Minnesota Department of Transportation
MEMO
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Date: February19th, 2016

To: Molly Kline, Project Engineer
Metro District

From: Hossana Teklyes, Asist. Foundation Manager
Office of Materials and Road Research

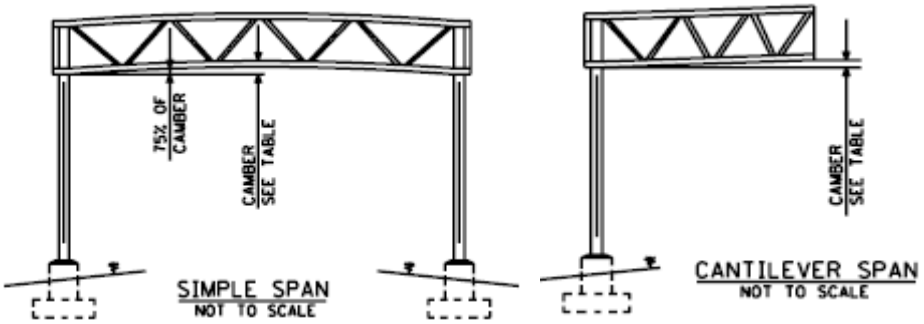
Concur: Rich Lamb, Foundations Design Build Engineer
Office of Materials and Road Research

RAL

Subject: SP 1918-110, Overhead Signs
TH110 EB between TH52 & Angell Rd.
Foundations Investigation and Recommendations

1.0 Project Description

This report provides a subsurface investigation and Foundations Investigation and Recommendations for two overhead sign along TH 110 EB. The overhead signs will be Simple Span **(I494-233)** and Cantilever Span **(I494-234)**. See attached plan for location of the overhead signs.



2.0 Field Investigation and Foundation Conditions

Two cone soundings were advanced in January of 2016 by MnDOT drilling crew along TH110. Copies of these soundings are included with this report.

The foundation soils at the proposed overhead sign locations vary, but can generally ranges from silty clay to silty sandy soil.

Please refer to the attached sounding and boring logs for a more complete description of the foundation soils.

3.0 Foundation Analysis

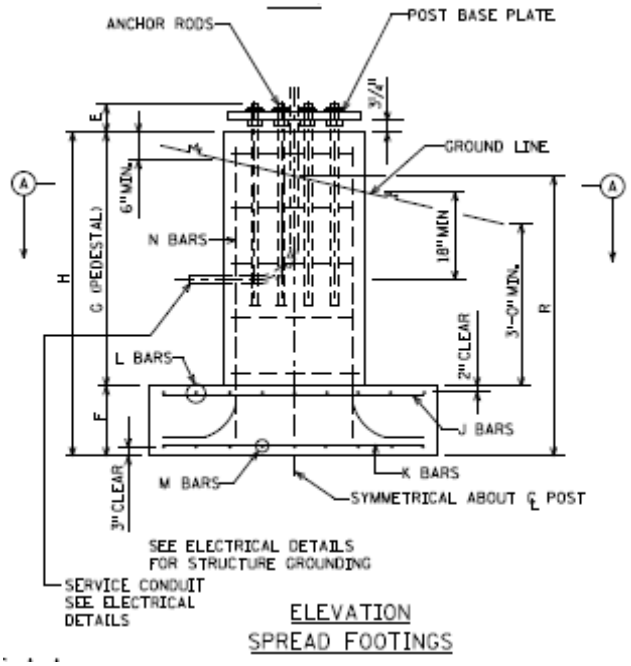
The overhead sign locations were determined from plans provided by Metro District. The sign

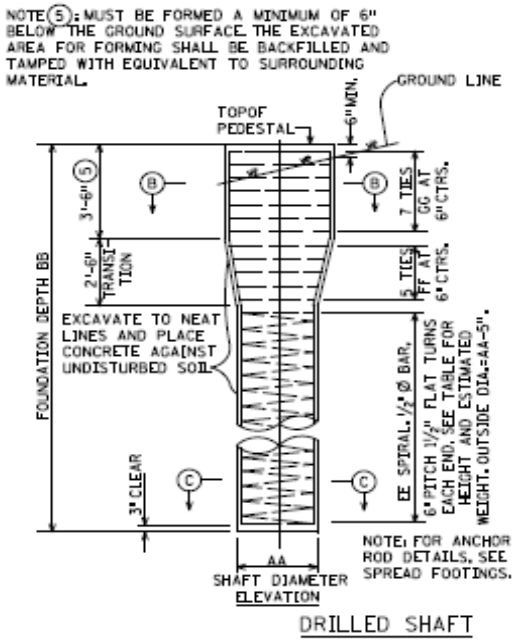
locations are shown on the attached sounding plans.

