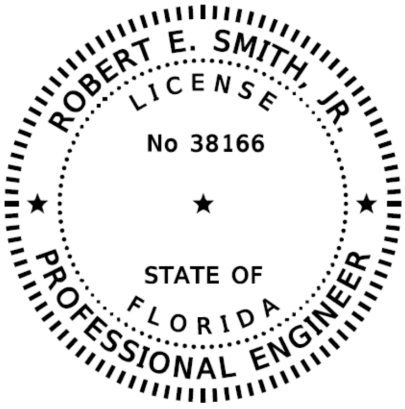
MOCCASIN WALLOW
SEGMENT 1– PHASE 1
PROJECT NO: 215615900

Structural Design Calculations: Mast Arms



This item has been digitally signed and sealed by:

Robert E Smith
2022.06.01 13:59:38-04'00'

On the date adjacent to the seal

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1.0 EXECUTIVE SUMMARY

This report contains the design calculations for the mast arms presented in the Standard Mast Arm Tabulation prepared for this project (refer to Sheet T-7 of the Contract Plans). The design specifications and methodology are briefly described in the following page.

2.0 DESIGN SPECIFICATIONS & METHODOLOGY

2.1 Design Specifications:

- FDOT Structures Manual, Dated January 2021
- AASHTO LRFD Specifications for Structural Supports for Signs, Luminaires and Traffic Signals, 1st Edition, 2015 with 2017 Interims.
- FDOT FY 2021-22 Design Standards, Index No. 649-030 & 649-031.

2.2 Design Methodology:

- Load and Resistance Factor Design (LRFD) Method

2.3 Wind Load:

- Wind Speed of 150 mph (Manatee County) (LRFDLTS-1, 3.8.3)

2.4 Soil Properties:

Refer to the Geotechnical Report, dated Aug. 14, 2019 and prepared by Driggers Engineering Services, Inc. for soil parameter recommendations at each location.

3.0 DESIGN CALCULATIONS

3.1 Minimum Vertical Clearance

All mast arms have a mounting height between 19-22 feet, which provides a minimum vertical clearance of at least 17.50 feet in all cases. Verification of the Vertical Clearance is presented in Table 1 below.

Mast Arm ID	STA.	Arm (ft)	Top of Foundation Elevation (ft)	Crown Elevation (ft)	Mounting Height UB (ft)	Max. Number of heads**	Vertical Clearance (ft)*	Verification
1	190+27	70	34.14	35.16	22.00	4	17.90	OK

* Vertical Clearance checked for standard 14 inches square heads with an additional 9in to the bottom to account for backplates and attachment hardware

** 5 head signals used have 2 columns of 2 heads with the 5th head on top, for vertical clearance purpose, it is considered as a 3 head signal. In cases with both 4 and 5 head signals, 4 head signals is considered for vertical clearance

3.2 Mast Arm Design

The design calculations for Mast Arms 1 are presented Next.

3.2.1 Pole 1

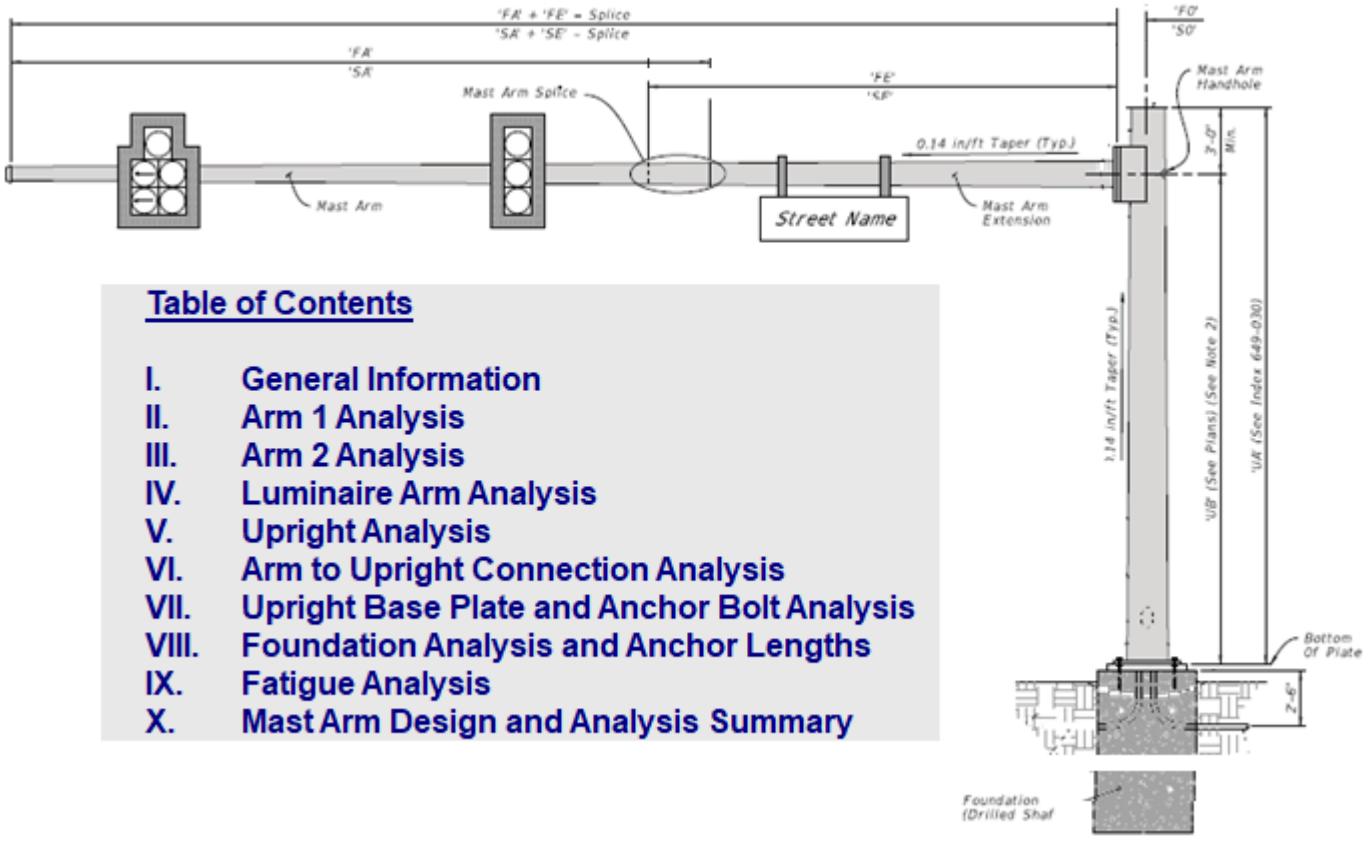
FDOT Mast Arm Traffic Signal Support Analysis Program V1.3

This program works in conjunction with FDOT Mast Arm Standard Plans 649-030 & 649-031.

References:
AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (LRFDLTS).
FDOT Structures Manual Volume 3 (SM V3).
AISC Steel Construction Manual

For more information see Reference.xmcd and Changes.xmcd.

Reference



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Data Folder and Files

Data Files Folder

Change Folder

C:\Users\cdominguez\Desktop\Moccasin Wallow Road\Moccasin Wallow Mast Arms (04-28)\Mast Arm MathCADs\MastArmV1.4\Data\

Required - Open Existing Data File. To save New Data Files, enter data variables at the end of Section IX.

Refresh List

Open File

A70DH-A50DH-P5DL.dat
A70DH-A70DH-P6DL.dat
A70S-P5SL - MastArm1.dat
A70S-P5SL.dat
A78D-A30D-P6DL.dat
A78D-A50D-P6DL.dat
A78D-A70D-P7DL.dat
A78DH-A40DH-P6DL.dat
A78DH-A60DH-P6DL.dat

I. General Information and Sign & Signal Data

Enter Project Information

Project Name	A/70/S-P/5/S/L		
Project No.	215615900		
Designed by	CD	*Date*	04 / 28 / 2022
Checked by	JR	*Date*	04 / 28 / 2022
Signal Name	MA 1		
Station/Offset	190+27 / 58.5' LT		

Enter Wind Speed

Design Wind Speed 150 *mph*

Extreme Event Wind Speed

SDG Wind Speeds by County

Enter Arm Lengths, Signal and Sign Data

Arm 1

Arm 1 Length 70 Reset Arm 1 Data

Arm 2 *Set Arm 2 Length = 0 for single arm Mast Arms*

Arm 2 Length 0 Reset Arm 2 Data

Arm1 Signal Number	*Distance to Signal (ft)*	*Number of Heads*
1	17.3	5
2	36.4	3
3	47.3	3
4	58.4	4
5		
6		
7		
8		
9		
10		

Arm2 Signal Number	*Distance to Signal (ft)*	*Number of Heads*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Arm 1 Sign Panels

Arm1 Sign Panel Number	*Distance to Panel (ft)*	*Panel Area (sf)*
1	4.5	17.5
2	13	6.25
3	29.5	9
4	39.2	9
5	70	1

Arm 2 Sign Panels

Arm2 Sign Panel Number	*Distance to Panel (ft)*	*Panel Area (sf)*
1		
2		
3		
4		
5		

Save Data for Signs and Signals

II. Arm 1 Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat" $V_{extreme} = 150 \cdot mph$

Reference:C:\Users\cdominguez\Desktop\Moccasin Wallow Road\Moccasin Wallow Mast Arms (04-28)\Mast Arm MathCADs\MastArmV1.4\LR

Help - Base Diameters | Help - Tube Wall Thickness

Arm Extension (for 2 piece arms only)

Enter Arm 1 Data

Iterate on Base Diameters and Wall Thicknesses

Arm Length (ft)	*Base Diameter 1 (in)*	*Wall Thickness 1 (in)*	*Base Diameter 2 (in)*	*Wall Thickness 2 (in)*
$L_{total.arm1} = 70\,ft$	14	0.375	18	0.5
feet, 40 ft. max. for 1 piece arms	*Measured flat to flat* 'FC'	'FD'	*Measured flat to flat* 'FG'	'FH'

Arm 1 Analysis including Existing Mast Arm Analysis (Additional Variables Required)

$L_{total.arm1} = 70\,ft$ 'FD'= 'FH'= $t_{wall.arm1} = \begin{pmatrix} 0.375 \\ 0.500 \end{pmatrix} \cdot in$ 'FC'= 'FG'= $Diameter_{base.arm1} = \begin{pmatrix} 14.00 \\ 18.00 \end{pmatrix} \cdot in$ BackPlate = "Rigid, 6 inches wide"

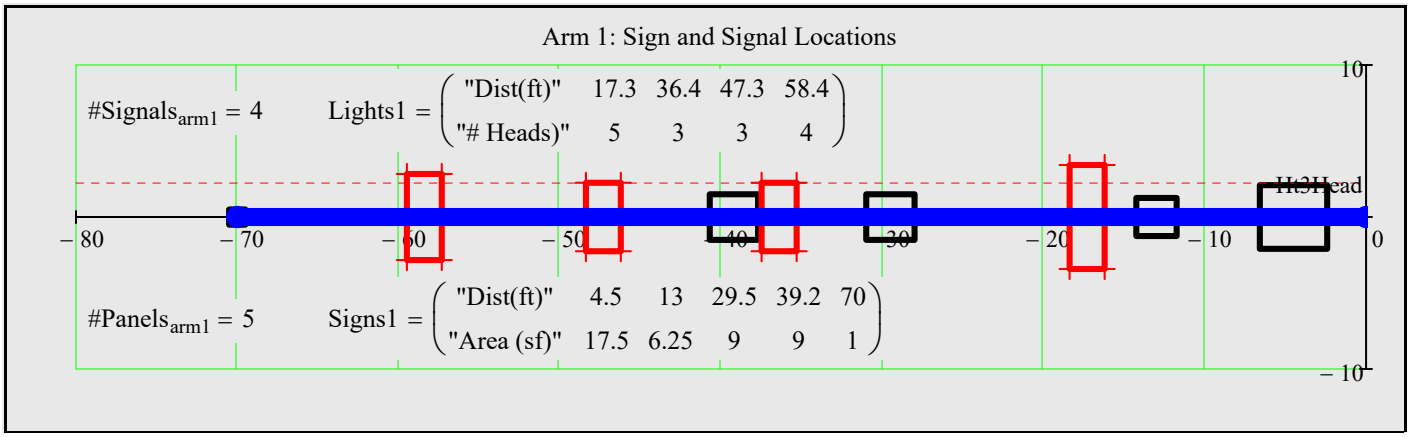
'FB'= 'FF'= $Diameter_{tip.arm1} = \begin{pmatrix} 8.68 \\ 13.10 \end{pmatrix} \cdot in$ $CheckTipDia_{arm1}$ = "OK"

'FA'= 'FE'= $L_{arm1} = \begin{pmatrix} 38.0 \\ 35.0 \end{pmatrix} \cdot ft$ $CheckSectionLength_{arm1}$ = "OK"

$L_{splice.provided.arm1} = 1.0\,ft$ $Classification_{arm1} = \begin{pmatrix} "Compact" \\ "Compact" \end{pmatrix}$

Arm 1 Combined Force Interaction Ratio and Deflection

$\max(CFI_{arm1}) = 0.55$ $CheckMaxCFI_{arm1}$ = "OK" $\max(\Delta_{arm1}) = 14.5 \cdot in$ $2 \cdot deg \cdot L_{total.arm1} = 29.3 \cdot in$



III. Arm 2 Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat" $V_{extreme} = 150 \cdot mph$

Help - Base Diameters | Help - Tube Wall Thickness

Arm Extension (for 2 piece arms only)

Enter Arm 2 Data

Iterate on Base Diameters and Wall Thicknesses

Arm Length (ft)	*Base Diameter 1 (in)*	*Wall Thickness 1 (in)*	*Base Diameter 2 (in)*	*Wall Thickness 2 (in)*
$L_{total.arm2} = 0\,ft$				
feet, 40 ft. max. for 1 piece arms	*Measured flat to flat* 'SC'	*for 1 & 2 piece arms* 'SD'	*Measured flat to flat* 'SG'	*for 2 piece arms only* 'SH'

Arm 2 Analysis including Existing Mast Arm Analysis

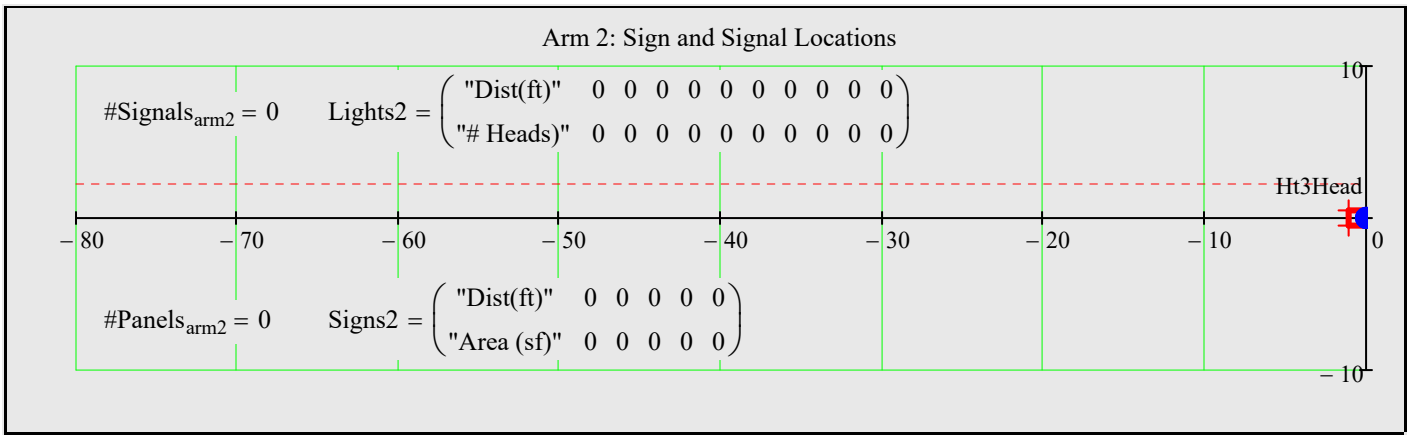
$L_{total.arm2} = 0\,ft$ 'SD'= 'SH'= $t_{wall.arm2} = \begin{pmatrix} 0.000 \\ 0.000 \end{pmatrix} \cdot in$ 'SC'= 'SG'= $Diameter_{base.arm2} = \begin{pmatrix} 0.00 \\ 0.00 \end{pmatrix} \cdot in$ $BackPlate = "Rigid, 6\ inches\ wide"$

'SB'= 'SF'= $Diameter_{tip.arm2} = \begin{pmatrix} 0.00 \\ 0.00 \end{pmatrix} \cdot in$ $CheckTipDia_{arm2} = "N/A"$ 'SA'= 'SE'= $L_{arm2} = \begin{pmatrix} 0.0 \\ 0.0 \end{pmatrix} \cdot ft$ $CheckSectionLength_{arm2} = "N/A"$

$L_{splice.provided.arm2} = 0.0\,ft$ $Classification_{arm2} = \begin{pmatrix} "Compact" \\ "N/A" \end{pmatrix}$

Arm 2 Combined Force Interaction Ratio and Deflection

$\max(CFI_{arm2}) = 0.00$ $CheckMaxCFI_{arm2} = "OK"$ $\max(\Delta_{arm2}) = 0.0 \cdot in$ $2 \cdot deg \cdot L_{total.arm2} = 0 \cdot in$



IV. Luminaire Arm Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat" $V_{extreme} = 150 \cdot mph$

Enter Luminaire Data

Set Lum. Ht. = 0 for no Luminaire

See Design Standards 649-030 and 649-031 for input values.

