



AUGUST 10, 2015

SEMINOLE COUNTY 2015 STANDARD MAST ARM DRAWINGS

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PREPARED FOR
SEMINOLE COUNTY TRAFFIC ENGINEERING
140 BUSH LOOP
SANDFORD, FL 32773
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COVER SHEET

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GENERAL NOTES

1. These Standards are intended solely for use by Seminole County, Florida for mast arm installations in Seminole County.
2. These Standards address only the structural details of the Mast Arm and the Drilled Shaft Foundation. Users of these Standards remain responsible for verifying that the complete Mast Arm assembly (structure, foundation, signal heads, and sign panels) meets all of the criteria and requirements of the appropriate governing agencies, including, but not limited to, providing adequate vertical & horizontal clearances, adequate sight distance, appropriate signalization, appropriate signal placement, and adequate sign panel size/positioning.
3. Utilities: Adequate provision must be made for the protection and/or relocation of existing utilities. Users of these standards are cautioned to verify that there will be no interference between the utilities and the mast arm foundation.

The Standard Foundation Details assume that the ground slope at the Mast Arm is a maximum of 4:1 (Horizontal to Vertical) or flatter for a minimum of 8 feet from the center of the Drilled Shaft Foundation in all directions and that no other significant conditions exist nearby that will adversely impact the Drilled Shaft Foundation capacity (underground vaults, manholes, large diameter utilities, ditches, drop-offs, etc.).

The Mast Arm Designer is responsible for verifying these conditions and shall use the Standard Foundation Details only where all of the above conditions are met.

ATTACHMENT OF TRAFFIC SIGNAL HEADS & ILLUMINATED SIGNS

1. Mast arm shop drawings shall include the attachment details.
2. Signal and power cables shall be completely encased in hollow tubes and hollow brackets between the head and the signal head/sign.
3. The support brackets shall attach to the arm using metal bands. Fastening to and/or welding to the arm is prohibited.
4. Field drill entry holes for signal cables and power cables. Fit holes with rubber grommet.
5. Illuminated Signs shall be attached below the arm using a free-swinging bracket. No other attachment position or method is permitted.

GEOTECHNICAL REQUIREMENTS & SOILS DATA LETTER

1. Site-specific Geotechnical Data is required for all Mast Arms. A Soil Boring shall be performed for each Mast Arm.
2. A Soils Data Letter shall be prepared by a Geotechnical Engineer and shall be submitted with the Mast Arm Structure Design Calculations and Shop Drawings. The Soils Data Letter shall be based upon a Soil Boring (SPT) not less than 30' in depth. Use of other methods other than SPT is not permitted.

The Soils Data Letter shall clearly state the following:
Applicable Standard Soil Type(s)
Internal Angle of Friction (Phi Angle)
Recommended Water Table Elevation for Design
Soil Dry Unit Weight
Soil Saturated Unit Weight
Soil Effective Unit Weight (Saturated Unit Weight minus Water Unit Weight)
SPT Blow Count
Minimum Tip Elevation (if applicable)
Shaft Length Extension due to Clay Layer (if applicable)
Special Conditions Encountered (Loose Soils, Hardpan, Voids, etc.)
3. The Geotechnical Engineer is advised that the Foundation Capacities have been determined assuming a single soil layer for the entire embedded length of the Drilled Shaft Foundation. The Geotechnical Engineer shall exercise appropriate engineering judgement when using weighted-average and/or other measures to ensure the single-layer soil properties will accurately model the actual existing multi-layer soil conditions. For highly variable soils, more than one Standard Soil Type may need to be provided. For example, one soil type may be applicable for a Drilled Shaft Foundation less than 16'-0" long while a different Standard Soil Type may be applicable for a Drilled Shaft Foundation longer than 16'-0". In all cases, the provided Standard Soil Type(s) must be applicable for the entire length of the Drilled Shaft Foundation. I.e., do not provide a Standard Soil Type for the upper soil layers and a different soil type for the lower soil layers.
4. Drilled Shaft Foundations shall not terminate in a soil layer with a SPT Blow Count (N) of 4 or less. The Soils Data Letter shall specifically note all such layers and shall provide a Minimum Tip Elevation. Where the Ground Elevation is not known, the Minimum Tip Elevation shall be expressed as a Minimum Tip Depth Below Grade.
5. The following criteria must be met in order to qualify as a Standard Soil Type:
 - A. The average soils parameters must meet all of the minimum values of the Standard Soil Type.
 - B. Within the limit of the Drilled Shaft Foundation, there can be not more than 5'-0" of soils with a SPT Blow Count (N) of 4 or less.
 - C. At the discretion of the Geotechnical Engineer, the soils within the length of the Drilled Shaft Foundation may contain a clay layer not exceeding 3'-0" thick (see Note #6).
6. At the discretion of the Geotechnical Engineer, the following procedure may be used for a soil profile that contains a clay layer not exceeding 3'-0" in thickness, but that otherwise fully meets all of the parameters for a Standard Soil Type:
 - A. The Drilled Shaft Foundation capacity shall be based upon the Standard Soil Type.
 - B. The Drilled Shaft Foundation shall be extended a minimum of 3'-0" longer than the length required by the Table of Foundation Capacities.
7. For each location where a Standard Soil Type applies, the standard foundation details shall be used. A Special Foundation Design is not required for that Mast Arm.
8. For locations where no Standard Soil Type is applicable, a Special Foundation Design is required. The Special Foundation shall be designed and detailed using the actual Mast Arm base reactions and the specific soils parameters provided in the Soils Data Letter. The Special Foundation shall be designed by a professional engineer registered in the State of Florida. Signed and sealed design calculations and foundation details shall be submitted concurrently with the mast arm design calculations and shop drawings. The Drilled Shaft Foundation design methodology shall comply with the Foundation Capacity Criteria used for these Standards (see Sheet 16).