As part of the overhead sign standard drawings (developed in the 1970's), standard foundations were developed to support the signs. These standard foundations consist of two spread footing and two drilled shaft designs to be used on different sign pole sizes (see Drawing ST-s, Standard Overhead Sign Supports Interim Design B).

- **Spread Footings:** **12.5 ft. x 18 ft.**
  9 ft. x 14 ft.

- **Drilled shafts:** **3 ft. diameter & 23 ft. deep**
  4 ft. diameter & 29 ft. deep





In addition, the standard foundation notes state the following requirements:

- All spread footings have an allowable design bearing pressure of 1 ¼ tons per square foot
- The drilled shafts have an allowable design lateral bearing pressure of 250 lbs. per square foot per foot of depth

Based on the soils at the proposed sign locations, the overhead signs can be supported on **Spread Footings or Drilled Shafts.** To have a level foundation footing, it is recommended to have a 2 ft. subcut below bottom of footing and backfilled with Aggregate Bedding (MnDOT Spec. 3149.2G) and compacted to 100%.

Table 1: Recommended Foundation Types

Name of Overhead Sign	***CPT(SPT) Taken***	***Recommended Foundation***	***Comments***
OH I494-233	C01	Spread Footing or Drilled Shafts	**If Spread Footing is used:** 2 ft. Subcut and backfill with Aggregate Bedding (MnDOT Spec. 3149.2G) is required
OH I494-234	C02	Spread Footing or Drilled Shafts	**If Spread Footing is used:** 2 ft. Subcut and backfill with Aggregate Bedding (MnDOT Spec. 3149.2G) is required

4.0 Foundation Recommendations

Based on the existing conditions along with an analysis of the project soils, we recommend the following:

1. Topsoil and other organic material be removed from areas where new fill is to be placed.

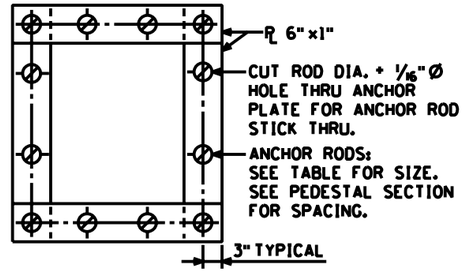
2. The overhead sign bases be supported based on recommendations presented in Table 1. The standard design foundation is shown in drawing STC-3. A copy of Drawing STC-3 is included with this report.

3. If Spread Footings are used, a 2 ft. subcut and a backfill with Aggregate Bedding (MnDOT Spec. 3149.2G) underneath bottom of footing is required for a level foundation footing.

Attachments: Drawing ST-3
Sounding Plan
Sounding Profiles
CPT Index Sheet
CPT Logs (C01 & C02) Unique Number (80457 & 80458)

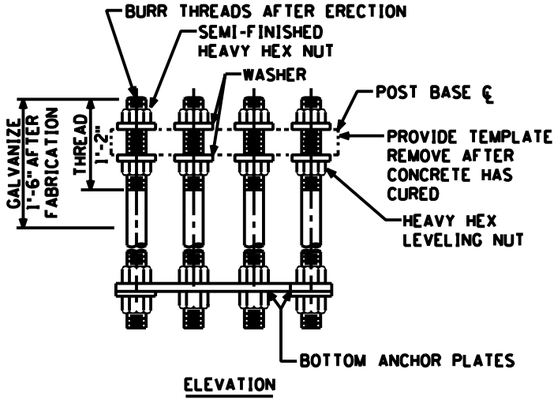
cc: J. Brunner
B. Johnson
J. Tayse

File

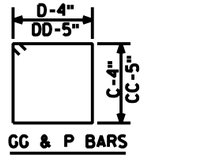


NOTE: ANCHOR PLATES SHOWN TYPICAL FOR ALL ANCHOR ROD SPACING.

ANCHOR PLATE PLAN



ELEVATION



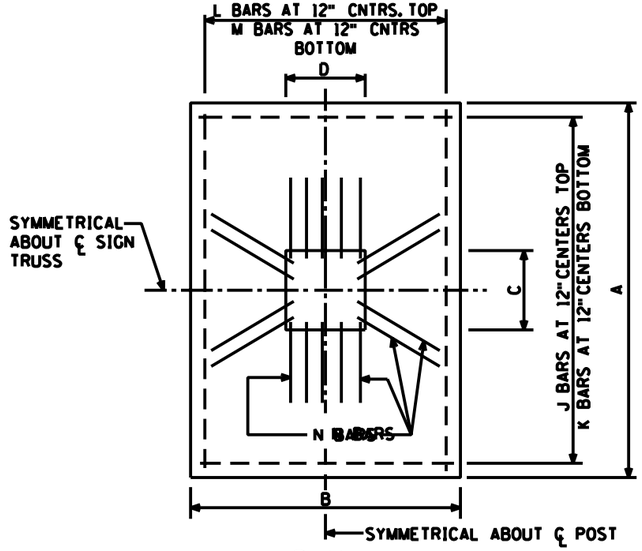
GG & P BARS

R=	
1'-1"	#8 BAR
1'-3"	#9 BAR
1'-4"	#10BAR
1'-6"	#11 BAR

2'-0"	#8 BAR
2'-3"	#9 BAR
2'-6"	#10 BAR
2'-9"	#11 BAR

N BARS

J, K, L, M, FF AND HH ARE STRAIGHT BARS
BAR BENDING DIAGRAMS



PLAN

SPECIFIC NOTES:

1. G IS IN FEET. ROUND UP TO WHOLE NUMBER. E.G. G=4.10/2G=8.2 NO. REQ'D=9.
2. G AND R ARE IN FEET.
3. BEND AS REQUIRED TO FORM A CLOSED LOOP.
4. FOR STRUCTURE STEEL SEE SPREAD FOOTING.
5. MUST BE FORMED A MIN. OF 6" BELOW THE GROUND SURFACE. THE SOIL EXCAVATED FOR FORMING SHALL BE BACKFILLED AND TAMPED TO EQUIVALENT COMPACTION AS SURROUNDING MATERAL.
6. SPECIAL LARGE RADIUS BENDS ARE REQUIRED. SEE "BAR BENDING DIAGRAMS" FOR SIZES OF RADII.

GENERAL NOTES:

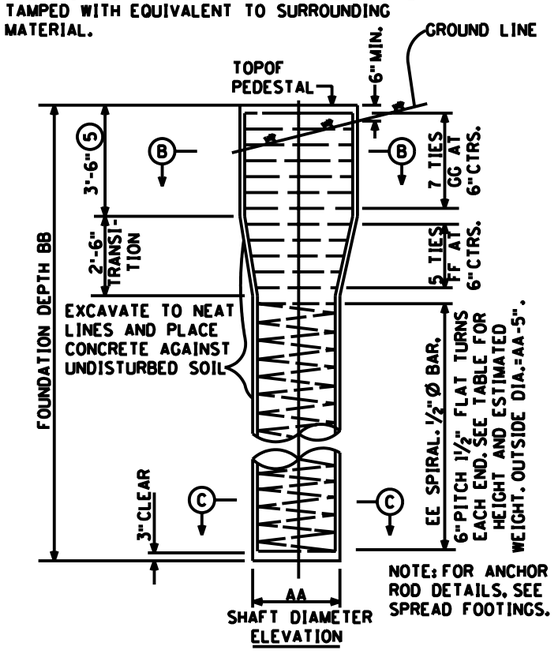
1. SEE THE FORMAT SHEET FOR FOOTING LOCATIONS, POST DESIGNATIONS, TOP OF PEDESTAL ELEVATIONS AND BOTTOM OF FOOTING ELEVATIONS.
2. ALL CONCRETE SHALL CONFORM TO CONCRETE MIX 3Y43 (MN/DOT 2461).
3. ALL BAR DIMENSIONS ARE OUT TO OUT OF BARS.
4. ALL SPREAD FOOTINGS HAVE AN ALLOWABLE DESIGN BEARING PRESSURE OF 1 1/4 T PER SQUARE FOOT.
5. DRILLED SHAFTS SHALL BE USED ONLY WHEN SPECIFIED IN THE CONTRACT PLANS.
6. THE DRILLED SHAFTS HAVE AN ALLOWABLE DESIGN LATERAL BEARING PRESSURE OF 250 LBS. PER SQ. FT. PER FOOT OF DEPTH.
7. UNLESS OTHERWISE NOTED, ALL REINFORCEMENT BARS SHALL BE EPOXY COATED IN ACCORDANCE WITH MN/DOT 3301. SPIRAL BARS AND J, K, L, & M BARS NEED NOT BE EPOXY COATED.
8. THE FOLLOWING TORQUE VALUES SHALL BE USED WHEN INSTALLING ALL ANCHOR NUTS FOR OVERHEAD SIGN STRUCTURES:

ANCHOR BOLT DIAMETER	TORQUE (FT./LBS.)
2 1/4"	375
2 1/2"	450

THE CONTRACTOR SHALL BURR THE THREADS OF THE ANCHOR BOLTS IN ACCORDANCE WITH MN/DOT 2402.3H AFTER TORQUEING NUTS.

ANCHOR ROD DETAILS

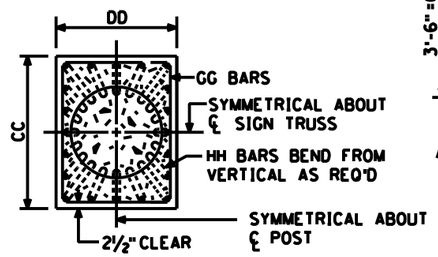
NOTE (5): MUST BE FORMED A MINIMUM OF 6" BELOW THE GROUND SURFACE. THE EXCAVATED AREA FOR FORMING SHALL BE BACKFILLED AND TAMPED WITH EQUIVALENT TO SURROUNDING MATERIAL.