Luminaire Height (ft)	Lum Horiz Length (ft)	Lum Arm Base Dia (in)	Lum Wall Thickness (in)	Slope	Lum Arm Radius (ft)	Lum Bolt Dia (in)	Lum Base Plate Thickness (in)
40	10	3	0.125	0.5	8	0.5	0.75
Std = 40 feet	*10 feet*	*3 inches*	*0.125 inches*	*0.5*	*8 feet*	*0.5 inches*	*0.75 inches*

Analyze Luminaire

Summary - Luminaire Arm Geometry

$\begin{pmatrix} CFI_{base.lumarm} \\ CSR_{bolt.lum} \\ D/C_{baseplate.lum} \\ D/C_{conn.plate.lum} \end{pmatrix} = \begin{pmatrix} 0.60 \\ 0.02 \\ 0.80 \\ 0.72 \end{pmatrix}$

'LA'= $Y_{luminaire} = 40\,ft$

'LB'= $X_{luminaire} = 10\,ft$

'LC'= $Diameter_{base.lumarm} = 3 \cdot in$

'LD'= $t_{wall.lumarm} = 0.125 \cdot in$

'LE'= $Slope_{lumarm} = 0.5$

'LF'= $r_{lumarm} = 8\,ft$

'LG'= $d_{bolt.lum} = 0.5 \cdot in$

'LH'= $t_{baseplate.lum} = 0.75 \cdot in$

'LJ'= $w_{base.lum} = \frac{1}{4} \cdot in$

'LK'= $w_{channel.lum} = \frac{1}{4} \cdot in$

V. Upright Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat" $V_{extreme} = 150 \cdot mph$

Help - Upright Base Diameter and Wall Thickness | Help - Gap Distance

Enter Upright Data

Total Height (ft)	*Height to Arm Connection (ft)*	*Base Diameter (in)*	*Wall Thickness (in)*	*Gap (in)*	
39	22	24	0.375	7.5	*arm 1 gap*
					arm 2 gap
'UA'	'UB'	'UD' *measured flat to flat*	'UE'		

Analyze Upright

Upright Combined Force Interaction Ratio and Deflections

Classification$_{pole}$ = "Compact"

$\max(CFI_{pole}) = 0.62$

$Check_{slope}$ = "OK"

$Check_{deflection}$ = "OK"

$\max(\Delta_{x.dl}) = 1.38 \cdot in$

$\max(\Delta_{z.dl}) = 0 \cdot in$

$Slope_z = 0 \cdot deg$

$Slope_x = 0.64 \cdot deg$

$Diameter_{conn.pole} = 20.9 \cdot in$

$$\max\left(\begin{pmatrix} Diameter_{base.arm1_0} \\ Diameter_{base.arm2_0} \end{pmatrix}\right) = 14 \cdot in$$

'UA'= $Y_{pole} = 39 \cdot ft$

'UB'= $Y_{arm.conn} = 22 \cdot ft$

'UC'= $Diameter_{tip.pole} = 18.6 \cdot in$

'UD'= $Diameter_{base.pole} = 24 \cdot in$

'UE'= $t_{wall.pole} = 0.375 \cdot in$

'UF'= $\alpha = 0 \cdot deg$

'UG'= $Y_{lum.conn} = 37.5\ ft$

VI. Arm to Upright Connection Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat"

for double arms, both connection plate heights must be equal

Help - Arm Connection Dimensions

Enter Connection Data

Connection Plate Height(in)	*Connection Plate Width (in)*	*Vertical Plate Thickness (in)*	*Bolt Diameter (in)*	*Arm Base Plate Thickness (in)*
30	36	0.75	1.25	3
'HT'	'FJ', 'SJ'	'FL', 'SL'	'FP', 'SP'	'FK', 'SK'

Analyze Connection

Connection Summary

'HT'= $h_{conn.plate} = 30 \cdot in$ $D/C_{ht.conn.plate} = 0.70$ $CheckHt_{conn.plate} = "OK"$

$D/C_{width.conn.plate_0} = 0.90$

$CheckWidth_{conn.plate_0} = "OK"$

$\begin{pmatrix} D/C_{t.baseplate.arm_0} \\ CFI_{t.vert.plate_0} \\ CSR_{bolt.conn_0} \end{pmatrix} = \begin{pmatrix} 0.83 \\ 0.51 \\ 0.80 \end{pmatrix}$

$\#Bolts_{conn_0} = 6$

'FJ'= $b_{conn.plate_0} = 36 \cdot in$

'FK'= $t_{baseplate.arm_0} = 3.00 \cdot in$

'FL'= $t_{vertical.plate_0} = 0.75 \cdot in$

'FN'= $w_{vertical.plate_0} = \frac{1}{2} \cdot in$

'FO'= $Offset_{conn_0} = 18.0 \cdot in$

'FP'= $d_{bolt.conn_0} = 1.25 \cdot in$

'FR'= $t_{conn.plate_0} = 2.50 \cdot in$

'FS'= $Spacing_{bolts.conn_0} = 12.5 \cdot in$

'FT'= $w_{conn.plate_0} = \frac{1}{2} \cdot in$

$D/C_{width.conn.plate_1} = 0.00$

$CheckWidth_{conn.plate_1} = "OK"$

$\begin{pmatrix} D/C_{t.baseplate.arm_1} \\ CFI_{t.vert.plate_1} \\ CSR_{bolt.conn_1} \end{pmatrix} = \begin{pmatrix} 0.00 \\ 0.00 \\ 0.00 \end{pmatrix}$

$\#Bolts_{conn_1} = 0$

'SJ'= $b_{conn.plate_1} = 0 \cdot in$

'SK'= $t_{baseplate.arm_1} = 0.00 \cdot in$

'SL'= $t_{vertical.plate_1} = 0 \cdot in$

'SN'= $w_{vertical.plate_1} = 0 \cdot in$

'SO'= $Offset_{conn_1} = 0.0 \cdot in$

'SP'= $d_{bolt.conn_1} = 0 \cdot in$

'SR'= $t_{conn.plate_1} = 0.00 \cdot in$

'SS'= $Spacing_{bolts.conn_1} = 0.00 \cdot in$

'ST'= $w_{conn.plate_1} = 0 \cdot in$

VII. Upright Base Plate & Anchor Bolt Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat"

Enter Anchorage Data

Anchor Bolt Diameter (in)	*Number of Anchor Bolts*	Help - Number of Anchor Bolts
2	8	
'BC'	'#Bolts'	

$Diameter_{base.pole} = 24 \cdot in$

Analyze Base Plate & Anchors

Base Plate and Anchor Summary

'#Bolts'= $\#AnchorBolts = 8$

$CSR_{anchor} = 0.32$

$CheckCSR_{anchorbolt} = "OK"$

$Diameter_{boltcircle.pole} = 32 \cdot in$

'BA'= $Diameter_{baseplate.pole} = 40 \cdot in$

'BB'= $t_{baseplate.pole} = 2.50 \cdot in$

'BC'= $d_{anchorbolt} = 2.00 \cdot in$

VIII. Foundation Analysis & Anchor Bolt Lengths

InputDataFile = "A70S-P5SL - MastArm1.dat"

Enter Drilled Shaft Data

Soil Type	Sand / Clay	
Soil Density, γ_{soil} (45-50 pcf typ.)	57.6	pcf
Friction Angle, ϕ (Sands)	30	deg
SPT Number (N_{blows} 5 min.) (Sands)	10	
Shear Strength, c (Clays)		ksf
Ground to Top of Shaft Offset	0.0	ft

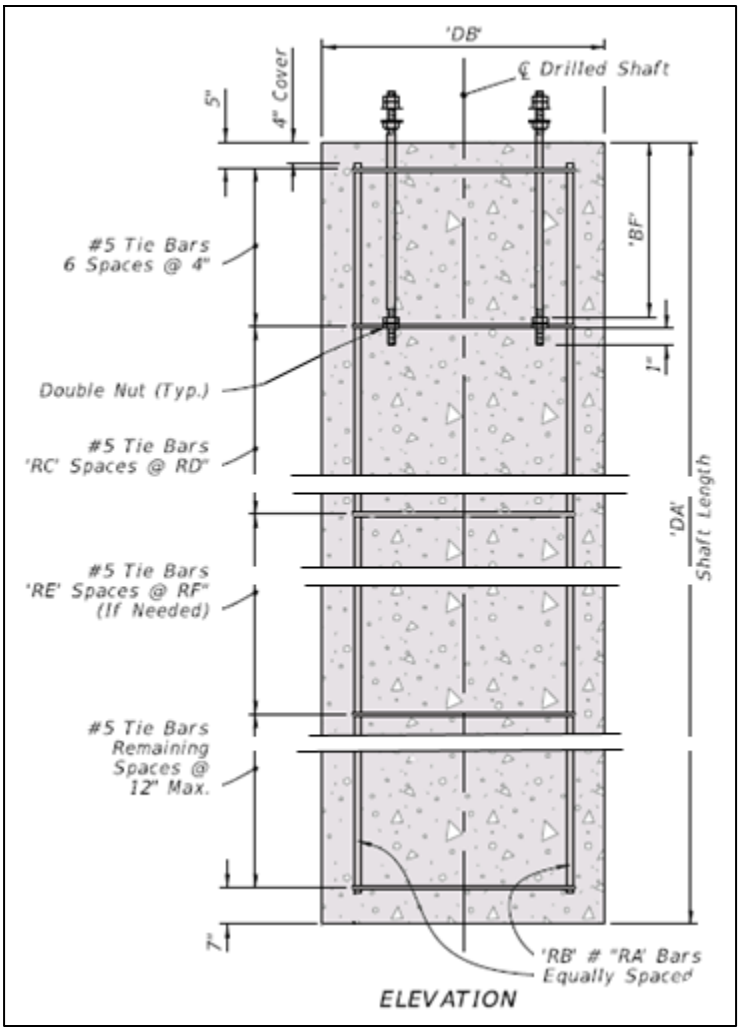
First Set of User Defined Stirrups:

Number of Stirrup Spaces	'RC'	10	
Stirrup Spacing	'RD'	6	in

Second Set of User Defined Stirrups:

Number of Stirrup Spaces enter zero for 12 inch spacing	'RE'	10	
Stirrup Spacing enter zero for 12 inch spacing	'RF'	9	in

Stirrup Bar Size, use #5 for all Standard Shafts: #5 / #6



Analyze Foundation

Shaft Length $L_{shaft} = 25\ ft$

Stirrup spacing $s_v = \begin{pmatrix} 4 \\ 6 \\ 9 \\ 12 \end{pmatrix} \cdot in$

Number of stirrup spaces $\#Spaces_{vbar} = \begin{pmatrix} 6 \\ 10 \\ 10 \\ 10 \end{pmatrix}$

Foundation Summary

CheckReinfClearSpacing = "OK"

CheckLongReinf$_{shr.tor}$ = "OK"

CheckMaxSpacingTransvReinf = "OK"

OverlapDesign = "Based on Overlap of Failure Cones"

OverlapTest = "Overlap of Failure Cones"

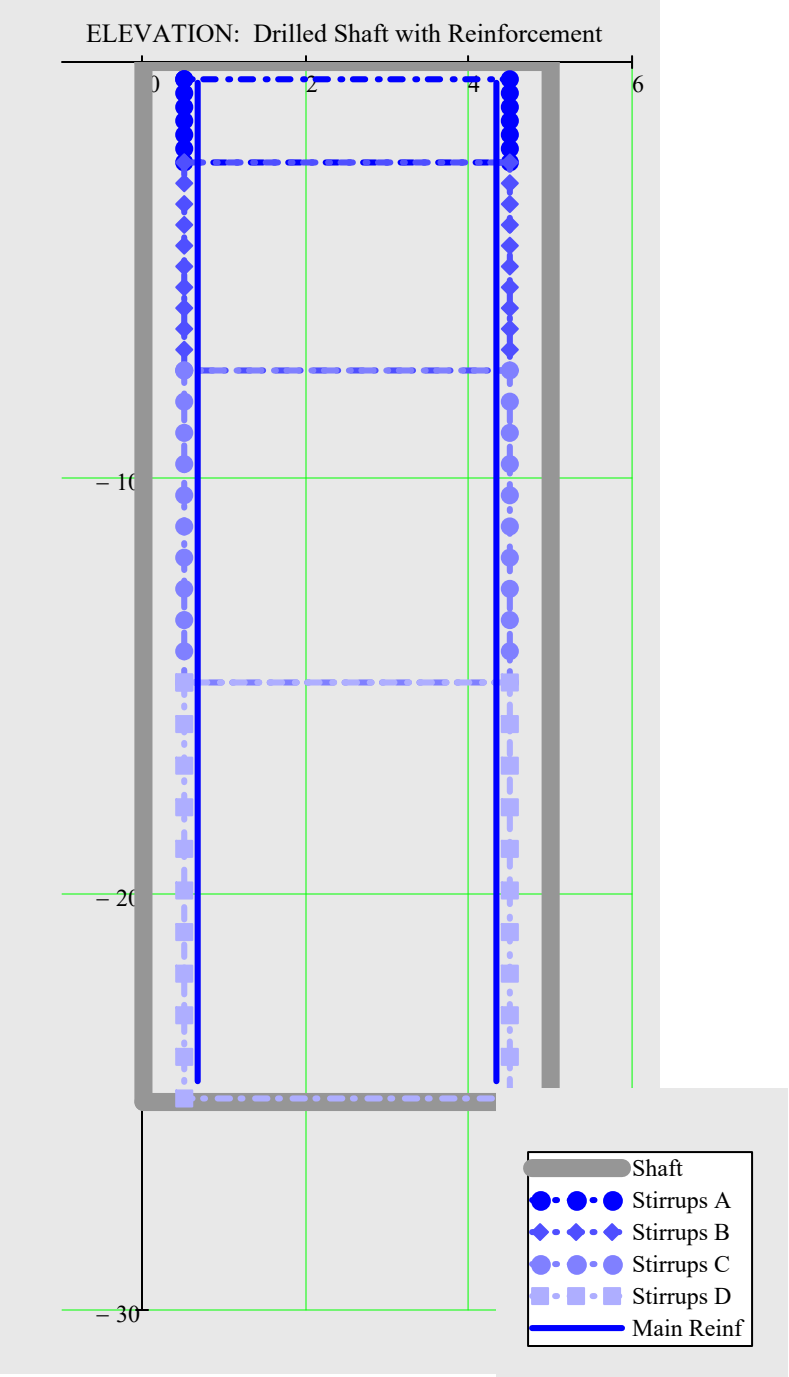
BreakoutTest = "OK"