SUBMITTAL REQUIREMENTS

The following information shall be provided for every Mast Arm structure:

1. Mast Arm Design Calculations
2. Mast Arm Shop Drawings
3. Soils Data Letter (with Soil Boring Log)
4. Special Foundation Design (required only for non-standard soils)

SPECIAL CONSTRUCTION REQUIREMENTS

1. All Construction shall comply with the Florida Department of Transportation "Standard Specifications for Road and Bridge Construction (2015)" except for method of payment.
2. Mast Arm Shop Drawings are required and fabrication shall not begin until the Shop Drawings are approved. Mast Arm Shop Drawings shall include the anchor rod orientation with respect to the arm(s) and the direction of traffic.
3. Foundation Materials:
 - A. Concrete: FDOT Class IV (Drilled Shaft)
Minimum 28-Day Compressive Strength = 4,000 psi
 - B. Reinforcing Steel: ASTM A615, Grade 60
Special Requirements apply to FDOT District 5 Submittals.
Contact the FDOT District 5 Geotechnical Department for Environmental Classification based upon the FDOT District 5 Corrosion Maps.
4. The Soils Data Letter may require a Minimum Tip Elevation in order to locate the bottom of the drilled shaft in a competent soil layer or to account for a clay layer. Drilled Shaft Foundations shall not be terminated above the stated Minimum Tip Elevation.
5. The top of the Drilled Shaft Foundation shall extend a minimum of 1" but not more than 6" above the adjacent finish ground line. The top of Drilled Shaft Foundations located within or abutting a sidewalk shall match the top of sidewalk elevation unless otherwise noted in the Mast Arm Designer's plans.
6. Natural Slurry shall not be relied upon to prevent caving of the soils and/or to maintain an open hole. Adequate measures shall be taken to control Artesian Water Conditions where encountered. Temporary Casing or other measures may be used. Permanent Casing is prohibited.
7. The Pole shall not be erected until the foundation concrete has achieved the specified 28-day compressive strength.
8. If the traffic signals or sign panels are not in place within two working days after the arm is erected, then a 3.0 feet by 2.0 feet blank 1/8" thick aluminum sign panel shall be attached to the bottom of the arm within six feet of the arm tip and shall remain in place until the signals and signs are installed.

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NOTES

MAST ARM STRUCTURAL DESIGN CRITERIA

1. Mast Arm Structure Design shall comply with:
 - A. American Society of State Highway and Transportation Officials "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals" (6th Edition with Interim Revisions through 2015)
 - B. Florida Department of Transportation Structures Design Manual (January 2015 Edition).
 - C. Fatigue shall be considered in accordance with the requirements of the Florida Department of Transportation Structures Design Manual (January 2015 Edition).
2. Basic Wind Speed: 130 mph
3. The Mast Arm Design Calculations shall clearly state the Foundation Reactions.
4. To ensure constructability of the drilled shaft foundations, the Mast Arm Anchor Rod Bolt Circle shall not exceed 24" without prior approval of Seminole County Traffic Engineering. An Anchor Rod Bolt Circle larger than 24" will require more stringent construction tolerances for the Drilled Shaft Construction than those in the FDOT Specifications, including more precise fabrication/placement of the reinforcing bar cage and more precise placement of the anchor rods.
5. A grout pad is required.
6. The mast arm structure details shown herein are not complete details. The details only indicate the desired appearance of the mast arm structure and the desired connection styles. The fabricator shall be responsible for the complete design and detailing of the mast arm structure. Calculations and Shop Drawings shall be signed and sealed by a professional engineer registered in the State of Florida in compliance with Florida laws and regulations.

MAST ARM STRUCTURE REQUIREMENTS

1. Materials:
 - Poles, Mast Arms & Backing Rings: ASTM A1011 Grade 50, 55, or 60 (less than 1/4") or ASTM A572 Grade 50, 55, 60, or 65" (1/4" and over) or ASTM A595 Grade A (55 ksi yield) or Grade B (60 ksi yield) ASTM A36
 - Steel Plates: ASTM A36
 - Weld Metal: E70XX
 - Bolts: ASTM A325 Type 1
 - Anchor Rods: ASTM F1554 Grade 55
 - Nuts for Anchor Rods: ASTM A563 Grade a Heavy Hex
 - Washers for Anchor Rods: ASTM F436, Type 1
 - Handhole Frame: ASTM A709 Grade 36 or ASTM A36
 - Handhole Cover: ASTM A1011 Grade 50, 55, 60, or 65
 - Caps: ASTM A1011 Grade 50, 55, 60, or 65 or ASTM B209
 - Nut Covers: ASTM B26 (319-F)
 - Stainless Steel Screws: AISI Type 316
 - Threaded Bars/Studs: ASTM A36 or ASTM A307
2. Perform all welding in accordance with the American Welding Society Structural Welding Code (Steel) ANSI/AWS D1.1 (current edition). For additional welding requirements see AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals, Section 5.15, Welded Connections.
3. All steel items shall be galvanized:
 - Nuts, Bolts, Washers, Anchor Rods, and Threaded Bars/Studs: ASTM F2329
 - All other items (including Pole & Mast Arm): ASTM A123
4. Locate the handhole 180 degrees from the arm on single arm poles. Locate the handhole 180 degrees from the first arm on double arm poles.
5. All bolt holes diameters shall be equal to the bolt diameter plus 1/16" prior to galvanizing. Hole diameters for Anchor Rods shall not exceed the bolt diameter plus 1/2" prior to galvanizing.
6. The diameter of wire access holes for Signals and Signs shall not exceed 1.5 inches.
7. Arms and Pole shall be tapered with a diameter changing at a rate of 0.14 inch per foot.
8. The Pole shall be installed vertically. Camber shall be accounted for in the arm connection.
9. Provide "J", "S", or "C" hook at top of Pole for signal cable support.
10. Use of split lock washers is not permitted.
11. Paint the entire structure after galvanizing. Painting shall be in accordance with the FDOT Specifications.