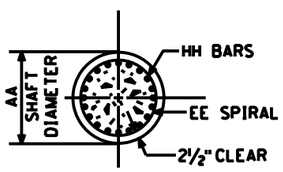
ELEVATION

NOTE: FOR ANCHOR ROD DETAILS, SEE SPREAD FOOTINGS.

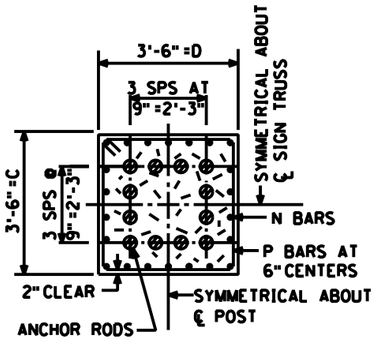
DRILLED SHAFT



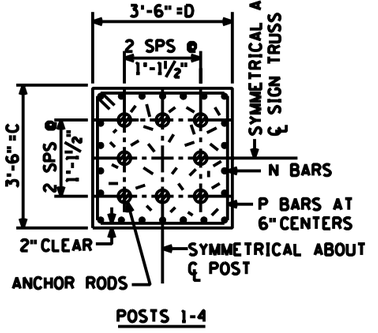
SECTION B-B



SECTION C-C

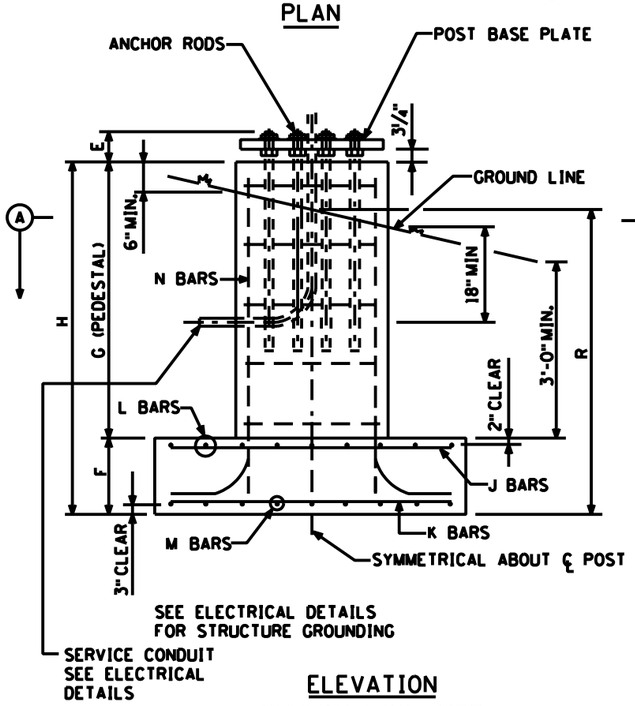


POSTS 5-7



POSTS 1-4

PEDESTAL CROSS SECTIONS A-A



ELEVATION

SPREAD FOOTINGS

DRILLED SHAFT												
POST NO.	DIMENSIONS				REINFORCING BARS				ESTIMATED QUANTITIES (4)	
	AA	BB	CC	DD	EE	FF (3)	GG	HH	CONCRETE CY	REIN STEEL LBS.
1-4	3'-0"Ø	23'-0"	3'-6"	3'-6"	16'-6" x 197 LBS.	5 #5 x 14'-1"	7 #5 x 14'-1"	20 #9 x 22'-7"	6.9	1910
5-7	4'-0"Ø	29'-0"	4'-0"	4'-0"	22'-6" x 362 LBS.	5 #5 x 16'-1"	7 #5 x 16'-1"	24 #10x 28'-7"	14.1	3490

SPREAD FOOTINGS				
SUMMARY OF ESTIMATED QUANTITIES				
CONCRETE CY (2)	REIN. STEEL LBS. (2)	ANCH. ASSM. LBS	ST. EXC. C.Y. (2)	
9.3 + 0.46 G	945 + 98G	781	7.4 R	
16.7 + 0.46 G	2333 + 133G	1320	12.1 R	