Stirrups $s_{v_0} = 4 \cdot in$ @ $\#Spaces_{vbar_0} = 6$: $D/C_{torsion_0} = 0.2$

Stirrups 'RC' ($s_{v_1} = 6 \cdot in$) @ 'RD' ($\#Spaces_{vbar_1} = 10$): $D/C_{torsion_1} = 0.4$

Stirrups 'RE' ($s_{v_2} = 9 \cdot in$) @ 'RF' ($\#Spaces_{vbar_2} = 10$): $D/C_{torsion_2} = 0.4$

Stirrups $s_{v_3} = 12 \cdot in$ @ $\#Spaces_{vbar_3} = 10$



Offset = 0 ft

$d_{long.bar} = 1.41 \cdot in$

$Dia_{bar.circle} = 45.3 \cdot in$

'DA'= $L_{shaft} = 25 \cdot ft$

'DB'= $Diameter_{shaft} = 5 \cdot ft$

'BF'= $L_{embedment.anchor} = 40 \cdot in$

$L_{anchor.bolt} = 53 \cdot in$

'RA'= $round\left(\frac{d_{long.bar}}{0.125in}\right) = 11$

'RB'= $\#LongBars_{prov} = 18$

$\#Spaces_{vbar_0} = 6$

$s_{v_0} = 4 \cdot in$

'RC'= $\#Spaces_{vbar_1} = 10$

'RD'= $s_{v_1} = 6 \cdot in$

'RE'= $\#Spaces_{vbar_2} = 10$

'RF'= $s_{v_2} = 9 \cdot in$

$\#Spaces_{vbar_3} = 10$

$s_{v_3} = 12 \cdot in$

Drilled Shaft extended to 25 ft due to proximity to box culvert

IX. Fatigue Analysis

InputDataFile = "A70S-P5SL - MastArm1.dat"

$FatigueCategory_{galloping} := 2$ $FatigueCategory_{natural.wind} := 2$ ***SM V3 11.6***

Analyze Structure for Fatigue

Fatigue Summary

K1 values within 2% of LTS thresholds of 3.0 and 4.0 may use next higher CAFT values

Arm and Pole Welds

$Check_{galloping.arm1} = "OK"$	$f_{galloping.arm1} = 3.5 \cdot ksi$	$CAFT_{fullpengroove.weld.arm1} = 4.5 \cdot ksi$
$Check_{galloping.arm2} = "NA"$	$f_{galloping.arm2} = 0.0 \cdot ksi$	$CAFT_{fullpengroove.weld.arm2} = "NA" \cdot ksi$
$Check_{galloping.pole} = "OK"$	$f_{galloping.pole} = 2.5 \cdot ksi$	$CAFT_{fullpengroove.weld.pole} = 4.5 \cdot ksi$
$Check_{nwg.arm1} = "OK"$	$f_{nwg.arm1} = 2.5 \cdot ksi$	$CAFT_{fullpengroove.weld.arm1} = 4.5 \cdot ksi$
$Check_{nwg.arm2} = "NA"$	$f_{nwg.arm2} = 0.0 \cdot ksi$	$CAFT_{fullpengroove.weld.arm2} = "NA" \cdot ksi$
$Check_{nwg.pole} = "OK"$	$f_{nwg.pole} = 2.2 \cdot ksi$	$CAFT_{fullpengroove.weld.pole} = 4.5 \cdot ksi$

$$CheckK1Values = \begin{pmatrix} "K1 \text{ is outside of 2\% of K1 thresholds}" \\ "K1 \text{ is outside of 2\% of K1 thresholds}" \\ "K1 \text{ is outside of 2\% of K1 thresholds}" \end{pmatrix} \quad \begin{pmatrix} K_{I.arm1} \\ K_{I.arm2} \\ K_{I.pole} \end{pmatrix} = \begin{pmatrix} 4.539 \\ 100.000 \\ 7.033 \end{pmatrix} \begin{pmatrix} "Arm\ 1\ Base\ Weld" \\ "Arm\ 2\ Base\ Weld" \\ "Upright\ Base\ Weld" \end{pmatrix}$$

A325 Connection Bolts

$$Check_{g.conn.bolt} = \begin{pmatrix} "OK" \\ "OK" \end{pmatrix} \quad f_{t.g.bolt} = \begin{pmatrix} 7.0 \\ 0.0 \end{pmatrix} \cdot ksi \quad CAFT_{conn.bolt} = 16 \cdot ksi$$

$$Check_{nwg.conn.bolt} = \begin{pmatrix} "OK" \\ "OK" \end{pmatrix} \quad f_{t.nwg.bolt} = \begin{pmatrix} 5.0 \\ 0.0 \end{pmatrix} \cdot ksi$$

Anchor Bolts

$Check_{g.anchor} = "OK"$	$f_{t.g.anchor} = 2.2 \cdot ksi$	$CAFT_{anchor.bolts} = 7 \cdot ksi$
$Check_{nwg.anchor} = "OK"$	$f_{t.nwg.anchor} = 1.9 \cdot ksi$	

Save Data File (optional)

☑ Use current input file

File Name A70S-P5SL - MastArm1.dat

Note: Select an output folder by using the "Change Folder" option above.

Save Data

Arm Designation Example

A70/D-A30/D/H-P5/D/L-DS/16/5

A70/D -	*Arm 70 feet long, Double Arm*
A30/D/H -	*Arm 30 feet long, Double Arm, Heavy Duty*
P5/D/L -	*Pole 5 , Double Arm, with Luminaire*
DS/16/5 -	*Drilled Shaft 16 ft deep, 5 foot diameter*

X. Mast Arm Design and Analysis Summary

InputDataFile = "A70S-P5SL - MastArm1.dat"

If comparing results to Standard Index 649-030, some values in the index have been increased to reduce the number of variations.

Subject = "A/70/S-P/5/S/L" **DesignedBy** = "CD" **PoleLocation** = "190+27 / 58.5' LT"

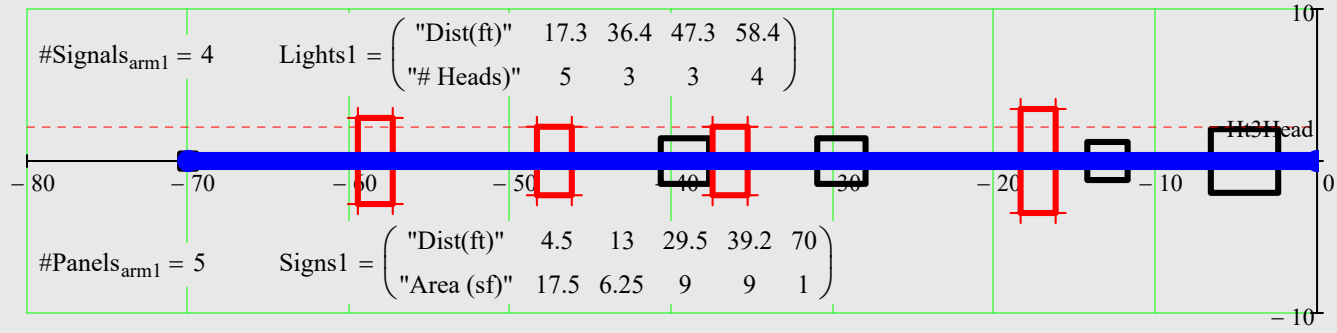
ProjectNo = "215615900" **CheckedBy** = "JR" **Date** = "04 / 28 / 2022" ExistingMastArm = "No"

For FDOT Mast Arm Support Structures, $\max(CFI) \le 0.95$ ***(See Structures Manual Volume3)***

1st Mast Arm

$V_{extreme} = 150 \cdot mph$ ExistingMastArm = "No" BackPlate = "Rigid, 6 inches wide"

Arm 1: Sign and Signal Locations



$\max(CFI_{arm1}) = 0.55$ CheckMaxCFI_arm1 = "OK" $L_{total.arm1} = 70\,ft$ $L_{splice.provided.arm1} = 0.985' \max(\Delta_{arm1}) = 14.5 \cdot in$

'FA'= 'FE'= $L_{arm1} = \begin{pmatrix} 38 \\ 35 \end{pmatrix} \cdot ft$ CheckSectionLength_arm1 = "OK"

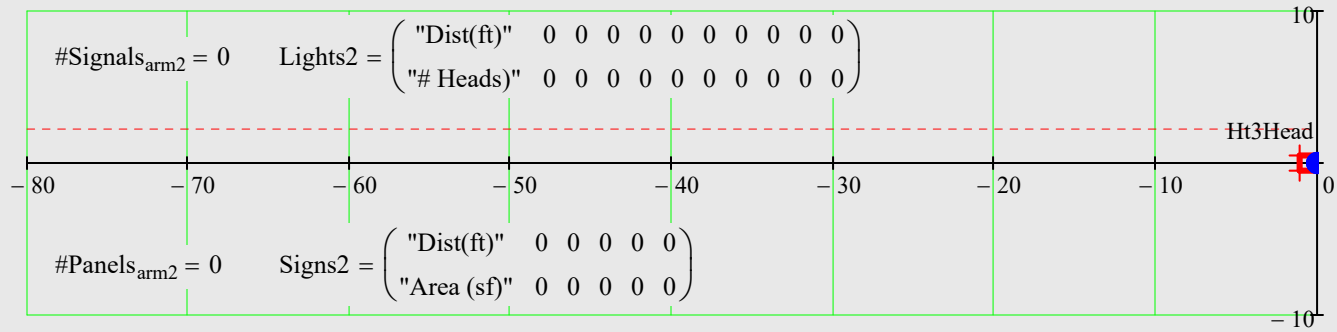
'FC'= 'FG'= $Diameter_{base.arm1} = \begin{pmatrix} 14.00 \\ 18.00 \end{pmatrix} \cdot in$

'FB'= 'FF'= $Diameter_{tip.arm1} = \begin{pmatrix} 8.68 \\ 13.10 \end{pmatrix} \cdot in$ CheckTipDia_arm1 = "OK"

'FD'= 'FH'= $t_{wall.arm1} = \begin{pmatrix} 0.375 \\ 0.500 \end{pmatrix} \cdot in$

2nd Mast Arm

Arm 2: Sign and Signal Locations



$\max(CFI_{arm2}) = 0.00$ CheckMaxCFI_arm2 = "OK" $L_{total.arm2} = 0\,ft$ $L_{splice.provided.arm2} = 0 \cdot ft$ $\max(\Delta_{arm2}) = 0 \cdot in$

'SA'= 'SE'= $L_{arm2} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \cdot ft$ CheckSectionLength_arm2 = "N/A"

'SC'= 'SG'= $Diameter_{base.arm2} = \begin{pmatrix} 0.00 \\ 0.00 \end{pmatrix} \cdot in$

'UF'= $\alpha = 0 \cdot deg$ **(Angle Between Arms)**

'SB'= 'SF'= $Diameter_{tip.arm2} = \begin{pmatrix} 0.00 \\ 0.00 \end{pmatrix} \cdot in$ CheckTipDia_arm2 = "N/A"

'SD'= 'SH'= $t_{wall.arm2} = \begin{pmatrix} 0.000 \\ 0.000 \end{pmatrix} \cdot in$

Luminaire Arm and Connection *(use MC10x33.6 channel for connection)*

$$\begin{pmatrix} CFI_{base.lumarm} \\ CSR_{bolt.lum} \\ D/C_{baseplate.lum} \\ D/C_{conn.plate.lum} \end{pmatrix} = \begin{pmatrix} 0.60 \\ 0.02 \\ 0.80 \\ 0.72 \end{pmatrix}$$

'LA'= $Y_{luminaire} = 40\,ft$

'LB'= $X_{luminaire} = 10\,ft$

'LC'= $Diameter_{base.lumarm} = 3 \cdot in$

'LD'= $t_{wall.lumarm} = 0.125 \cdot in$

'LE'= $Slope_{lumarm} = 0.5$

'LF'= $r_{lumarm} = 8\,ft$

'LG'= $d_{bolt.lum} = 0.5 \cdot in$

'LH'= $t_{baseplate.lum} = 0.75 \cdot in$

'LJ'= $w_{base.lum} = \frac{1}{4} \cdot in$

'LK'= $w_{channel.lum} = \frac{1}{4} \cdot in$

Upright

$\max(CFI_{pole}) = 0.62$ $Check_{deflection} = "OK"$ $Check_{slope} = "OK"$

'UA'= $Y_{pole} = 39 \cdot ft$

'UB'= $Y_{arm.conn} = 22 \cdot ft$

'UC'= $Diameter_{tip.pole} = 18.6 \cdot in$

'UD'= $Diameter_{base.pole} = 24 \cdot in$

'UE'= $t_{wall.pole} = 0.375 \cdot in$

'UF'= $\alpha = 0 \cdot deg$

'UG'= $Y_{lum.conn} = 37.5\,ft$

1st Arm to Upright Connection

$D/C_{ht.conn.plate} = 0.70$

'HT'= $h_{conn.plate} = 30 \cdot in$

$CheckHt_{conn.plate} = "OK"$

$\#Bolts_{conn_0} = 6$

'FO'= $Offset_{conn_0} = 18.0 \cdot in$

$D/C_{width.conn.plate_0} = 0.90$

'FJ'= $b_{conn.plate_0} = 36 \cdot in$

'FP'= $d_{bolt.conn_0} = 1.25 \cdot in$

$CheckWidth_{conn.plate_0} = "OK"$

'FK'= $t_{baseplate.arm_0} = 3 \cdot in$

'FR'= $t_{conn.plate_0} = 2.5 \cdot in$

$$\begin{pmatrix} D/C_{t.baseplate.arm_0} \\ CFI_{t.vert.plate_0} \\ CSR_{bolt.conn_0} \end{pmatrix} = \begin{pmatrix} 0.83 \\ 0.51 \\ 0.80 \end{pmatrix}$$

'FL'= $t_{vertical.plate_0} = 0.75 \cdot in$

'FS'= $Spacing_{bolts.conn_0} = 12.5 \cdot in$

'FN'= $w_{vertical.plate_0} = \frac{1}{2} \cdot in$

'FT'= $w_{conn.plate_0} = \frac{1}{2} \cdot in$

2nd Arm to Upright Connection

$D/C_{width.conn.plate_1} = 0.00$

'HT'= $h_{conn.plate} = 30 \cdot in$

$CheckWidth_{conn.plate_1} = "OK"$

$\#Bolts_{conn_1} = 0$

'SO'= $Offset_{conn_1} = 0.0 \cdot in$

$$\begin{pmatrix} D/C_{t.baseplate.arm_1} \\ CFI_{t.vert.plate_1} \\ CSR_{bolt.conn_1} \end{pmatrix} = \begin{pmatrix} 0.00 \\ 0.00 \\ 0.00 \end{pmatrix}$$