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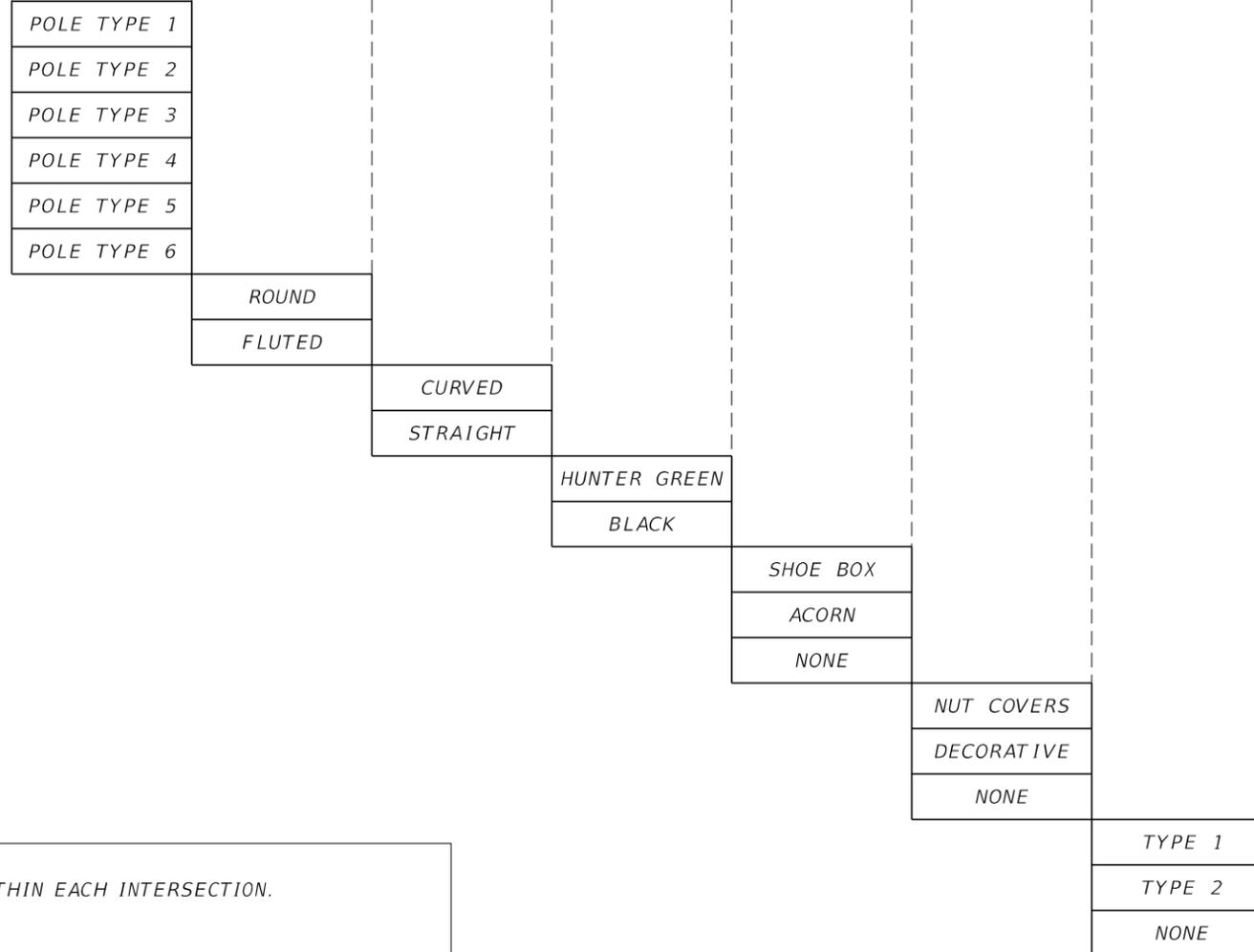
**STRUCTURAL DESIGN CRITERIA
&
MAST ARM STRUCTURE REQUIREMENTS**

SPECIFICATION OF MAST ARMS

The information shown in this table shall be specified for Mast Arm Structures constructed using these standards.
Provide additional information and requirements as required and appropriate.

POLE I.D.	POLE TYPE	POLE STYLE	ARM STYLE	COLOR	LUMINAIRE	BASE	BANNER	FIRST ARM LENGTH	SECOND ARM LENGTH	ANGLE BETWEEN ARMS
POLE A										
POLE B										
POLE C										
POLE D										

AVAILABLE OPTIONS



NOTE: MAST ARM STYLE SHALL BE CONSISTENT WITHIN EACH INTERSECTION.
FOR EACH INTERSECTION,
USE EITHER ALL ROUND POLES OR ALL FLUTED POLES,
USE EITHER ALL STRAIGHT ARMS OR ALL CURVED ARMS.
A MIXTURE OF POLES WITH LUMINAIRES AND WITHOUT LUMINAIRES IS PERMITTED.

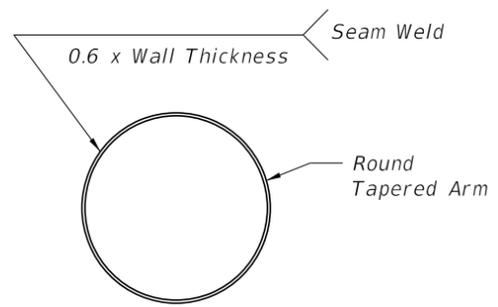
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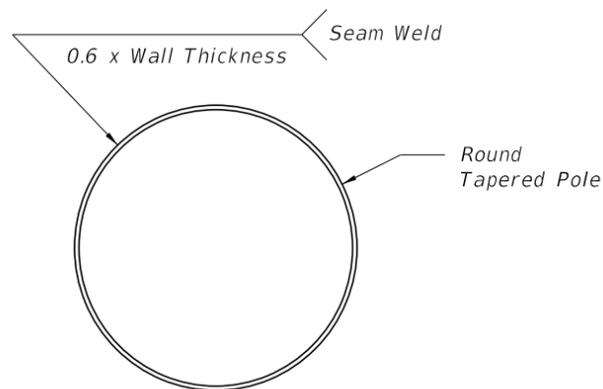
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POLE SCHEDULE