SPREAD FOOTINGS																										
POST NO.							ANCHOR RODS			J REIN. BARS			K REIN. BARS			L REIN. BARS			M REIN. BARS			(6) N REIN. BARS			P REIN. BARS (1)		
	A	B	C	D	E	F	NO. REQ'D	DIA.	LENGTH	NO. REQ'D	SIZE	LENGTH	NO. REQ'D	SIZE	LENGTH	NO. REQ'D	SIZE	LENGTH	NO. REQ'D	SIZE	LENGTH	NO. REQ'D	SIZE	LENGTH	NO. REQ'D	SIZE	LENGTH
1-4	14'-0"	9'-0"	3'-6"	3'-6"	8 1/2"	2'-0"	8	2 1/4"	3'-10 1/2"	14	#4	8'-6"	14	#6	8'-6"	10	#5	13'-6"	10	#7	13'-6"	20	#9	H + 2'-6"	26	#5	14'-3"
5-7	18'-0"	12'-6"	3'-6"	3'-6"	9"	2'-0"	12	2 1/2"	4'-0"	19	#4	12'-0"	19	#6	12'-0"	13	#6	17'-6"	13	#10	17'-6"	24	#10	H + 2'-9"	26	#5	14'-3"

STANDARD OVERHEAD SIGN SUPPORTS
INTERIM DESIGN B

FOUNDATIONS AND ANCHOR RODS

DRAWING ST-3

State Proj. No.

Sheet No. 86 of 99 Sheets

DGN ST13 10-5-98

REVISED 10/5/98

Google earth

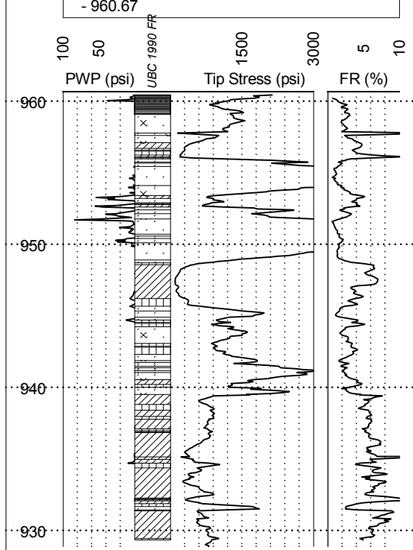
feet 700
meters 200

SP1918-110 (TH110 EB) OVERHEAD SIGNS

- **I494-233 : Sign Bridge (Simple Span)**
- **I494-234: Cantilever**

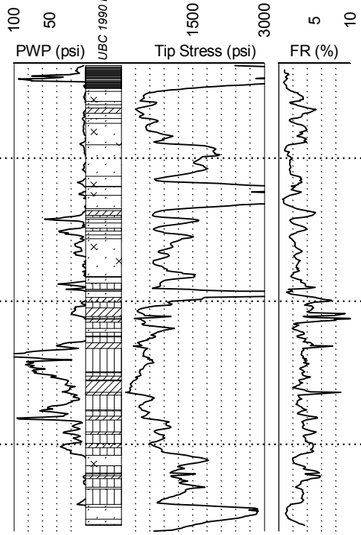
c-01 - #80457

- 960.67



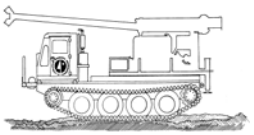
c-02 - #80458

- 966.65



960
950
940
930
920
910
900
890

Minnesota Department of Transportation
Geotechnical Section
Cone Penetration Test Index Sheet 1.0 (CPT 1.0)



USER NOTES, ABBREVIATIONS AND DEFINITIONS

This Index sheet accompanies Cone Penetration Test Data. Please refer to the Boring Log Descriptive Terminology Sheet for information relevant to conventional boring logs.

This Cone Penetration Test (CPT) Sounding follows ASTM D 5778 and was made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since this sounding was not taken to gather information relating to the construction of the project, the data noted in the field and recorded may not necessarily be the same as that which a contractor would desire. While the Department believes that the information as to the conditions and materials reported is accurate, it does not warrant that the information is necessarily complete. This information has been edited or abridged and may not reveal all the information which might be useful or of interest to the contractor. Consequently, the Department will make available at its offices, the field logs relating to this sounding.

Since subsurface conditions outside each CPT Sounding are unknown, and soil, rock and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this sounding will necessarily be the same as or similar to those shown on this log. Furthermore, the Department will not be responsible for any interpretations, assumptions, projections or interpolations made by contractors, or other users of this log.

Water pressure measurements and subsequent interpreted water levels shown on this log should be used with discretion since they represent dynamic conditions. Dynamic Pore water pressure measurements may deviate substantially from hydrostatic conditions, especially in cohesive soils. In cohesive soils, water pressures often take extended periods of time to reach equilibrium and thus reflect their true field level. Water levels can be expected to vary both seasonally and yearly. The absence of notations on this log regarding water does not necessarily mean that this boring was dry or that the contractor will not encounter subsurface water during the course of construction.