'SJ'= $b_{conn.plate_1} = 0 \cdot in$

'SP'= $d_{bolt.conn_1} = 0 \cdot in$

'SK'= $t_{baseplate.arm_1} = 0 \cdot in$

'SR'= $t_{conn.plate_1} = 0 \cdot in$

'SL'= $t_{vertical.plate_1} = 0 \cdot in$

'SS'= $Spacing_{bolts.conn_1} = 0 \cdot in$

'SN'= $w_{vertical.plate_1} = 0 \cdot in$

'ST'= $w_{conn.plate_1} = 0 \cdot in$

Pole Base Plate

$CSR_{anchor} = 0.32$

$CheckCSR_{anchorbolt} = "OK"$

'#Bolts'= $\#AnchorBolts = 8$

$Diameter_{boltcircle.pole} = 32 \cdot in$

'BA'= $Diameter_{baseplate.pole} = 40 \cdot in$

'BB'= $t_{baseplate.pole} = 2.5 \cdot in$

'BC'= $d_{anchorbolt} = 2.00 \cdot in$

'BF'= $L_{embedment.anchor} = 40 \cdot in$

$L_{anchor.bolt} = 53 \cdot in$

Foundation

$D/C_{torsion.max} = 0.45$

$CheckD/C_{shear.and.torsion} = "OK"$

$CheckReinfClearSpacing = "OK"$

$CheckLongReinf_{shr.tor} = "OK"$

$CheckMaxSpacingTransvReinf = "OK"$

$OverlapDesign = "Based on Overlap of Failure Cones"$

$OverlapTest = "Overlap of Failure Cones"$

$BreakoutTest = "OK"$

$Clearance_{csl.to.nut} = 3.5 \cdot in$

$Offset = 0\ ft$

$d_{long.bar} = 1.41 \cdot in$

$Dia_{bar.circle} = 45.3 \cdot in$

'DA'= $L_{shaft} = 25 \cdot ft$

'DB'= $Diameter_{shaft} = 5 \cdot ft$

'RA'= $round\left(\frac{d_{long.bar}}{0.125in}\right) = 11$

'RB'= $\#LongBars_{prov} = 18$

'RC'= $\#Spaces_{vbar_1} = 10$

'RD'= $s_{v_1} = 6 \cdot in$

'RE'= $\#Spaces_{vbar_2} = 10$

'RF'= $s_{v_2} = 9 \cdot in$

Fatigue

$Check_{galloping.arm1} = "OK"$

$Check_{nwg.arm1} = "OK"$

$Check_{galloping.arm2} = "NA"$

$Check_{nwg.arm2} = "NA"$

$Check_{galloping.pole} = "OK"$

$Check_{nwg.pole} = "OK"$

$Check_{g.conn.bolt} = \begin{pmatrix} "OK" \\ "OK" \end{pmatrix}$

$Check_{nwg.conn.bolt} = \begin{pmatrix} "OK" \\ "OK" \end{pmatrix}$

$Check_{g.anchor} = "OK"$

$Check_{nwg.anchor} = "OK"$

K1 values within 2% of LTS thresholds may use next higher CAFT values

$$CheckK1Values = \begin{pmatrix} "K1 \text{ is outside of } 2\% \text{ of K1 thresholds}" \\ "K1 \text{ is outside of } 2\% \text{ of K1 thresholds}" \\ "K1 \text{ is outside of } 2\% \text{ of K1 thresholds}" \end{pmatrix}$$

$$\begin{pmatrix} K_{I.arm1} \\ K_{I.arm2} \\ K_{I.pole} \end{pmatrix} = \begin{pmatrix} 4.539 \\ 100.000 \\ 7.033 \end{pmatrix} \begin{pmatrix} "Arm\ 1\ Base\ Weld" \\ "Arm\ 2\ Base\ Weld" \\ "Upright\ Base\ Weld" \end{pmatrix}$$

WRITE to Special Mast Arm Assembly Data Tables

Mast Arm Tip Deflection

Compare Mast Arm deflection of each arm to a proposed camber

$Camber_{arm1} := 2 \cdot deg$ $Camber_{arm2} := 2 \cdot deg$

$Deflection_{arm1} := Slope_x \cdot L_{total.arm1} + \max(\Delta_{arm1}) = 23.9 \cdot in$

$CamberArm1_{upward} := \sin(Camber_{arm1}) \cdot L_{total.arm1} = 29.3 \cdot in$

$Deflection_{arm2} := \left[Slope_z \cdot L_{total.arm2} \cdot (\sin(\alpha))\right] + Slope_x \cdot L_{total.arm2} \cdot \cos(\alpha) + \max(\Delta_{arm2}) = 0 \cdot in$

$CamberArm2_{upward} := \sin(Camber_{arm2}) \cdot L_{total.arm2} = 0 \cdot in$

Check Clearance Between Connection Plates *(for Two Arm Structures only)*

$\alpha = 0 \cdot deg$ $\alpha := if[(\alpha > 180 \cdot deg), (360 \cdot deg - \alpha), \alpha]$

$Offset_{conn_0} = 18 \cdot in$ $b_{conn.plate_0} = 36 \cdot in$ $h_{conn.plate} = 30 \cdot in$ $\alpha = 0 \cdot deg$

$Offset_{conn_1} = 0 \cdot in$ $b_{conn.plate_1} = 0 \cdot in$

$x1 := Offset_{conn_0} - t_{conn.plate_0} - h_{conn.plate} \cdot \frac{\sin(Camber_{arm1})}{2} = 15 \cdot in$ $y1 := \frac{b_{conn.plate_0}}{2} = 18 \cdot in$

$x2 := \left(Offset_{conn_1} - t_{conn.plate_1} - h_{conn.plate} \cdot \frac{\sin(Camber_{arm2})}{2}\right) \cdot \cos(\alpha) + \frac{b_{conn.plate_1}}{2} \cdot \sin(\alpha) = -0.5 \cdot in$

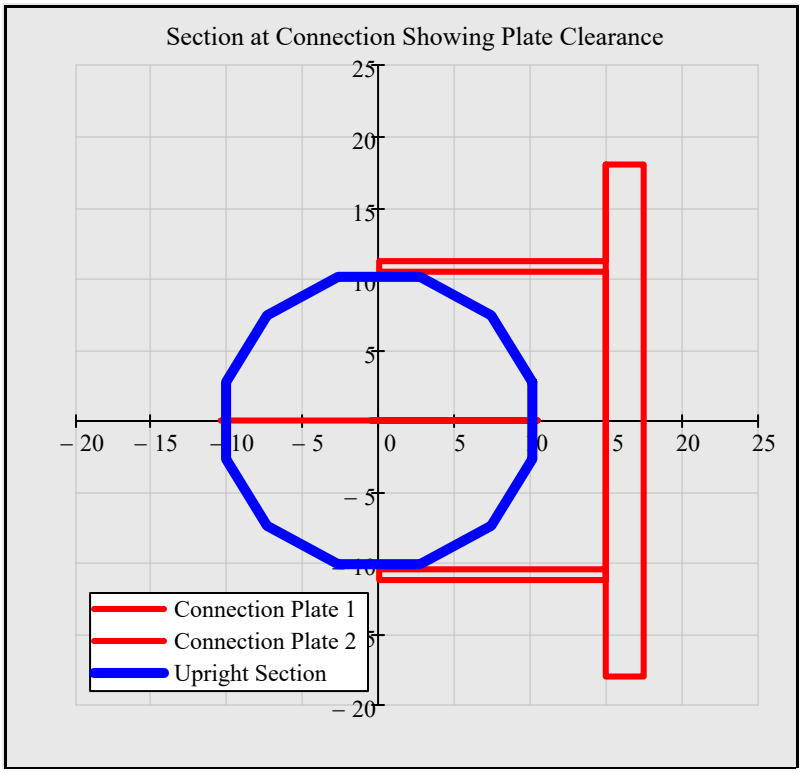
$y2 := \left(Offset_{conn_1} - t_{conn.plate_1} - h_{conn.plate} \cdot \frac{\sin(Camber_{arm2})}{2}\right) \cdot \sin(\alpha) - \frac{b_{conn.plate_1}}{2} \cdot \cos(\alpha) = 0 \cdot in$

$Clearance_{plate.to.plate} := if\left[(x1 > x2) \cdot (y2 > y1), \sqrt{(x1 - x2)^2 + (y1 - y2)^2}, 0 \cdot in\right] = 0 \cdot in$

(if Clearance < 2 inches, a redesign is required.

Coordinates for Drawings

Plan View - Connection Plate Clearance for Two Arm Connections



$Clearance_{plate.to.plate} = 0 \cdot in$

$Diameter_{conn.pole} = 20.9 \cdot in$

'FR'= $t_{conn.plate_0} = 2.5 \cdot in$

'FJ'= $b_{conn.plate_0} = 36 \cdot in$

'FL'= $t_{vertical.plate_0} = 0.75 \cdot in$

'FO'= $Offset_{conn_0} = 18.0 \cdot in$

$Gap_0 = 7.5 \cdot in$

'SR'= $t_{conn.plate_1} = 0 \cdot in$

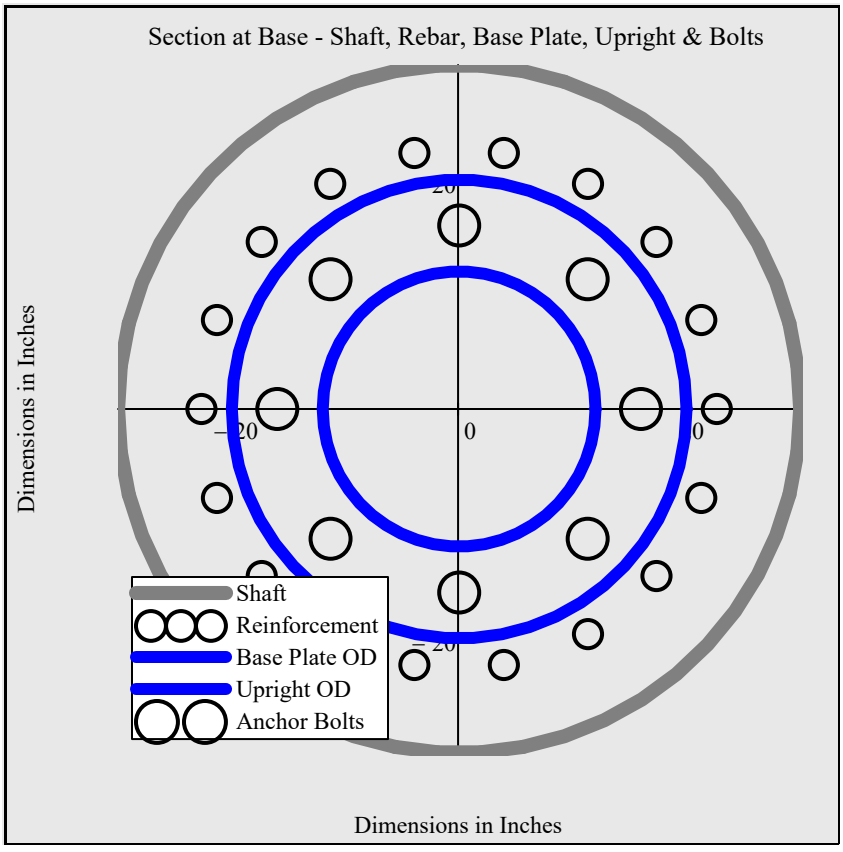
'SJ'= $b_{conn.plate_1} = 0 \cdot in$

'SL'= $t_{vertical.plate_1} = 0 \cdot in$

'SO'= $Offset_{conn_1} = 0.0 \cdot in$

$Gap_1 = 0 \cdot in$

Plan View - Drilled Shaft, Base Plate, Upright, Anchor Bolts, & Reinforcing Steel



$Clearance_{bar.to.nut} = 4.1 \cdot in$

'UD'= $Diameter_{base.pole} = 24 \cdot in$

'BA'= $Diameter_{baseplate.pole} = 40 \cdot in$

'DB'= $Diameter_{shaft} = 60 \cdot in$

$Diameter_{boltcircle.pole} = 32 \cdot in$

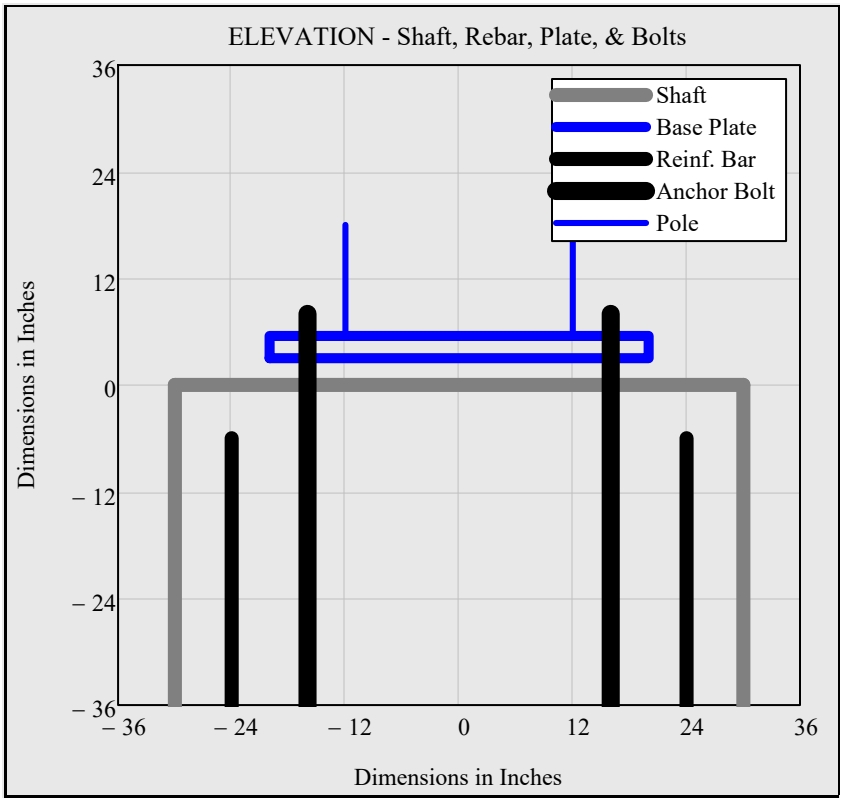
$Dia_{bar.circle} = 45.3 \cdot in$

$\#AnchorBolts = 8$

$\#LongBars_{prov} = 18$

Note: The Plan and Elevation Views do not show the 4 or 5 1.9" O.D. Nondestructive Integrity Testing Access Tubes that are tied to the inside of the reinforcing cage (see FDOT Spec 455-16.4).