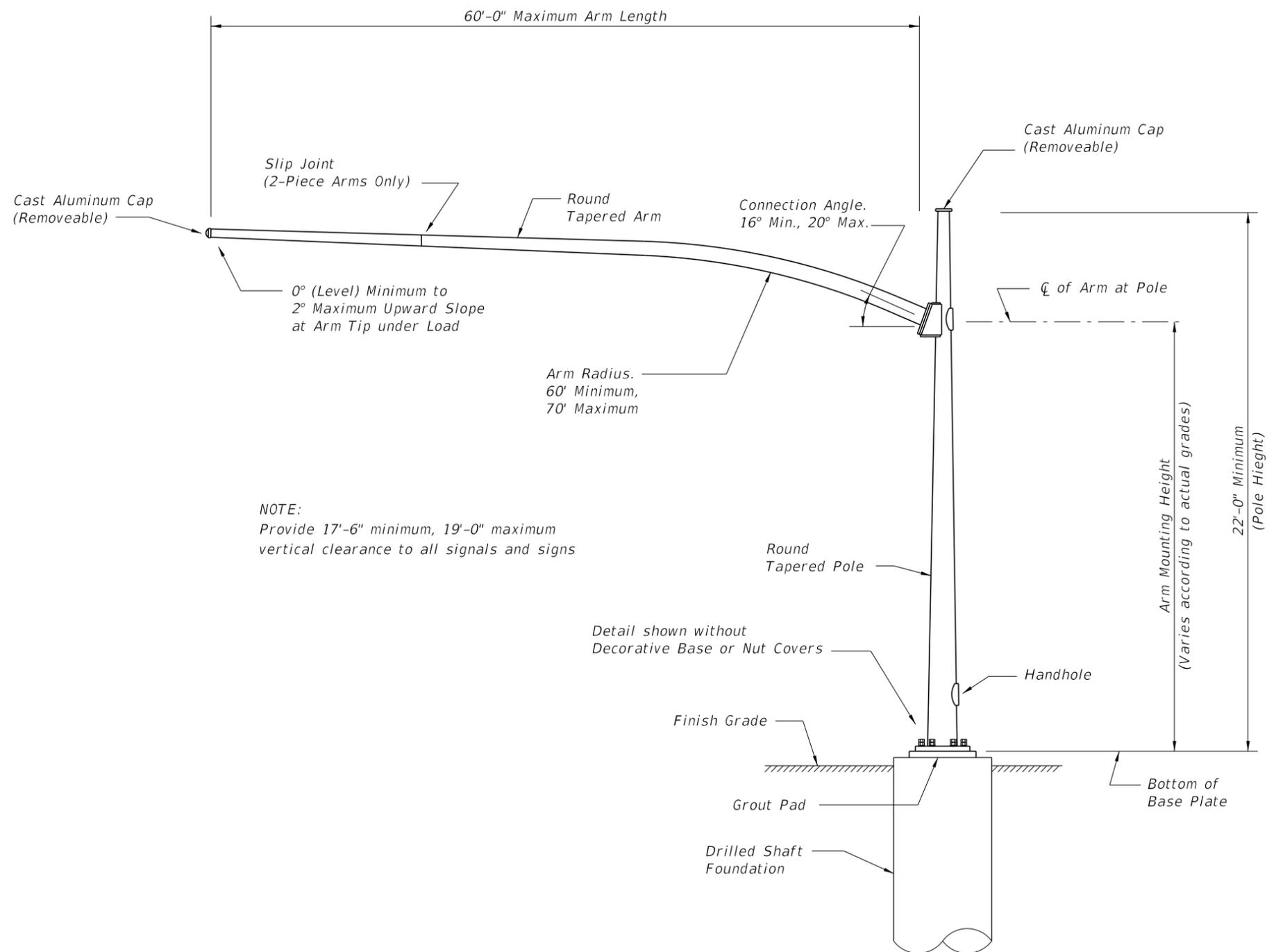
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TYPICAL SECTION THROUGH ARM



TYPICAL SECTION THROUGH POLE



NOTE:
Provide 17'-6" minimum, 19'-0" maximum
vertical clearance to all signals and signs

ELEVATION - POLE TYPE 1

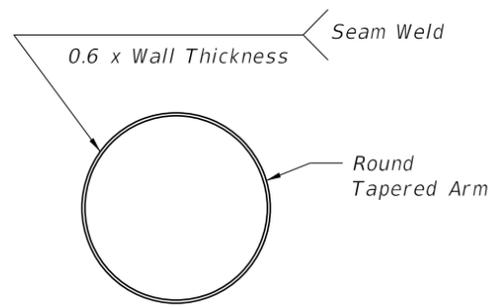
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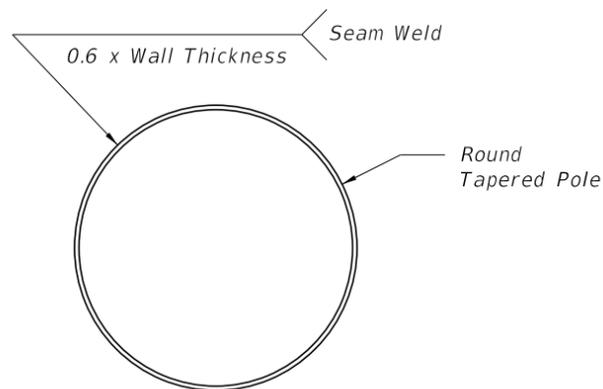
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POLE TYPE 1
ROUND POLE
CURVED ARM

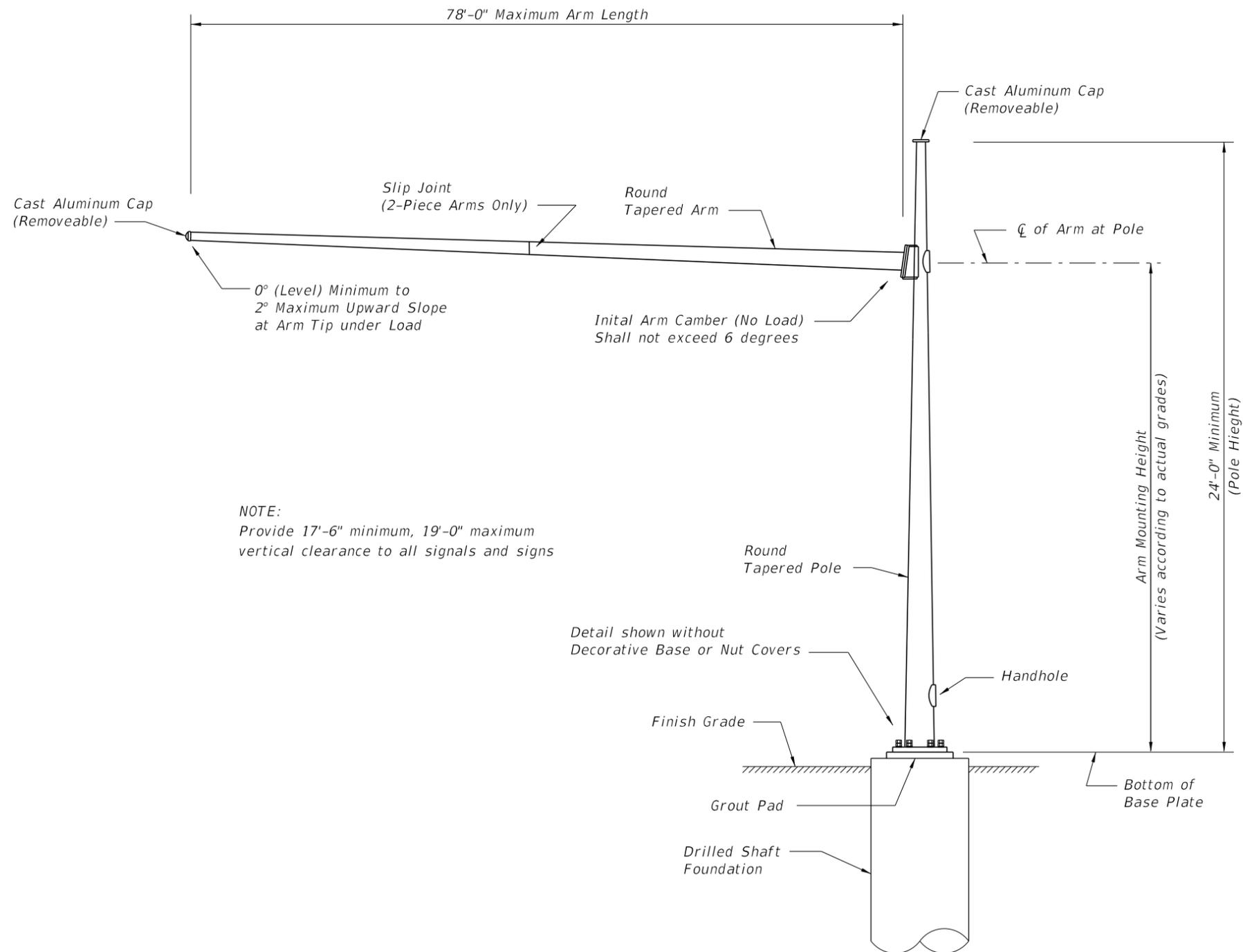
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TYPICAL SECTION THROUGH ARM