CPT Terminology

CPT ..... Cone Penetration Test
CPTU..... Cone Penetration Test with Pore Pressure measurements
SCPTU..... Cone Penetration Test with Pore Pressure and Seismic measurements
Piezocone...Common name for CPTU test

(Note: This test is not related to the Dynamic Cone Penetrometer DCP)

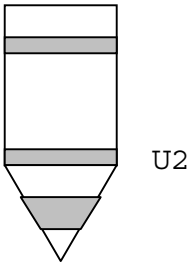
q_T TIP RESISTANCE
The resistance at the cone corrected for water pressure. Data is from cone with 60 degree apex angle and a 10 cm^2 end area.

f_s SLEEVE FRICTION RESISTANCE
The resistance along the sleeve of the penetrometer.

FR Friction Ratio
Ratio of sleeve friction over corrected tip resistance.
FR = fs/qt

V_s Shear Wave Velocity
A measure of the speed at which a siesmic wave travels through soil/rock.

PORE WATER MEASUREMENTS
Pore water measurements reported on CPT Log are representative of water pressures measured at the U2 location, just behind the cone tip, prior to the sleeve, as shown in the figure below. These measurements are considered to be dynamic water pressures due to the local disturbance caused by the cone tip. Dynamic water pressure decay and Static water pressure measurements are reported on a Pore Water Pressure Dissipation Graph.



SBT SOIL BEHAVIOR TYPE
Soil Classification methods for the Cone Penetration Test are based on correlation charts developed from observations of CPT data and conventional borings. Please note that these classification charts are meant to provide a guide to Soil Behavior Type and should not be used to infer a soil classification based on grain size distribution.

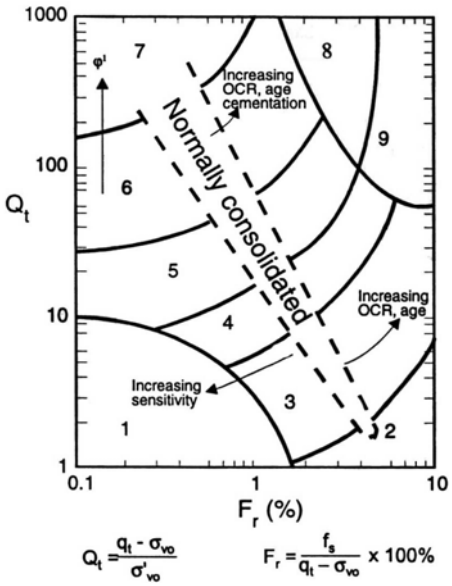
The numbers corresponding to different regions on the charts represent the following soil behavior types:

1. Sensitive, Fine Grained
2. Organic Soils - Peats
3. Clays - Clay to Silty Clay
4. Silt Mixtures - Clayey Silt to Silty Clay
5. Sand Mixtures - Silty Sand to Sandy Silt
6. Sands - Clean Sand to Silty Sand
7. Gravelly Sand to Sand
8. Very Stiff Sand to Clayey Sand
9. Very Stiff, Fine Grained

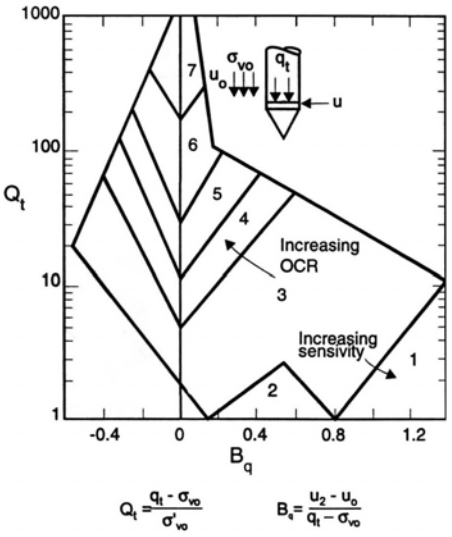
Note that engineering judgment, and comparison with conventional borings is especially important in the proper interpretation of CPT data in certain geo-materials.

The following charts are used to provide a Soil Behavior Type for the CPT Data.

Robertson CPT 1990
Soil Behavior type based on friction ratio



Robertson CPTU 1990
Soil Behavior type based on pore pressure



where ...
Q_T ..... normalized cone resistance
B_q ..... pore pressure ratio
F_r ..... Normalized friction ratio
σ_{vo} ..... overburden pressure
σ'_{vo} ..... effective over burden pressure
u_2 ..... measured pore pressure
u_0 ..... equilibrium pore pressure