Elevation View - Drilled Shaft, Base Plate, Anchor Bolts, & Reinforcing Steel



$Clearance_{bar.to.nut} = 4.1 \cdot in$

'UD'= $Diameter_{base.pole} = 24 \cdot in$

'BA'= $Diameter_{baseplate.pole} = 40 \cdot in$

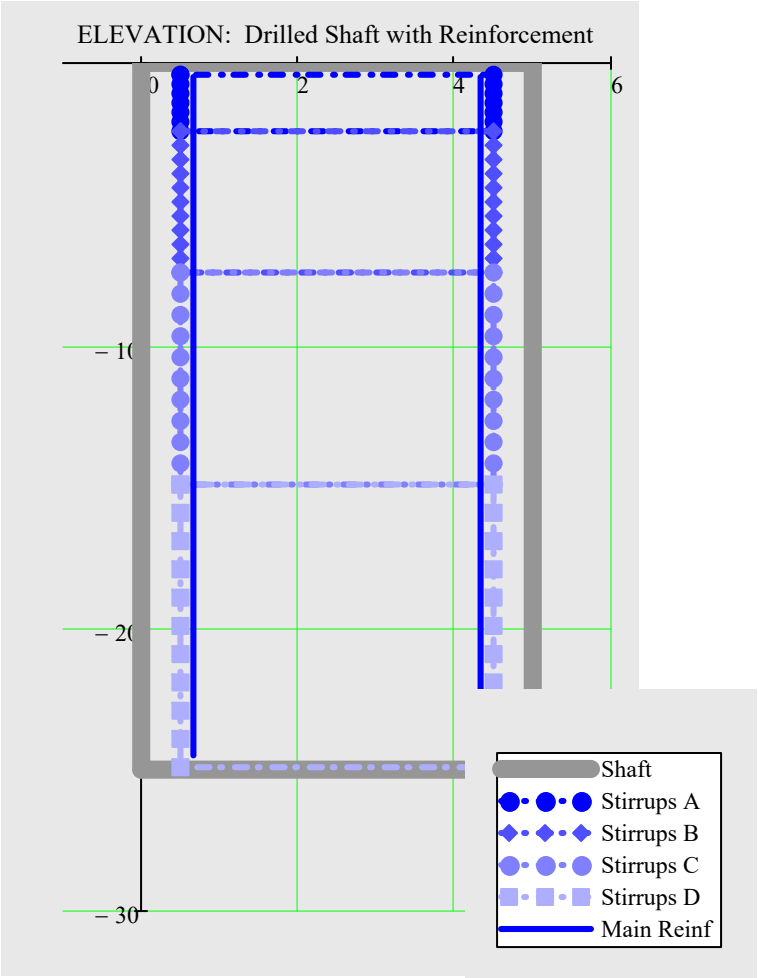
'BB'= $t_{baseplate.pole} = 2.5 \cdot in$

'DB'= $Diameter_{shaft} = 60 \cdot in$

$Diameter_{boltcircle.pole} = 32 \cdot in$

$Dia_{bar.circle} = 45.3 \cdot in$

Elevation View - Drilled Shaft with Main Reinforcement and Stirrups



$$s_v = \begin{pmatrix} 4 \\ 6 \\ 9 \\ 12 \end{pmatrix} \cdot in$$ *stirrup spacing*

$$\#Spaces_{vbar} = \begin{pmatrix} 6 \\ 10 \\ 10 \\ 10 \end{pmatrix}$$ *number of stirrup spaces*

APPENDIX A: SPECIAL MAST ARM ASSEMBLY DATA TABLE

SPECIAL MAST ARM ASSEMBLIES DATA TABLE

Table Date 01-01-12

NUMBER OF LOCATIONS	STRUCTURE NUMBER	FIRST ARM				FIRST ARM EXTENSION				SECOND ARM				SECOND ARM EXTENSION				POLE						
		FA(ft)	FB(in)	FC(in)	FD(in)	FE(ft)	FF(in)	FG(in)	FH(in)	SA(ft)	SB(in)	SC(in)	SD(in)	SE(ft)	SF(in)	SG(in)	SH(in)	UA(ft)	UB(ft)	UC(in)	UD(in)	UE(in)	UF(deg)	UG(ft)
1	1	38.0	8.68	14	0.375	35	13.10	18	0.5	-	-	-	-	-	-	-	-	39	22	18.6	24	0.375	-	37.5

SPECIAL MAST ARM ASSEMBLIES DATA TABLE (CONT.)

Table Date 01-01-12

STRUCTURE NUMBER	FIRST ARM CONNECTION (in) First Arm Camber Angle = 2 Degrees											SECOND ARM CONNECTION (in) Second Arm Camber Angle = 2 Degrees										
	#Bolts	HT	FJ	FK	FL	FN	FO	FP	FR	FS	FT	#Bolts	HT	SJ	SK	SL	SN	SO	SP	SR	SS	ST
1	6	30	36	3	0.75	0.5	18.0	1.25	2.5	12.5	0.5	-	-	-	-	-	-	-	-	-	-	-

SPECIAL MAST ARM ASSEMBLIES DATA TABLE (CONT.)

Table Date 07-01-15

STRUCTURE NUMBER	POLE BASE CONNECTION (in)					SHAFT AND REINF.								LUMINAIRE AND LUMINAIRE CONNECTION										
	#Bolts	BA	BB	BC	BF	DA(ft)	DB(ft)	RA	RB	RC	RD(in)	RE	RF(in)	LA(ft)	LB(ft)	LC(in)	LD(in)	LE	LF(ft)	LG(in)	LH(in)	LJ(in)	LK(in)	LL(deg)
1	8	40	2.5	2	40	25	5	11	18	10	6	10	9	40	10	3	0.125	0.5	8	0.5	0.75	0.25	0.25	45

NOTES [Notes Date 07-01-13]:

1. *Structures 2 thru 8 are existing structures constructed under another project, thus not included in this data table*
2. *Work with Index 649-031.*
3. *Design Wind Speed = 150mph*

FOUNDATION NOTES:

1. *Design based on Borings taken 8/14/2019 sealed by Driggers Engineering Services, Inc.*
2. *Assumptions and Values used in design:*
   Soil Type = Sand
   Soil Layer Thickness = Varies
   Soil Friction Angle = Varies
   Soil Weight = Varies
   Design Water Table is at ground surface

REVISIONS

DATE	DESCRIPTION	DATE	DESCRIPTION

ROBERT E. SMITH, JR., P.E.
P.E. LICENSE NUMBER 38166
STANTEC CONSULTING SERVICES INC.
2056 VISTA PARKWAY, SUITE 100
WEST PALM BEACH, FLORIDA 33411

MANATEE COUNTY PUBLIC WORKS
ENGINEERING DIVISION

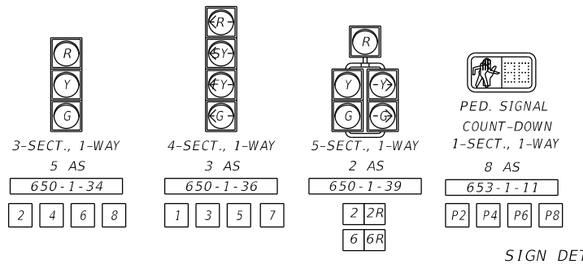
ROAD NO.	COUNTY	STANTEC PROJECT ID
FORT HAMER RD EXT. SEG. A	MANATEE	215615900

SPECIAL MAST ARM ASSEMBLIES

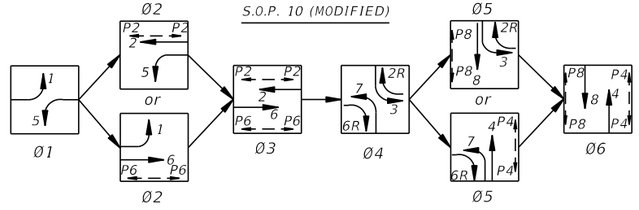
SHEET NO. T-8

APPENDIX B: STANDARD MAST ARM TABULATION

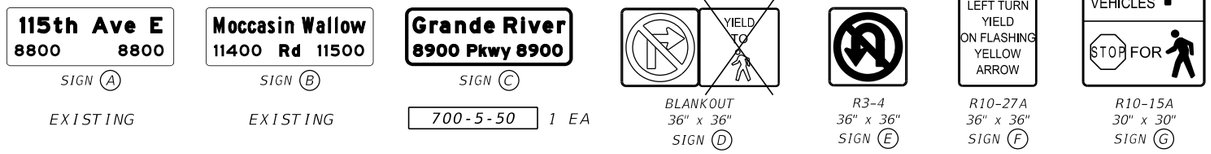
SIGNAL HEAD DETAILS



S.O.P. 10 (MODIFIED)



SIGN DETAILS



700-3-501 6 EA

FTP-68B-06

CONTROLLER TIMINGS									
TIMING FUNCTION									
MOVEMENT NUMBER		1	2	3	4	5	6	7	8
TIMING FUNCTION	MINIMUM GREEN	8	20	8	12	8	20	8	12
	EXTENSION	3	5	3	3	3	5	3	3
	MAXIMUM GREEN 1	20	70	20	30	20	70	20	30
	MAXIMUM GREEN 2								
	YELLOW CLEARANCE	4.8	4.8	3.4	3.4	4.8	4.8	3.4	3.4
	ALL RED	2.4	2.4	3.6	3.6	2.4	2.4	3.6	3.6
	PEDESTRIAN WALK		7		7		7		7
	PED. CLEARANCE		33		22		27		24
	RECALL		MIN				MIN		

LEGEND

- C ------- CCTV CAMERA
- A ------- WAVETRONIX ADVANCE RADAR DETECTOR — 660-3-42A 1 EA
- M ------- WAVETRONIX MATRIX RADAR DETECTOR — 660-3-42M 1 EA
- B ------- BLUETOOTH DETECTOR
- DZ3A ------- DETECTION ZONE

WAVETRONIX MATRIX VEHICLE DETECTION ASSIGNMENTS			
DETECTOR	DETECTION ZONE	CONNECT TO TIMING FUNCTION	DELAY TIME (SECS.)
M1	1A	TF 1	
	6A, 6B	TF 6	
	6R	TF 7	
M2	7A	TF 7	
	4A	TF 4	
M3	5A	TF 5	
	2A, 2B	TF 2	
	2R	TF 3	
M4	3A	TF 3	
	8A	TF 8	

NOTES:

1. MAJOR STREET IS MOCCASIN WALLOW, MOVEMENTS 1, 2, 5, 6. MINOR STREET IS 115th AVE. E., MOVEMENTS 3, 4, 7, 8.
2. FURNISH AND INSTALL FTP-68B-06 SIGNS AT PED. DETECTOR LOCATIONS.
3. STANDARD SOP 10, MODIFIED FOR EASTBOUND AND WESTBOUND RIGHT TURN OVERLAPS WITH THE FOLLOWING:
   A. CONCURRENT/ACTUATED PEDESTRIANS FOR MOVEMENTS P2, P4, P6, AND P8.
   B. WHEN SIGNAL IS IN FLASHING MODE, MOVEMENTS 2 AND 6 SHALL FLASH YELLOW. ALL OTHER MOVEMENTS SHALL FLASH RED.
4. SEE SHEETS T-9 - T-14 FOR FIBER OPTIC INTERCONNECT DETAILS.
5. TIMINGS ARE INITIAL AND MAY REQUIRE FIELD ADJUSTMENT AS DIRECTED BY PROJECT ENGINEER.
6. CONTRACTOR SHALL DISCONNECT "YIELD TO PEDESTRIAN" PORTION OF EXISTING SIGN (D).

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

LAWRENCE E. OVERN, II, P.E.
P.E. LICENSE NUMBER 60816
STANTEC CONSULTING SERVICES INC.
6920 PROFESSIONAL PARKWAY EAST
SARASOTA, FLORIDA 34240
CERTIFICATE OF AUTHORIZATION 27013

MANATEE COUNTY PUBLIC WORKS DEPT.
ENGINEERING SERVICES

ROAD NAME	COUNTY	STANTEC PROJECT ID
FORT HAMER RD EXT. SEG. A	MANATEE	215615900

SIGNALIZATION PLAN

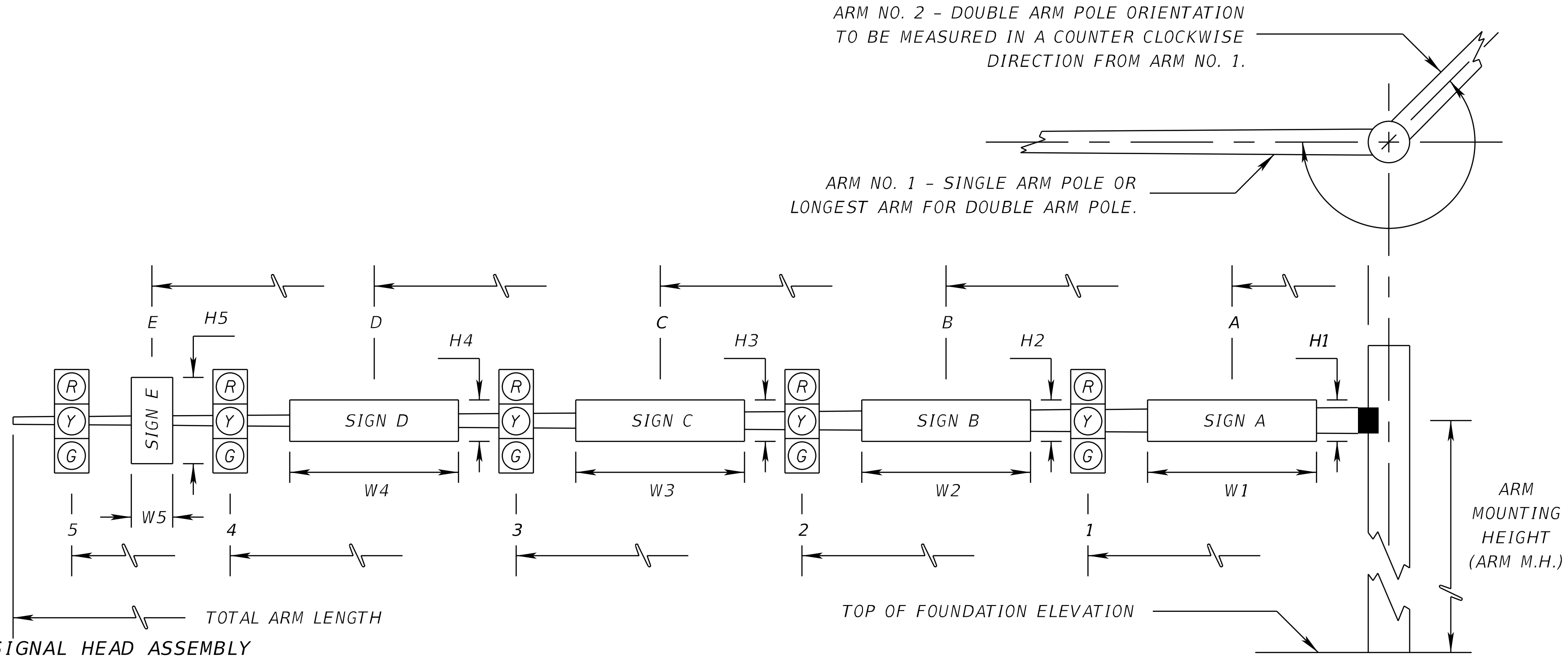
SHEET NO. T-5

$USER$ $DATE$ $TIME$ $FILE$

THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C.