TYPICAL SECTION THROUGH POLE



NOTE:
Provide 17'-6" minimum, 19'-0" maximum vertical clearance to all signals and signs

ELEVATION - POLE TYPE 2

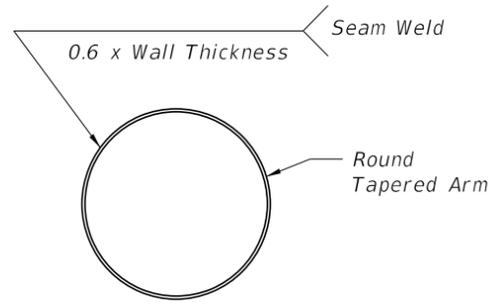
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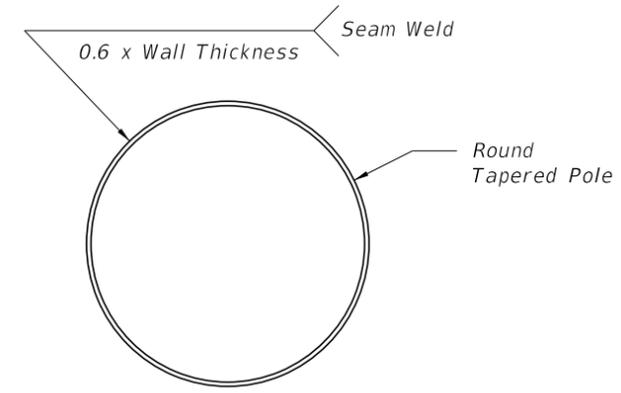
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POLE TYPE 2
ROUND POLE
STRAIGHT ARM

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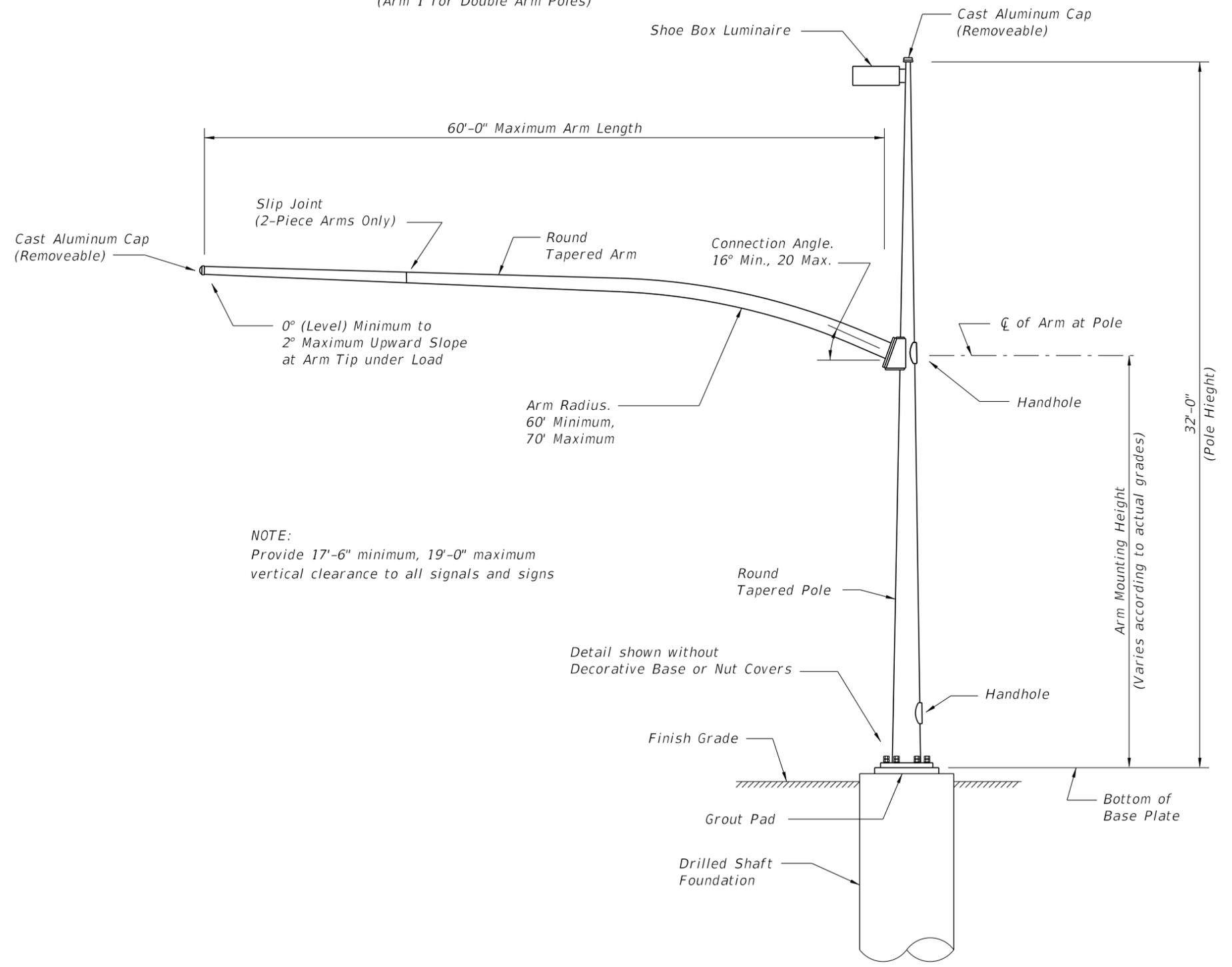


TYPICAL SECTION THROUGH ARM



TYPICAL SECTION THROUGH POLE

NOTE:
Designer shall detail orientation of luminaire with respect to Signal Arm (Arm 1 for Double Arm Poles)



NOTE:
Provide 17'-6" minimum, 19'-0" maximum vertical clearance to all signals and signs

