frac{100 \times 35 \times 12}{.7854\,(45)^2 \times 3600} + \frac{100 \times 3.75}{.7854\,(3.75)^2} \times \frac{(1-.3^2)}{870} \times .88 \times .5 \times 12$$

$$= .007'' + .188''$$

$$= 0.195'' = \boxed{0.2''}$$

Sub-Grade Modulus at 35'

① $$k_s = \frac{22.4\ E_s\,(1-\mu)}{(1+\mu)(3-4\mu)\left[2\ln\frac{2L}{B} - .443\right]}$$

$$= 1.24\,E_s$$

$$= \underline{1077.5} \text{ ksf.}$$

also ② $$k_s = \frac{3}{B}E_s$$

$$= \frac{3}{3.75}E_s$$

$$= 0.8\,E_s$$

$$= 696 \text{ ksf.}$$

Avg $k_s = 1.02\,E_s$
$= 887$ ksf.

say $\boxed{k_s = 885 \text{ ksf}}$

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(V)

Bridge Site
- # 5 - Northern Avenue
- # 6 - 12th. Street
- # 7 - 16th. Street

Same as for Bridge Site # 1

Bridge Site #5 – Northern Avenue (V)

At 35′ depth clayey, silty, gravelly soil (GW-GM/GC)

Take N value at 35 ft depth as 70

and $\bar{N} = 50$

Design considerations same as for Bridge Site #1

Depth	Blow Count I	Blow Count II
1		4
2	87	6
3	100	14
4	37	19
5	28	32
6	53	90
7	36	106
8	31	90/3″
9	40	
10	41	
11	103	74 } 11′
		75 } 11½′
16	95	68 } 12′
16½	76	103
17	45	
21′	78	
21½′	53	110
22′	34	
26	41	70
26½′	48	105
27′	72	
31′	64	
31½′	61	54 + 53
32′	93	
36	61 + 40/4″ =	108

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Bridge Site # 6 – 12th Street

Depth	Blow Count I	Blow Count II

Soil at 35 ft depth

Silty, clayey Sand with Gravel & Cobbles
(highly Cemented)
(SM-SC)

N value at 35 ft. is taken as 70

Corrected N value = 50

Same as for Bridge #1

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VII

Bridge Site # 7 – 16th Street

Silty, clayey Sand with Gravel (SC)

N value taken at 30 ft depth as 70

$\bar{N} = 50$

Same as for Bridge # 1

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Bridge Site # 8 — Glendale Ave

Summary

Soil at 17' & below Silty Sand with gravel & cobbles (S

N at 30 ft depth = 100
& $\bar{N}$ — " — = 80

All. Bearing pressure at 30 ft. for 1" limiting Settlement
= 10 TSf

Drilled Pile
- Pile length = 30 ft.
- Pile Dia = 2.5 ft.
- All Pile Capacity = 150 Tons.
- Q_T for (100 kips) = 0.325"
- Contact pressure for (100 kips load) = 9.2 TSf.

Modulus of Sub Grade Reaction at 30 ft. depth

k_s = 930 kSf

Bridge Site #8 - Glendale Ave

Soil at 17 ft depth is silty sand with some gravel & cobbles (SM)

N value at 17 ft & below taken as 100

$\bar{N}$ at 30 ft depth = 80

$p = \frac{30 \times 130}{2200}$
$= 1.8$ Tons

$C_N = .77 \log \frac{20}{p}$
$= 0.8$

Allowable Bearing pressure ~~for spread (mat)~~ ~~footings~~ ~~10 tsf~~ at 30 ft depth for $\bar{N} = 80$ for footing width ≤ 1.2 m
$= \underline{10 \text{ TSf.}}$

Pile Capacity

$\bar{N} = 80$

$q_p = 0.4 \times 80 \times \frac{30}{2.5}$
$= 384$ TSf

q_p limiting $= 125$ TSf. (corresponding to N = 60)

$\therefore Q_p = 125 \times (.7854)(2.5)^2$
$= 613.6$ Tons.

All. Capacity $= \underline{150 \text{ Tons}}$.

Contact pressure for 45 Tons load
$= \frac{45}{.7854 (2.5)^2} = \boxed{9.2 \text{ TSf} < 10 \text{ TSf}}$

O.k.

Settlement

for silty sand, $E_s = 300(N+6)$

$= \frac{300 \times 86}{50} = 516$ ksf

$\frac{1200(86)}{50} =$

also $E_s = 13.5 \times 80 = 1080$ ksf

Take $E_s = 800$ ksf

$$\rho_T = \frac{100 \times 30 \times 12}{.7854(30)^2 \times 3600} + \frac{100 \times 2.5}{.7854 \times (2.5)^2} \times \frac{(1-.3^2)}{800} \times .88 \times .5 \times 12$$

$= 0.015'' + 0.306''$

$= 0.321''$

say $\boxed{\rho_T = 0.325 \text{ inches}}$

Sub-Grade Modulus at 30 ft.

① $$k_s = \frac{22.4 \; E_s(1-\mu)}{(1+\mu)(3-4\mu)\left[2\ln\frac{2L}{B} - .443\right]}$$

$= 1.133 E_s = 906.6$ ksf

also ② $k_s = \frac{3}{B} E_s$

$= 3/2.5 \, E_s = 1.2 E_s = 960$ ksf

Avg $\boxed{k_s = 930 \text{ ksf}}$

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Bridge Site

# 9	—	Maryland Ave
# 10	=	24th Street
# 11	=	32nd Street

(Same as for Bridge Site # 8)

Bridge Site # 9 — MAryland Ave

Soil at 4 ft & below upto 30 ft is

silty, clayey sand with Gravel (SM)

N value at 10 ft & below is taken

as 100

$\bar{N}$ at 30 ft depth taken as 80.

(Provide same as for Bridge Site #8)

Bridge Site #10 — 24 th Street

Soil at 15 ft & below

Silty, sand + ~~clayey~~ + Gravelly Soil highly cemented.

N value is taken as 100 at 30 ft depth.
$\bar{N}$ is taken as 80

(Provide same as for #8)

Bridge Site #11. — 32nd Street

Soil at 30 ft depth is
Silty, clayey Sand with Some Gravel (SC)
Water Table at 18 ft.
N value at 30 ft is taken as 100
& $\bar{N}$ is 88.

(Provide Same as for Bridge Site #8)