SPECIAL INSTRUCTIONS

ID NO.	PED. BUTTON		PED. SIGNALS		HANDHOLE LOCATION



* DENOTES NUMBER OF SECTIONS IN SIGNAL HEAD ASSEMBLY

* DENOTES NUMBER OF SECTIONS IN SIGNAL HEAD ASSEMBLY

SIGNAL DATA

ID NO.	SHEET NO.	LOCATION BY STA.	TOP OF FOUND. ELEVATION	RDWY ARM NO.	CROWN ELEV.	SIGNAL V/H	BACK PLATES Y/N	PED. SIGNAL Y/N	DISTANCE FROM POLE 1	*	2	*	3	*	4	*	5	*	6	*	TOTAL ARM LENGTH	ARM M.H.	ANGLE BETWEEN DUAL ARMS 90/270
1	T-5	190+27	58.5' LT	1	35.16	V	Y	N	17.3	5	36.4	3	47.3	3	58.4	4					70	22.0	
		--------------	-------	2																			-----
2	T-5	191+73	91' LT	1	32.37	V	Y	N	34.1	3	46.1	3	58.1	4	70.0	3					78	21.0	
		--------------	-------	2																			-----
3	T-5	192+3.5	57' RT	1	35.26	V	Y	N	8.9	5	27.3	3	38.8	3	49.8	4	64.2	4	75.7	3	78	22.0	
	-----	--------------	-------	2																			-----
4	T-5	190+38	80.3' RT	1	34.18	V	Y	N	21.0	3	33.0	3	45.0	4							60	22.0	
	-----	--------------	-------	2																			-----
5	T-6	209+4.5	60.1' RT	1	39.46	V	Y	N	34.7	5	52.7	3	64.7	3	76.5	4					78	22.0	
		--------------	-------	2																			-----
6	T-6	209+13.3	77.2' LT	1	40.89	V	Y	N	24.7	5	43.6	3	55.0	3	66.2	4	69.2	3			78	22.0	
		--------------	-------	2																			-----
7	T-6	210+58.5	85.3' LT	1	39.18	V	Y	N	24.3	5	42.3	3	53.3	3	64.3	4					70	21.0	
	-----	--------------	-------	2																			-----
8	T-6	211+77	52.3' RT	1	41.04	V	Y	N	9.0	5	23.7	3	35.5	3	46.4	3	57.4	3	60.3	4	78	22.0	
	-----	--------------	-------	2																			-----
				1																			
---	-----	--------------	-------	2																			-----
				1																			
---	-----	--------------	-------	2																			-----
				1																			
---	-----	--------------	-------	2																			-----
				1																			
---	-----	--------------	-------	2																			-----
				1																			
---	-----	--------------	-------	2																			-----
				1																			
---	-----	--------------	-------	2																			-----

SIGN DATA

DISTANCE FROM POLE / HEIGHT AND WIDTH OF SIGN

ID NO.	RDWY ARM NO.	A	H1	W1	B	H2	W2	C	H3	W3	D	H4	W4	E	H5	W5
1	1	4.5	2.5	7.0	13.0	2.5	2.5	29.5	3.0	3.0	39.2	3.0	3.0			
	2															
2	1	9.5	2.5	8.0	25.5	2.5	2.5	29.0	3.0	3.0	52.5	3.0	3.0	62.0	3.0	3.0
	2															
3	1	4.0	2.5	7.0	18.6	2.5	2.5	44.9	3.0	3.0	57.7	3.0	3.0			
	2															
4	1	10.0	2.5	8.0	15.6	2.5	2.5	39.0	3.0	3.0	49.5	3.0	3.0			
	2															
5	1	20.0	2.5	8.0	30.0	2.5	2.5	70.7	2.5	2.0						
	2															
6	1	10.0	2.5	7.0	16.5	2.5	2.5	72.2	3.0	3.0						
	2															
7	1	16.0	2.5	8.0	30.0	2.5	2.5	58.8	2.5	2.0						
	2															
8	1	4.0	2.5	7.0	15.6	2.5	2.5	53.8	3.0	3.0						
	2															
	1															
---	2															
	1															
---	2															
	1															
---	2															
	1															
---	2															
	1															
---	2															
	1															
---	2															

THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C.

REVISIONS

DATE	DESCRIPTION	DATE	DESCRIPTION

LAWRENCE E. OVERN, II, P.E.
P.E. LICENSE NUMBER 60816
STANTEC CONSULTING SERVICES INC.
6920 PROFESSIONAL PARKWAY EAST
SARASOTA, FLORIDA 34240
CERTIFICATE OF AUTHORIZATION 27013

MANATEE COUNTY PUBLIC WORKS DEPT.
ENGINEERING SERVICES

ROAD NAME	COUNTY	STANTEC PROJECT ID
FORT HAMER RD EXT. SEG. A	MANATEE	215615900

MAST ARM TABULATION

SHEET NO.
T-7

APPENDIX C: GEOTECHNICAL REPORT

REPORT OF THE SUBSURFACE SOIL INVESTIGATION

NEW TRAFFIC SIGNAL STRUCTURES MOCCASIN WALLOW ROAD AND 115TH AVENUE EAST MANATEE COUNTY, FLORIDA

August 14, 2019

Moccasin Wallow Associates, LLC
5800 Lakewood Ranch Boulevard
Sarasota, Florida 34240

Attention: Mr. Tom Panaseny

RE: Results of the Subsurface Soil Investigation
New Traffic Signal Structures
Moccasin Wallow Road and 115th Avenue East
Manatee County, Florida
Our File: DES 198409

Dear Mr. Panaseny:

In accordance with your request and authorization, **DRIGGERS ENGINEERING SERVICES, INC.** has completed the requested soil borings for the subject project. The following pages present the results of our field investigation and provide soil strength parameters and recommendations for deep foundation design.

GEOTECHNICAL INVESTIGATION PROGRAM

SOIL BORINGS – To check subsurface soil and groundwater conditions for the proposed signal pole locations, four (4) Standard Penetration Test (SPT) borings were advanced to a nominal depth of 25 feet below present grade at the survey staked locations depicted on Plate I of the report attachments. Each boring location was survey staked by the project surveyor.

The Standard Penetration method of testing and sampling was used to provide soil samples for visual classification and to develop Standard Penetration resistance data reflective of the strength and bearing capability of the soils penetrated. The upper 6 feet of the borings were advanced with a hand auger as a precaution against encountering unidentified buried utility lines. A static hand cone penetrometer was used in advance of the hand auger to provide a measure of the relative density or consistency of the soils.

Sarasota
Phone: 727.471.6655
Fax: 941.371.8962
saroffice@driggers-eng.com

Clearwater
P.O. Box 17839 • Clearwater, Florida 33762
Phone: 727.571.1313 • Fax: 727.471.6653
clwoffice@driggers-eng.com

Spring Hill
Phone: 727.471.6657
Fax: 727.471.6653
sphilloffice@driggers-eng.com

The results of the borings are included in the report appendix. The boring logs present visual soil descriptions and estimated Unified Soil Classifications versus depth below existing grade, as well as penetration resistances and groundwater information. Also attached is a brief description of this method of sampling and testing.

INDICATED SUBSURFACE CONDITIONS

SOIL CONDITIONS – The borings have identified fine sands with variable silt and clay fines content along with varying amounts of shell and phosphate at varying depths to a depth of 23 feet below existing grade where clay soil was penetrated to the termination depth of the boring at 25 feet below grade. The sands were primarily classified as SP, SP-SM and SM soils in the Unified Soil Classification System (USCS) while the clay soil was classified as CH. Standard Penetration resistance data suggests the fine sands are generally loose to dense in relative density and the clay soil is very stiff to hard in relative consistency.

GROUNDWATER CONDITIONS – Groundwater was encountered at a depth of 4.1 to 6.8 feet below grade. The groundwater level was checked during the start of the rainy season. Therefore, we would expect levels could certainly rise higher during the peak wet season and/or a major storm event.

GEOTECHNICAL EVALUATION

STRUCTURE TYPE – We understand that four (4) traffic signal structures are proposed. The signal pole structures will induce combined compression, overturning, sliding and torsional forces on the planned foundation element. As of the time of this writing, the desired foundation type has been determined to be a deep foundation or drilled shaft.

DEEP FOUNDATION – It is our understanding that each signal pole may be supported by a single drilled shaft penetrating a sufficient depth to provide the necessary compression, overturning/lateral and torsional resistance. The required penetration of the drilled shaft will be established by the project structural engineer.

The design soil strength parameters are tabulated and included in Plate I of the report attachments. The soil parameters must be utilized in conjunction with appropriate factors of safety as well as design procedures applicable to drilled shaft foundation constructed in a wet-hole environment. This information should be utilized in developing the drilled shaft embedment and size requirements consistent with the design loading conditions and an appropriate factor of safety.

It is further recommended that a program of continued geotechnical inspection be implemented. Careful inspection should be planned to check for the proper installation and penetration depth based upon the project specifications, including concrete quality assurance testing.

DRIGGERS ENGINEERING SERVICES, INC. appreciates this opportunity to be of service to you on this project. Should you have any questions concerning the results of our findings and recommendations, please do not hesitate to contact the undersigned at your convenience.

Respectfully submitted,
DRIGGERS ENGINEERING SERVICES, INC.

Jeffry A. Driggers, P.E.
Project Engineer
FL Registration No. 70598

JAD\REP\198409
Copies submitted: (2) TPanaseny@nealland.com
Frank.Domingo@stantec.com

APPENDIX

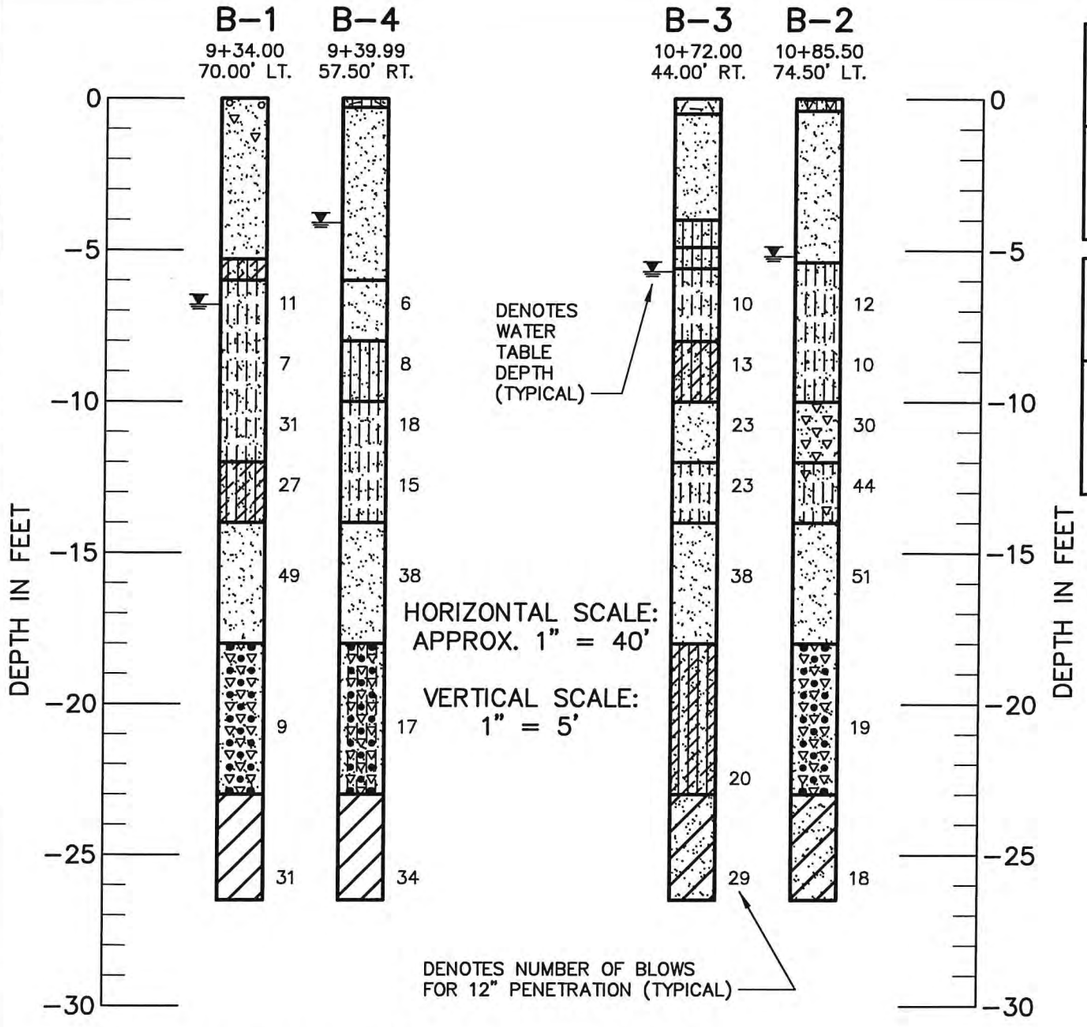
PLATE I – REPORT OF CORE BORINGS

STANDARD PENETRATION TEST BORING LOGS

HAND AUGER BORINGS / HAND CONE SOUNDING LOGS

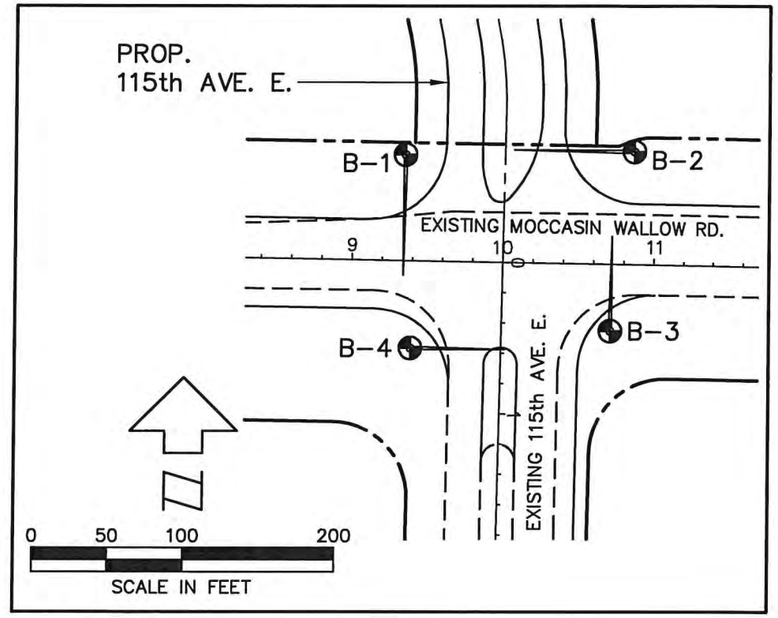
METHOD OF TESTING

PLATE I – REPORT OF CORE BORINGS



GRANULAR MATERIALS – RELATIVE DENSITY	SPT – BLOWS PER FOOT
VERY LOOSE	LESS THAN 4
LOOSE	4–10
MEDIUM DENSE	10–30
DENSE	30–50
VERY DENSE	GREATER THAN 50

SILTS AND CLAYS – CONSISTENCY	SPT – BLOWS PER FOOT
VERY SOFT	LESS THAN 2
SOFT	2–4
FIRM	4–8
STIFF	8–15
VERY STIFF	15–30
HARD	GREATER THAN 30



LEGEND:

STANDARD PENETRATION TEST BORING/HAND CONE SOUNDING LOCATION

DESIGN SOIL STRENGTH PARAMETERS FOR BORING B-1

DEPTH INTERVAL (feet)	FRICTION ANGLE	UNCONFINED COMPRESSIVE STRENGTH (tsf)	MOIST UNIT WEIGHT (pcf)	BUOYANT UNIT WEIGHT (pcf)	SATURATED UNIT WEIGHT (pcf)
0–8	30°	---	110	60	120
8–12	35°	---	---	60	120
12–14	32°	---	---	60	120
14–18	35°	---	---	60	120
18–23	30°	---	---	60	120
23–26.5	---	2000	---	60	100

DESIGN SOIL STRENGTH PARAMETERS FOR BORING B-2

DEPTH INTERVAL (feet)	FRICTION ANGLE	UNCONFINED COMPRESSIVE STRENGTH (tsf)	MOIST UNIT WEIGHT (pcf)	BUOYANT UNIT WEIGHT (pcf)	SATURATED UNIT WEIGHT (pcf)
0–10	30°	---	110	60	120
10–12	32°	---	---	60	120
12–14	35°	---	---	60	120
14–18	36°	---	---	60	120
18–23	32°	---	---	60	120
23–26.5	---	1500	---	60	100

DESIGN SOIL STRENGTH PARAMETERS FOR BORING B-3

DEPTH INTERVAL (feet)	FRICTION ANGLE	UNCONFINED COMPRESSIVE STRENGTH (tsf)	MOIST UNIT WEIGHT (pcf)	BUOYANT UNIT WEIGHT (pcf)	SATURATED UNIT WEIGHT (pcf)
0–8	30°	---	110	60	120
8–14	32°	---	---	60	120
14–18	35°	---	---	60	120
18–23	32°	---	---	60	120
23–26.5	---	1500	---	60	100

DESIGN SOIL STRENGTH PARAMETERS FOR BORING B-4

DEPTH INTERVAL (feet)	FRICTION ANGLE	UNCONFINED COMPRESSIVE STRENGTH (tsf)	MOIST UNIT WEIGHT (pcf)	BUOYANT UNIT WEIGHT (pcf)	SATURATED UNIT WEIGHT (pcf)
0–10	30°	---	110	60	120
10–14	32°	---	---	60	120
14–18	35°	---	---	60	120
18–23	32°	---	---	60	120
23–26.5	---	2000	---	60	100

LEGEND OF SOIL BORING PROFILE SYMBOLS:

- FINE SAND (SP) (A-3)
- SLIGHTLY SILTY FINE SAND (SP-SM) (A-3)
- SILTY FINE SAND (SM) (A-2-4)
- SILTY, SLIGHTLY CLAYEY FINE SAND (SM) (A-2-4)
- CLAY (CH) OR (CL) (A-7-6)
- SANDY CLAY (CH) (A-7-6)
- ROOTS
- SHELL
- PHOSPHATE
- LIMESTONE FRAGMENTS

CAD FILE NAME: A:\PROFILE\198409-P&P.DWG

DATE	NAME	REVISION	APPROVED BY:

PREPARED BY

DRIGGERS ENGINEERING SERVICES, INCORPORATED

JEFFRY A. DRIGGERS, P.E.
FL LICENSE NO.
70598

	NAME	DATE
DESIGNED BY:	RDB	8/9/19
DRAWN BY:	RDB	8/9/19
CHECKED BY:	JAD	8/9/19
SUPERVISED BY:	FJD	

REPORT OF CORE BORINGS

Traffic Signal Structures
Moccasin Wallow Rd. & 115th Ave. E.
Manatee County, Florida

DES PROJ. NO.: DES 198409

SHEET NO.: Page D8 of D21

PLATE I

STANDARD PENETRATION TEST BORING LOGS

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 198409 **BORING NO.** B-1

Project Traffic Signal Structures, Moccasin Wallow Road & 115th Avenue East, Manatee County, Florida

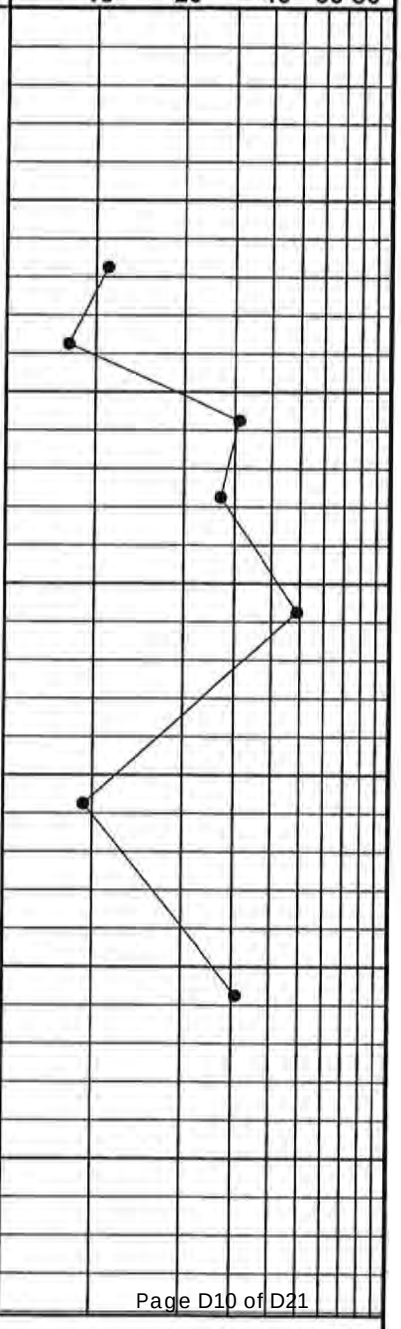
Location See Plate I **Foreman** C.O.

Completion Depth 26.5' **Date** 7/24/19 **Depth To Water** 6.8' **Time** **Date** 7/24/19

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL:	
0			Grayish-brown Fine SAND with trace of limestone fragments (SP) (A-3)	
			Brown Fine SAND with trace of shell fragments (SP) (A-3)	
			Brown Fine SAND (SP) (A-3)	
5			Light brown Fine SAND (SP) (A-3)	
			Brown Fine SAND (SP) (A-3)	
			Brownish-gray silty, slightly clayey Fine SAND (SM) (A-2-4)	9/6/5
			Loose to dense brown to light grayish-brown slightly silty Fine SAND (SP-SM) (A-3)	4/4/3
10				14/16/15
			Medium dense brown silty, slightly clayey Fine SAND (SM) (A-2-4)	12/10/17
15			Dense light grayish-brown Fine SAND (SP) (A-3)	18/22/27
			Loose light grayish-brown Fine SAND with abundant shell and phosphate (SP) (A-3)	
20				5/5/4
			Hard dark green CLAY (CL) (A-7-6)	
25				10/13/18
30				

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP

10 20 40 60 80



Remarks Borehole Grouted

Casing Length

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 198409 **BORING NO.** B-2

Project Traffic Signal Structures, Moccasin Wallow Road & 115th Avenue East, Manatee County, Florida

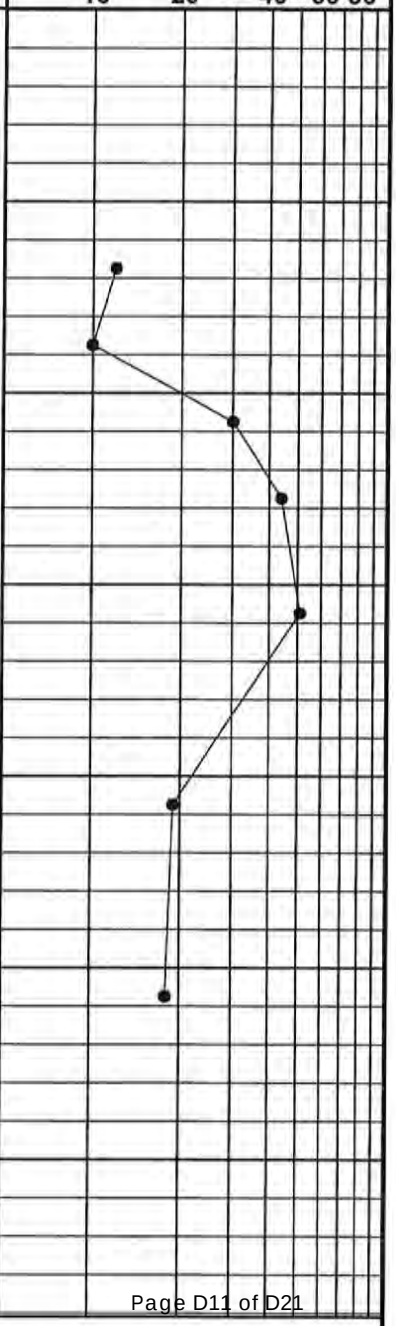
Location See Plate I **Foreman** C.O.

Completion Depth 26.5' **Date** 7/24/19 **Depth To Water** 5.2' **Time** **Date** 7/24/19

DEPTH, FT	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
SURF. EL:		
0	Grayish-brown slightly silty Fine SAND with shell fragments (SP-SM) (A-3)	
	Brown Fine SAND (SP) (A-3)	
	Brownish-gray Fine SAND (SP) (A-3)	
	Brown Fine SAND (SP) (A-3)	
5	Grayish-brown Fine SAND (SP) (A-3)	
	Brown Fine SAND (SP) (A-3)	
	Medium dense to loose light brown to light grayish-brown slightly silty Fine SAND (SP-SM) (A-3)	6/7/5
		8/5/5
10	Medium dense light brown Fine SAND with shell (SP) (A-3)	9/15/15
	Dense light grayish-brown slightly silty Fine SAND with trace of shell (SP-SM) (A-3)	19/25/19
15	Very dense light brown Fine SAND (SP) (A-3)	15/25/26
	Medium dense light grayish-brown Fine SAND with abundant shell and phosphate (SP) (A-3)	
20		9/9/10
	Very stiff dark grayish-brown sandy CLAY (CH) (A-7-6)	
25		7/7/11
30		

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP

10 20 40 60 80



Remarks Borehole Grouted

Casing Length

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 198409 **BORING NO.** B-3

Project Traffic Signal Structures, Moccasin Wallow Road & 115th Avenue East, Manatee County, Florida

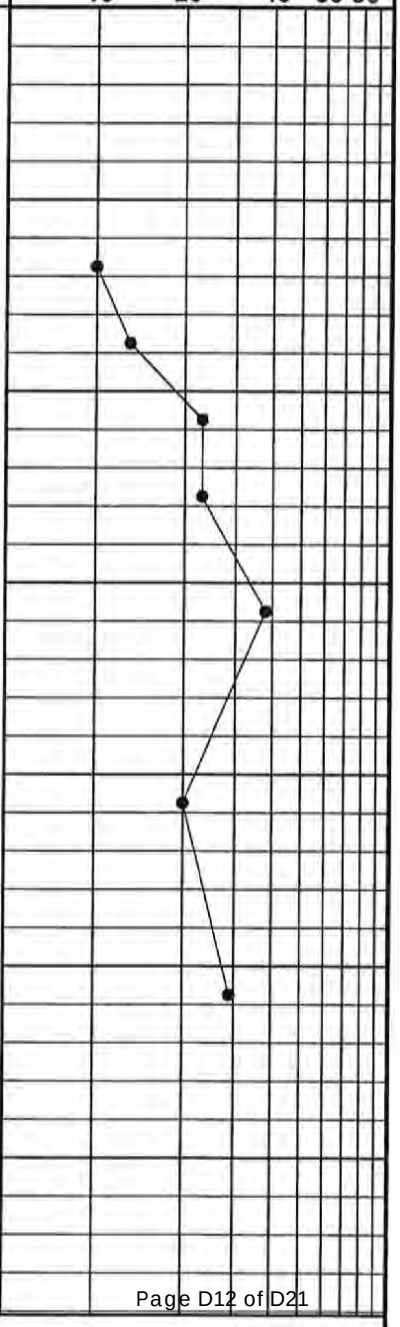
Location See Plate I **Foreman** C.O.

Completion Depth 26.5' **Date** 7/24/19 **Depth To Water** 5.7' **Time** _____ **Date** 7/24/19

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL:	
0			Brown Fine SAND with roots (SP) (A-3)	
			Light brown Fine SAND (SP) (A-3)	
5			Brown slightly silty Fine SAND (SP-SM) (A-3)	
			Brown silty Fine SAND (SM) (A-2-4)	
			Loose brown slightly silty Fine SAND (SP-SM) (A-3)	4/5/5
			Medium dense light brown silty, slightly clayey Fine SAND (SM) (A-2-4)	8/6/7
10			Medium dense tan Fine SAND (SP) (A-3)	7/10/13
			Medium dense tan slightly silty Fine SAND (SP-SM) (A-3)	14/11/12
15			Dense light grayish-brown Fine SAND (SP) (A-3)	12/20/18
			Medium dense light brown silty, slightly clayey Fine SAND (SM) (A-2-4)	9/11/9
20				
			Very stiff dark green sandy CLAY (CH) (A-7-6)	
25				12/16/13
30				

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP

10 20 40 60 80



Remarks Borehole Grouted

Casing Length _____

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 198409 **BORING NO.** B-4

Project Traffic Signal Structures, Moccasin Wallow Road & 115th Avenue East, Manatee County, Florida

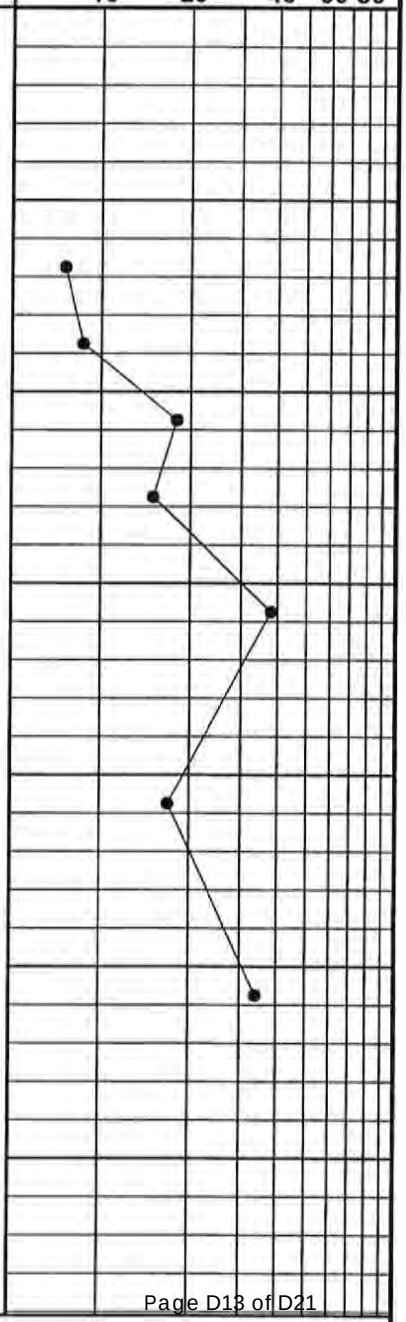
Location See Plate I **Foreman** C.O.

Completion Depth 26.5' **Date** 7/23/19 **Depth To Water** 4.1' **Time** _____ **Date** 7/23/19

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL:	
0			Dark grayish-brown slightly silty Fine SAND with roots (SP-SM) (A-3)	
			Light grayish-brown Fine SAND (SP) (A-3)	
			Gray Fine SAND (SP) (A-3)	
			Light brown Fine SAND (SP) (A-3)	
5			Light grayish-brown Fine SAND (SP) (A-3)	
			Light brown Fine SAND (SP) (A-3)	
			Loose brown slightly silty Fine SAND (SP-SM) (A-3)	3/3/3
			Loose brown silty Fine SAND (SM) (A-2-4)	4/3/5
10			Medium dense light grayish-brown slightly silty Fine SAND (SP-SM) (A-3)	7/9/9
				6/8/7
15			Dense light grayish-brown Fine SAND (SP) (A-3)	11/16/22
			Medium dense light brown slightly silty Fine SAND with abundant shell and phosphate (SP-SM) (A-3)	
20				8/8/9
			Hard green CLAY (CL) (A-7-6)	
25				7/13/21
30				

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP

10 20 40 60 80



Remarks Borehole Grouted

Casing Length _____

HAND AUGER BORING / HAND CONE SOUNDING LOGS

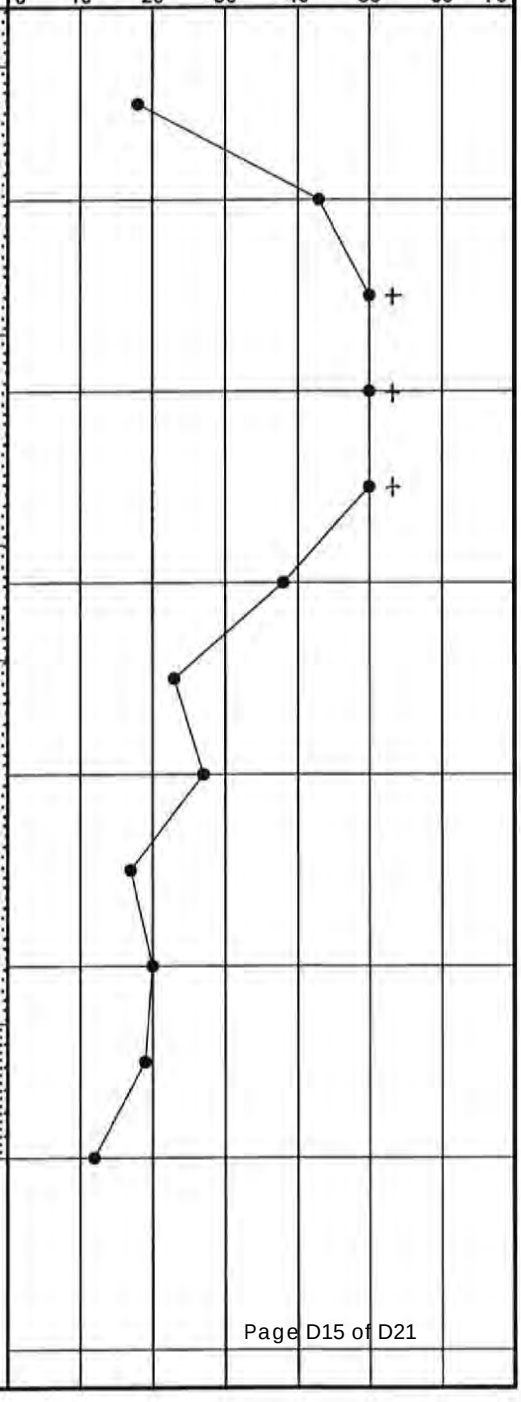
DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Traffic Signal Structures Moccasin Wallow Road & 115th Avenue East Manatee County, Florida Project No.: DES 198409	**CLIENT:** Moccasin Wallow Associates, LLC
TECHNICIAN: C.O.	**WATER TABLE:** See "Note" / **DATE:** 7/24/19
LOCATION: See Plate I	**DATE:** 7/24/19 / **COMPLETION DEPTH:** 6.0'
	TEST NUMBER: B-1