ELEVATION - POLE TYPE 3

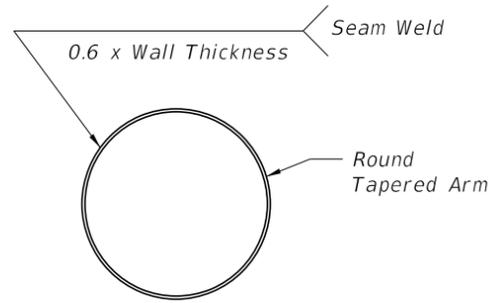
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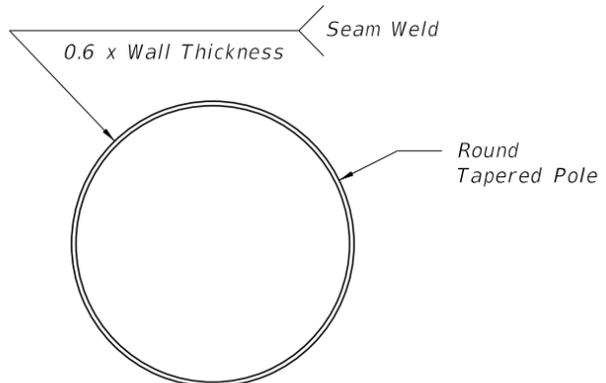
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POLE TYPE 3
ROUND POLE WITH LUMINAIRE
CURVED ARM

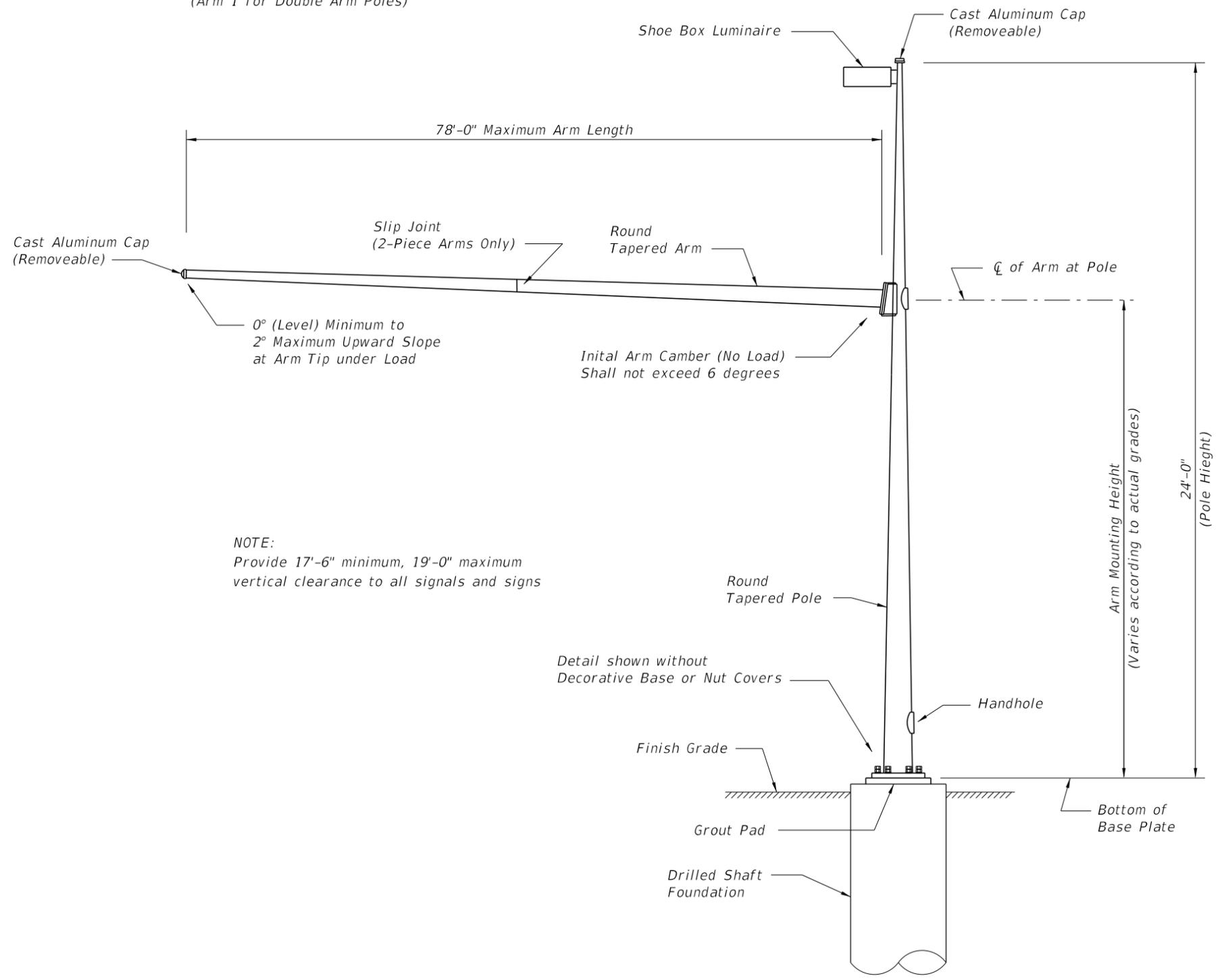
NOTE:
 Designer shall detail orientation of
 luminaire with respect to Signal Arm
 (Arm 1 for Double Arm Poles)



TYPICAL SECTION THROUGH ARM



TYPICAL SECTION THROUGH POLE



NOTE:
 Provide 17'-6" minimum, 19'-0" maximum
 vertical clearance to all signals and signs

ELEVATION - POLE TYPE 4

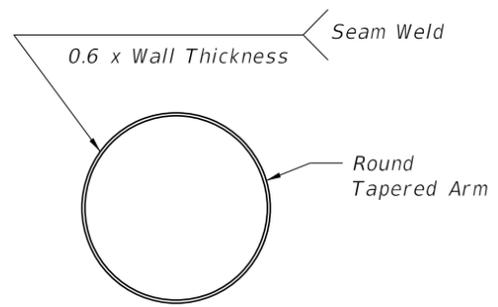
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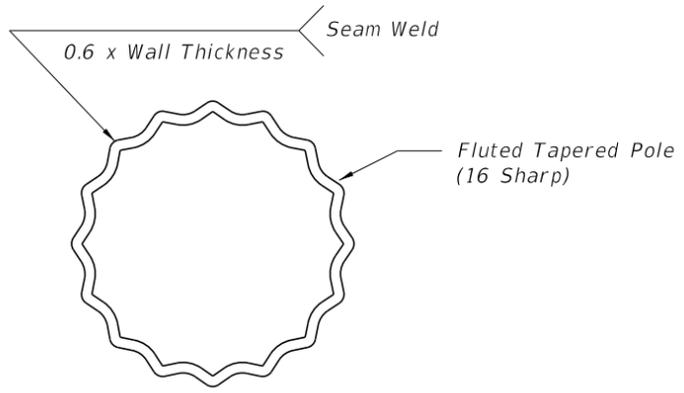
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POLE TYPE 4
ROUND POLE WITH LUMINAIRE
STRAIGHT ARM