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

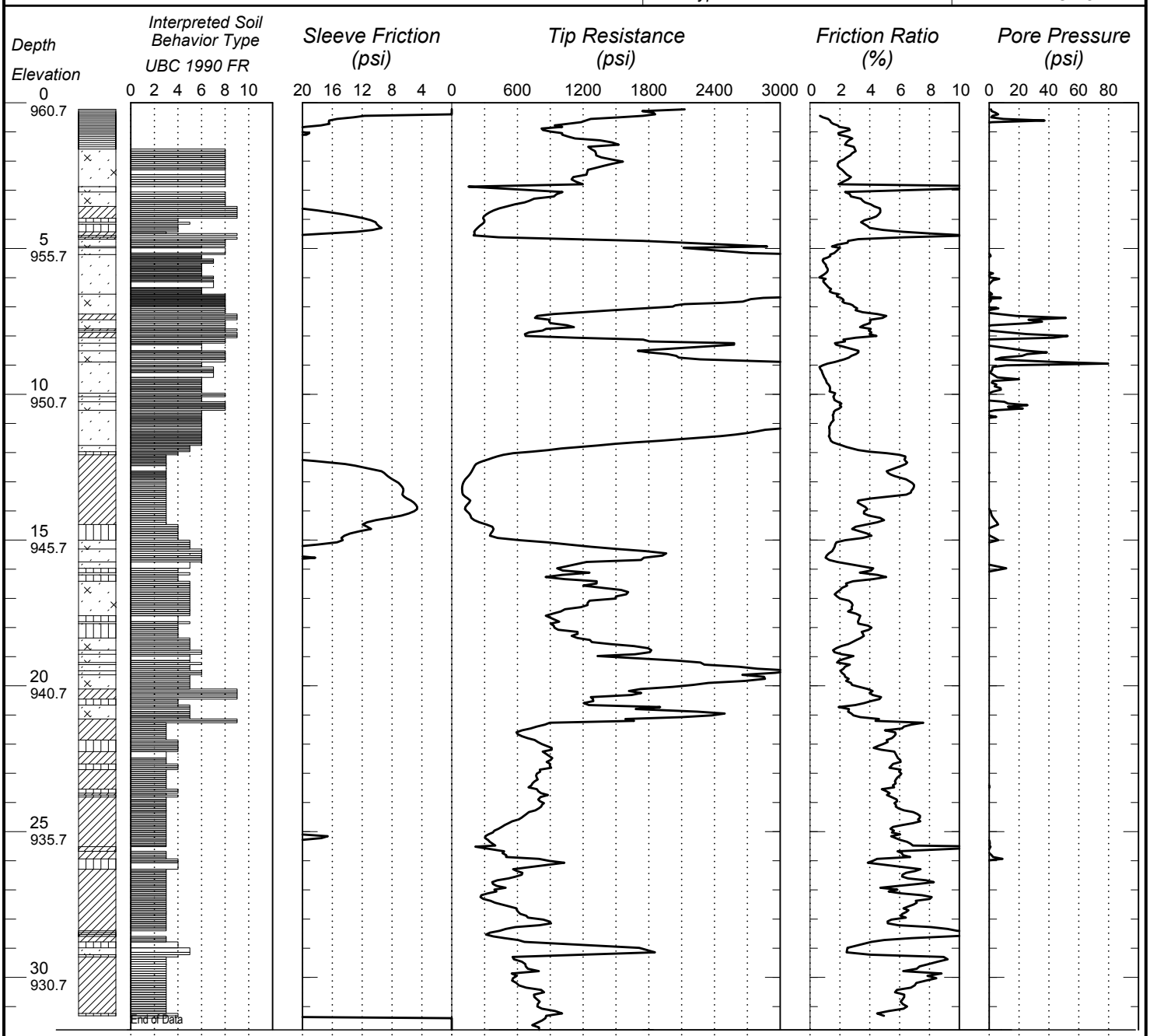
CONE PENETRATION TEST RESULTS

UNIQUE NUMBER 80457

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Sounding No.	Ground Elevation
SP 1918-110	**Overhead Signs**	**T.H. 110 AND Robert-494**	**c-01**	**960.7** *(DTM)*

Location **Dakota Co. Coordinate: X=559890 Y=248759** (ft.)	*CPT Machine* **205146 CPT Truck (H)**	*SHEET 1 of 1*
Latitude (North)=44°52'46.99" *Longitude (West)=93°05'08.3"*	*CPT Operator* **O'Donnel, Pat**	*Date Completed*
No Station-Offset Information Available	*Hole Type* **CPT-STD**	**1/28/16**



Index Sheet Code 3.0 G:\geotech\cptdata\TH110\1918-110-Pat (01-28-2016)\SP 1918-110 Cone 1-28-16 001.CPT

Soil Class Rock Class Edit: Date: 2/18/16
G:\GINT\PROJECTS-ACTIVE\1918-110-TH 110- SIGN BASE.GPJ