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Grayish-brown Fine SAND with trace of limestone fragments (SP) (A-3)	0
	Brown Fine SAND with trace of shell fragments (SP) (A-3)	1
	Brown Fine SAND (SP) (A-3)	2
	Light brown Fine SAND (SP) (A-3)	3
	Brown Fine SAND (SP) (A-3)	4
		5
	Brownish-gray silty, slightly clayey Fine SAND (SM) (A-2-4)	6
	Note: Water Table not encountered within depth of 6.0'. LEGEND: • + Denotes Penetration Resistance in excess of 50 TSF	7

SYMBOL



DRIGGERS ENGINEERING SERVICES INCORPORATED

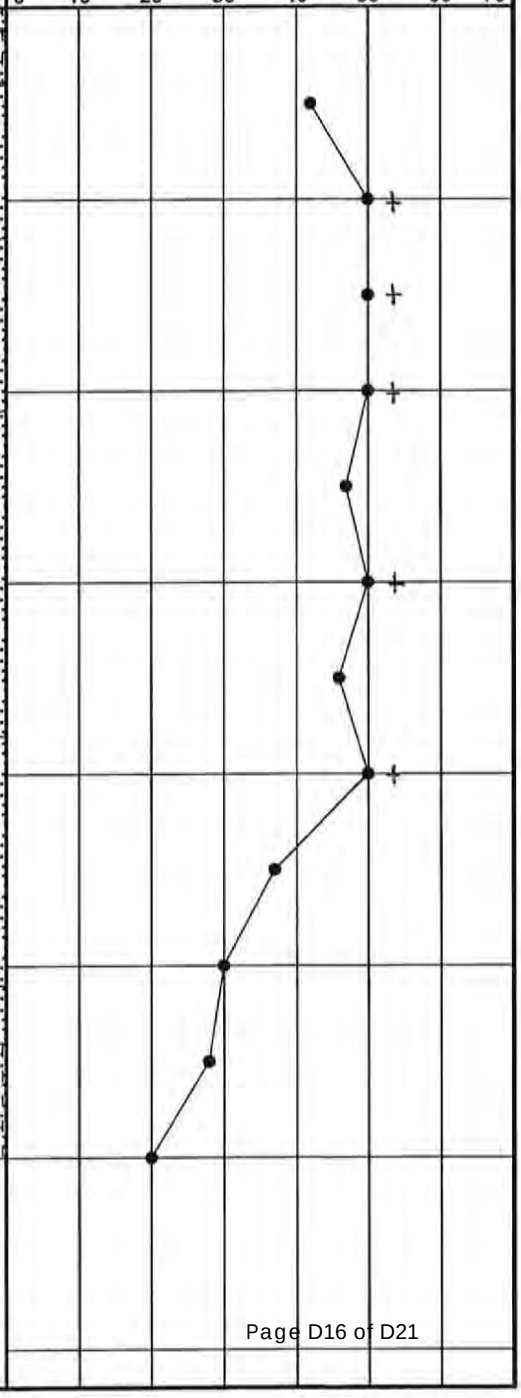
HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Traffic Signal Structures Moccasin Wallow Road & 115th Avenue East Manatee County, Florida Project No.: DES 198409	**CLIENT:** Moccasin Wallow Associates, LLC
	WATER TABLE: 5.2' — **DATE:** 7/24/19
TECHNICIAN: C.O.	**DATE:** 7/24/19 — **COMPLETION DEPTH:** 6.0'
LOCATION: See Plate I	**TEST NUMBER:** B-2

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Grayish-brown slightly silty Fine SAND with shell fragments (SP) (A-3)	0
	Brown Fine SAND (SP) (A-3)	1
	Brownish-gray Fine SAND (SP) (A-3)	2
	Brown Fine SAND (SP) (A-3)	3
	Grayish-brown Fine SAND (SP) (A-3)	4
		5
	Brown Fine SAND (SP) (A-3)	
	Light brown slightly silty Fine SAND (SP-SM) (A-3)	6
	LEGEND: • + Denotes Penetration Resistance in excess of 50 TSF	7

SYMBOL

HAND CONE TIP RESISTANCE (TSF)

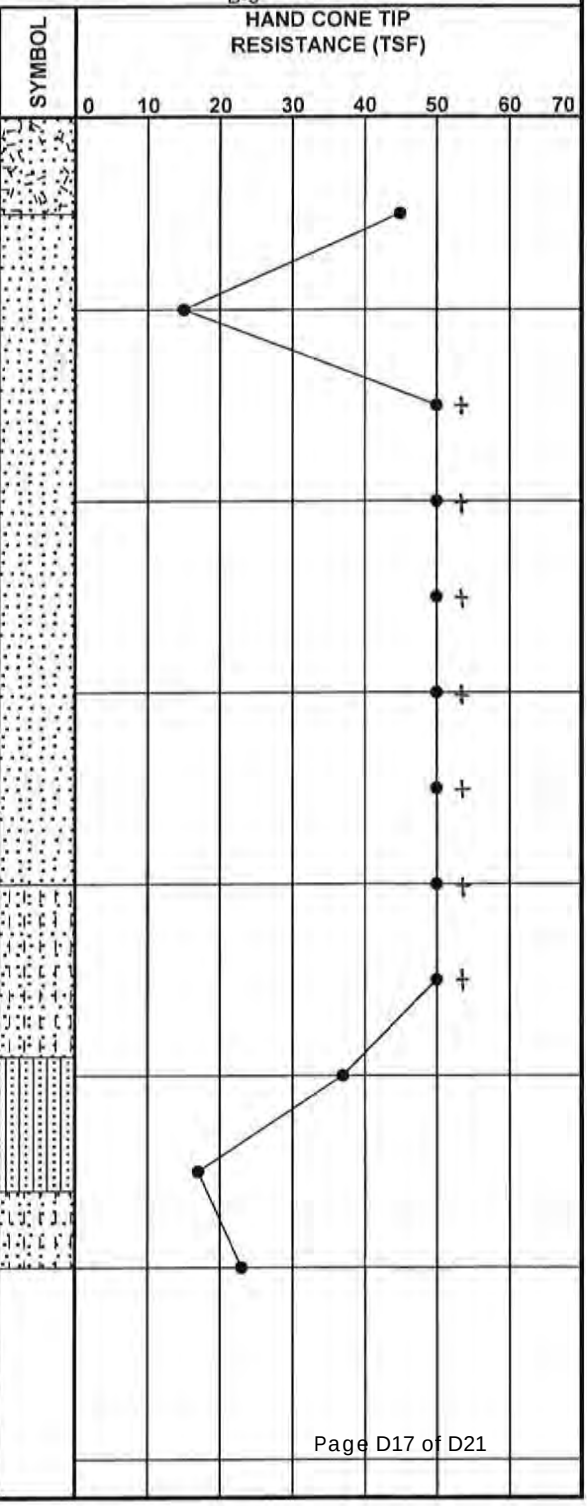


DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Traffic Signal Structures Moccasin Wallow Road & 115th Avenue East Manatee County, Florida Project No.: DES 198409	CLIENT: Moccasin Wallow Associates, LLC
	WATER TABLE: 5.7' / DATE: 7/24/19
TECHNICIAN: C.O.	DATE: 7/24/19 / COMPLETION DEPTH: 6.0'
LOCATION: See Plate I	TEST NUMBER: B-3

ELEV. (FT)	DESCRIPTION	DEPTH (FT)
	Brown Fine SAND with roots (SP) (A-3)	0
	Light brown Fine SAND (SP) (A-3)	1
		2
		3
		4
	Brown slightly silty Fine SAND (SP-SM) (A-3)	
	Brown silty Fine SAND (SM) (A-2-4)	5
	Brown slightly silty Fine SAND (SP-SM) (A-3)	6
	LEGEND: • + Denotes Penetration Resistance in excess of 50 TSF	7



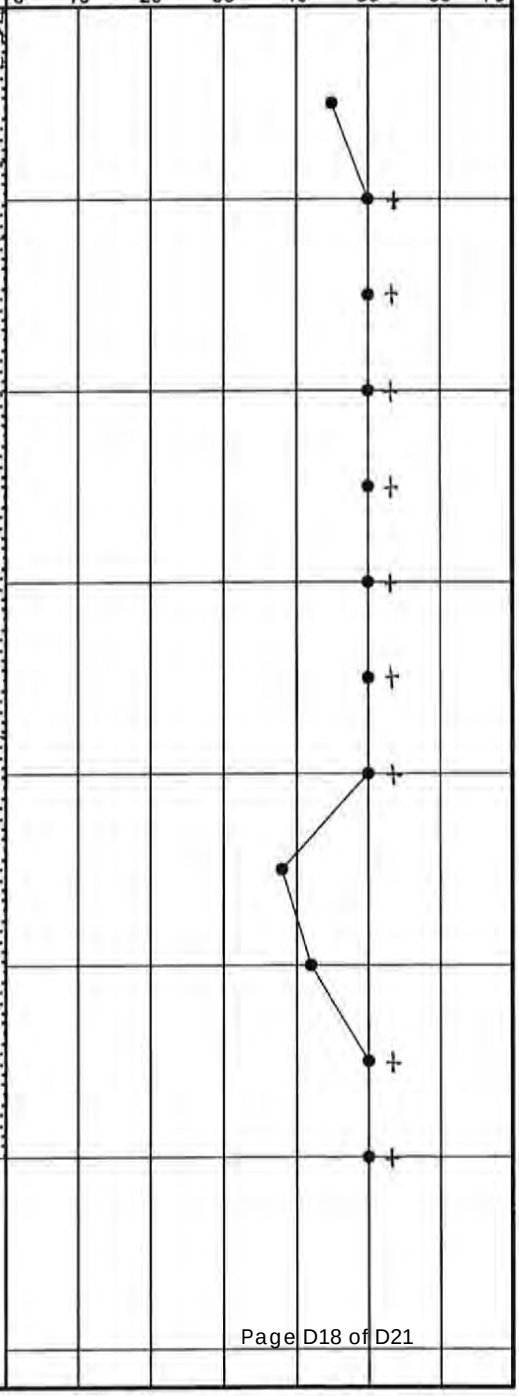
DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT: Traffic Signal Structures Moccasin Wallow Road & 115th Avenue East Manatee County, Florida Project No.: DES 198409	CLIENT: Moccasin Wallow Associates, LLC
	WATER TABLE: 4.1' / DATE: 7/23/19
TECHNICIAN: C.O./N.N.	DATE: 7/23/19 / COMPLETION DEPTH: 6.0'
LOCATION: See Plate I	TEST NUMBER: B-4

ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL
	Dark grayish-brown slightly silty Fine SAND with roots (SP-SM) (A-3)	0	
	Light grayish-brown Fine SAND (SP) (A-3)		
	Gray Fine SAND (SP) (A-3)	1	
	Light brown Fine SAND (SP) (A-3)		
		2	
	Light grayish-brown Fine SAND (SP) (A-3)		
		3	
	Light brown Fine SAND (SP) (A-3)	4	
		5	
		6	
	LEGEND: • + Denotes Penetration Resistance in excess of 50 TSF	7	

HAND CONE TIP RESISTANCE (TSF)



METHOD OF TESTING

STANDARD PENETRATION TEST
AND
SOIL CLASSIFICATION

STANDARD PENETRATION TEST (ASTM D-1586)

In the Standard Penetration Test borings, a rotary drilling rig is used to advance the borehole to the desired test depth. A viscous drilling fluid is circulated through the drill rods and bit to stabilize the borehole and to assist in removal of soil and rock cuttings up and out of the borehole.

Upon reaching the desired test depth, the 2 inch O.D. split-barrel sampler or "split-spoon", as it is sometimes called, is attached to an N-size drill rod and lowered to the bottom of the borehole. A 140 pound hammer, attached to the drill string at the ground surface, is then used to drive the sampler into the formation. The hammer is successively raised and dropped for a distance of 30 inches using a rope and "cathead" assembly. The number of blows is recorded for each 6 inch interval of penetration or until virtual refusal is achieved. In the above manner, the samples are ideally advanced a total of 18 inches. The sum of the blows required to effect the final 12 inches of penetration is called the blowcount, penetration resistance or "N" value of the particular material at the sample depth.

After penetration, the rods and sampler are retracted to the ground surface where the core sample is removed, sealed in a glass jar and transported to the laboratory for verification of field classification and storage.

SOIL SYMBOLS AND CLASSIFICATION

Soil and rock samples secured in the field sampling operation were visually classified as to texture, color and consistency. The Unified Soil Classification was assigned to each soil stratum per ASTM D-2487. Soil classifications are presented descriptively and symbolically for ease of interpretation. The stratum identification lines represent the approximate boundary between soil types. In many cases, this transition may be gradual.

Consistency of the soil as to relative density or undrained shear strength, unless otherwise noted, is based upon Standard Penetration resistance values of "N" values and industry-accepted standards. "N" values, or blowcounts, are presented in both tabular and graphical form on each respective boring log at each sample interval. The graphical plot of blowcount versus depth is for illustration purposes only and does not warrant continuity in soil consistency or linear variation between sample intervals.

The borings represent subsurface conditions at respective boring locations and sample intervals only. Variations in subsurface conditions may occur between boring locations. Groundwater depths shown represent water depths at the dates and time shown only. The absence of water table information does not necessarily imply that groundwater was not encountered.

HAND CONE PENETRATION TEST

The cone penetration test was performed using a DGSI Model S-215 double rod Static Cone Penetrometer.

Dual rods enable the cone stress to be measured directly. Soil friction on the outer rod does not influence the reading. Depending upon the application, either the maximum bearing for an increment of push or the least bearing for an increment can be reported. If you were investigating for soft spots, you would take the least reading. In typical use, you would force the cone into the soil 6 inches, retract the cone slightly until the gauge reads zero, then advance an additional 6 inch increment. If you meet with refusal, the cone can be removed and the hole opened with a hand auger to permit a continuation of measurements against depth.

The tool has been designed to allow a maximum force of 250 lbs. to be applied, somewhat more than the average weight of an operator. The unit can be operated in a vertical or horizontal position. The cone tip has an included angle of 60°. The cone has a section area of 1.5 cm^2. The maximum total bearing (Q_c) is 70 kg/cm^2.

The reading (Q_c) is in kg/cm^2 which is essentially equal to ton/ft^2.

The cone index (Q_c) is read directly. The correlation between the cone index and soil constants is not absolute. Generally, the following results have been determined through extensive field use of the unit. Further verification of correlation in your local soil types is essential.

Standard Penetration (Sands)	**Strength and Cohesion**
Test "N" Value $Q_c = 4$ "N"	Q_u - Unconfined compression (kg/cm^2) c - Cohesion (kg/cm2)
	Uniform clay and silty clays: $Q_c = 5\ Q_u$ $Q_c = 10\ c$
	Clayey Silts: $Q_c = (10 \text{ to } 20)\ Q_u$ $Q_c = (20 \text{ to } 40)\ c$