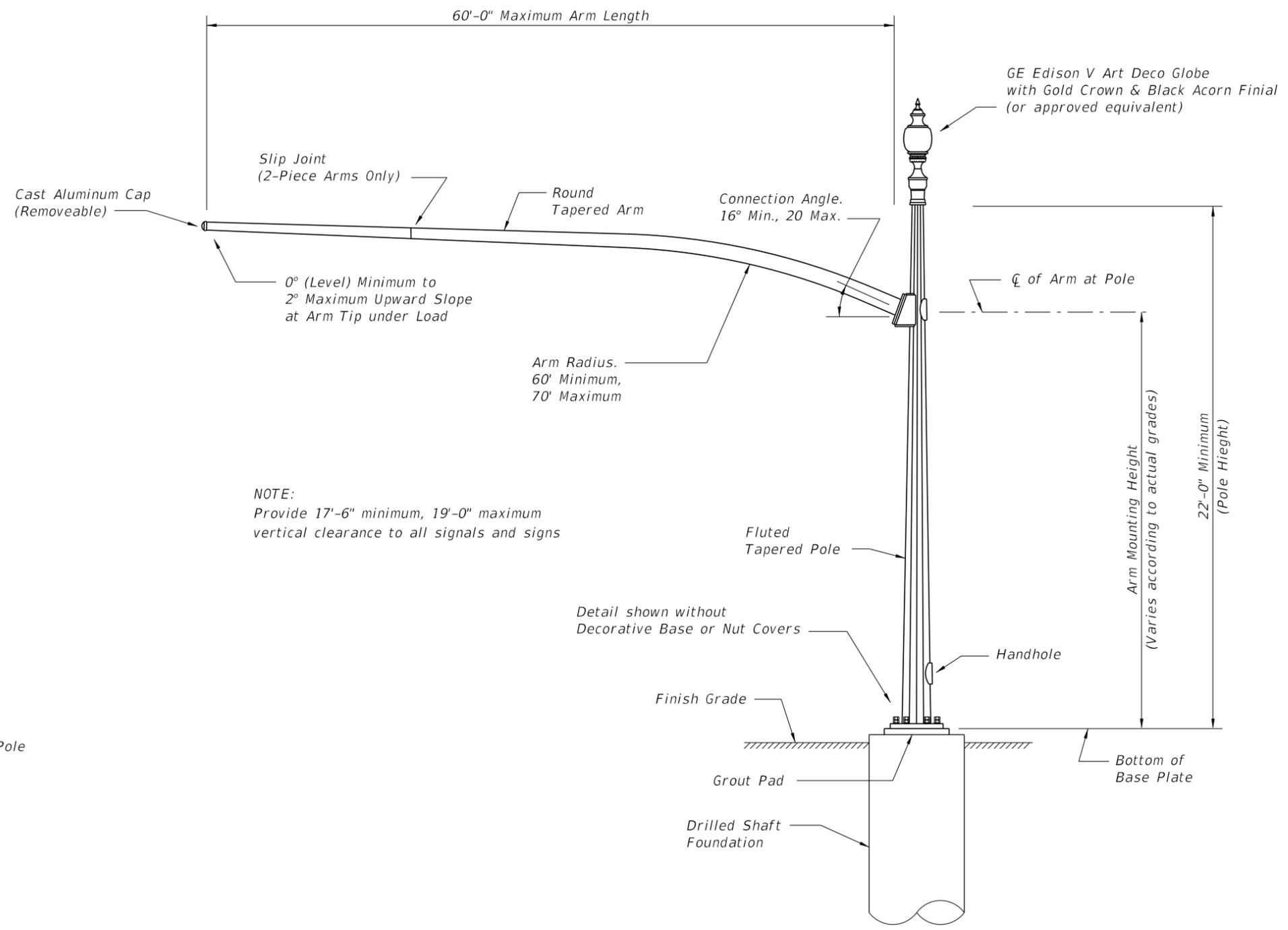
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TYPICAL SECTION THROUGH ARM



TYPICAL SECTION THROUGH POLE



ELEVATION - POLE TYPE 5

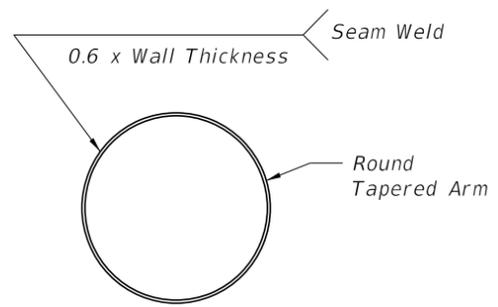
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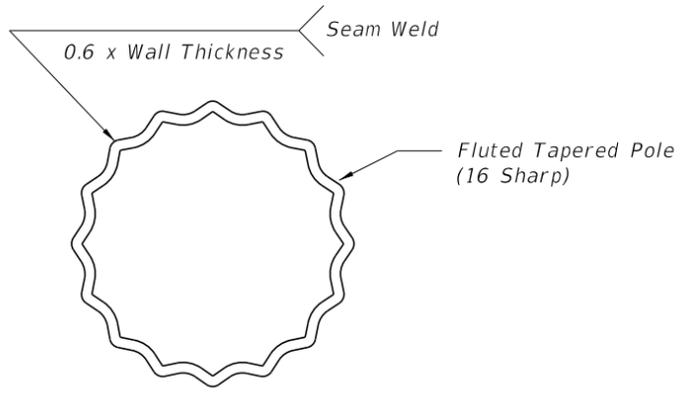
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POLE TYPE 5
FLUTED POLE
CURVED ARM