MINNESOTA DEPARTMENT OF TRANSPORTATION - GEOTECHNICAL SECTION

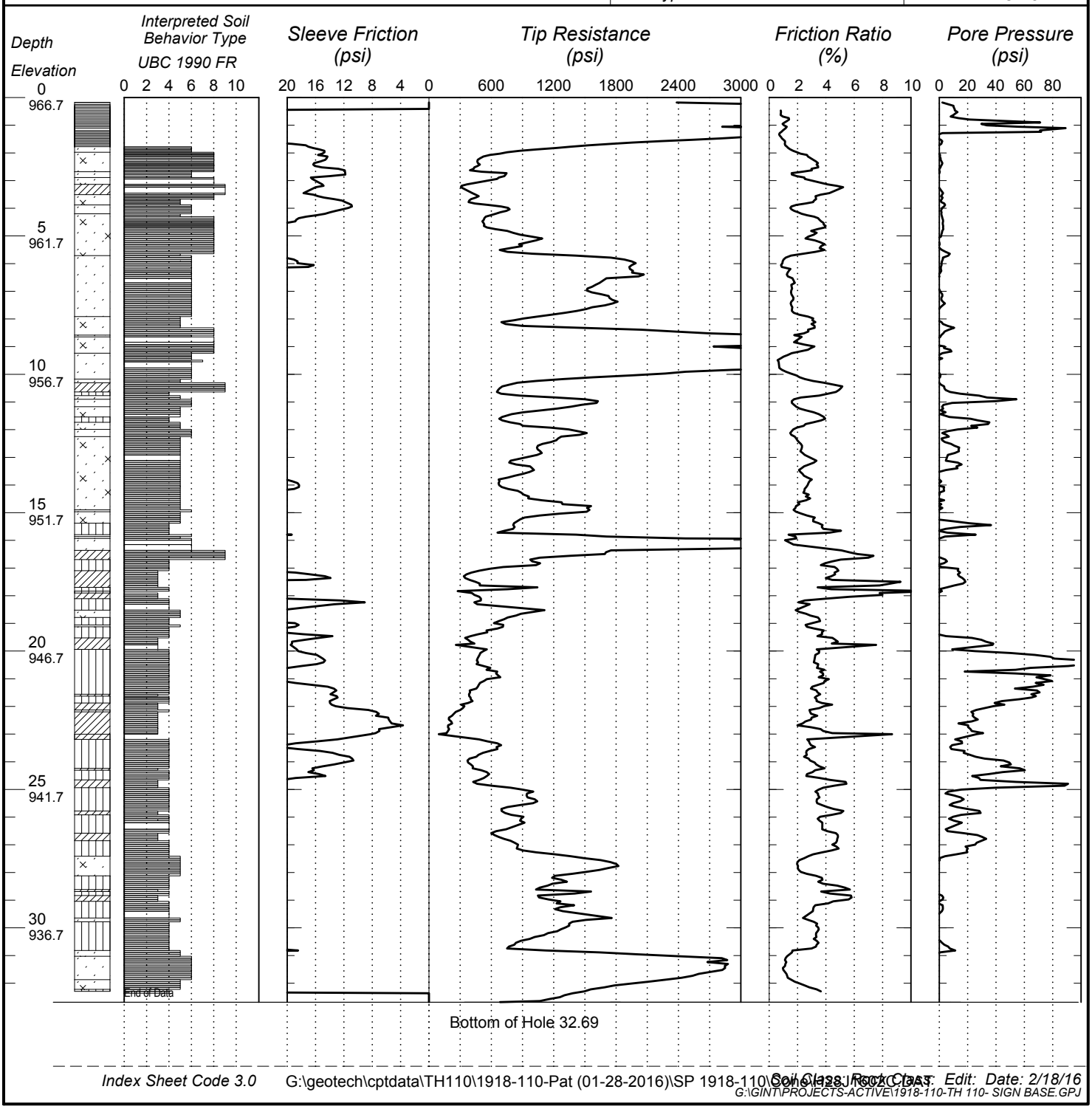
CONE PENETRATION TEST RESULTS

UNIQUE NUMBER 80458

U.S. Customary Units

State Project	Bridge No. or Job Desc.	Trunk Highway/Location	Sounding No.	Ground Elevation
SP 1918-110	**Overhead Signs**	**T.H. 110 AND Robert-494**	**c-02**	**966.7** *(DTM)*

Location **Dakota Co. Coordinate: X=560594 Y=248232** (ft.)	*CPT Machine* **205146 CPT Truck (H)**	*SHEET 1 of 1*
Latitude (North)=44°52'41.76" *Longitude (West)=93°04'58.55"*	*CPT Operator* **O'Donnel, Pat**	*Date Completed*
No Station-Offset Information Available	*Hole Type* **CPT-STD**	**1/28/16**



Index Sheet Code 3.0 G:\geotech\cptdata\TH110\1918-110-Pat (01-28-2016)\SP 1918-110\Cone-128_1602.CPT *Soil Class: Rock Class: Edit: Date: 2/18/16*

G:\GINT\PROJECTS-ACTIVE\1918-110-TH 110- SIGN BASE.GPJ