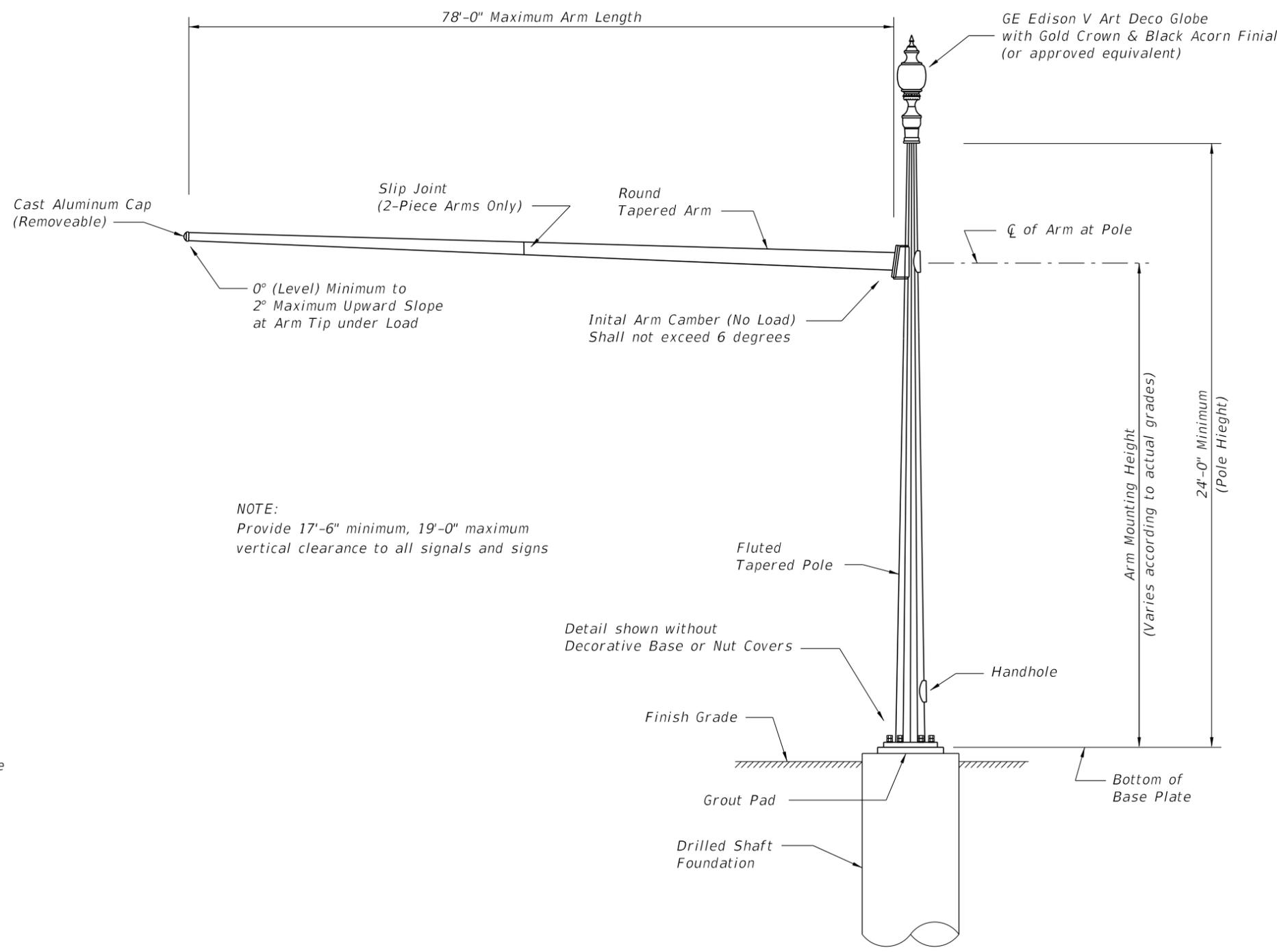
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TYPICAL SECTION THROUGH ARM



TYPICAL SECTION THROUGH POLE



NOTE:
Provide 17'-6" minimum, 19'-0" maximum vertical clearance to all signals and signs

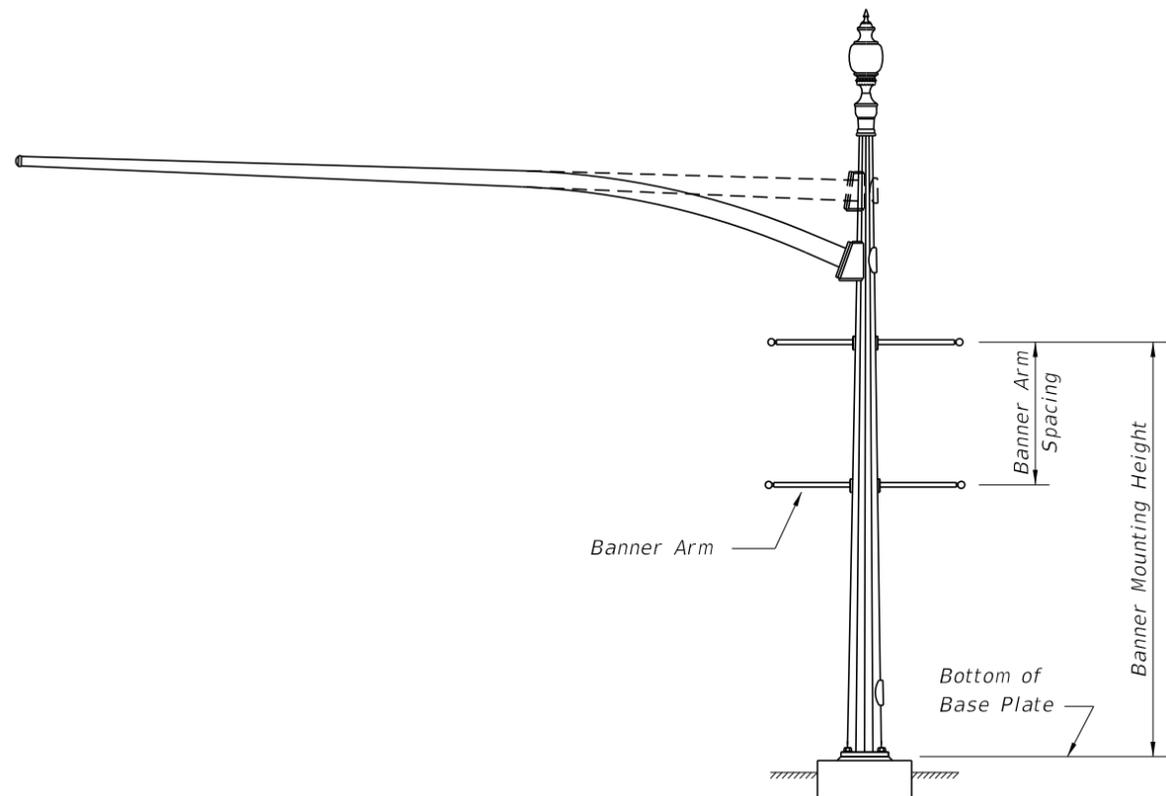
ELEVATION - POLE TYPE 6

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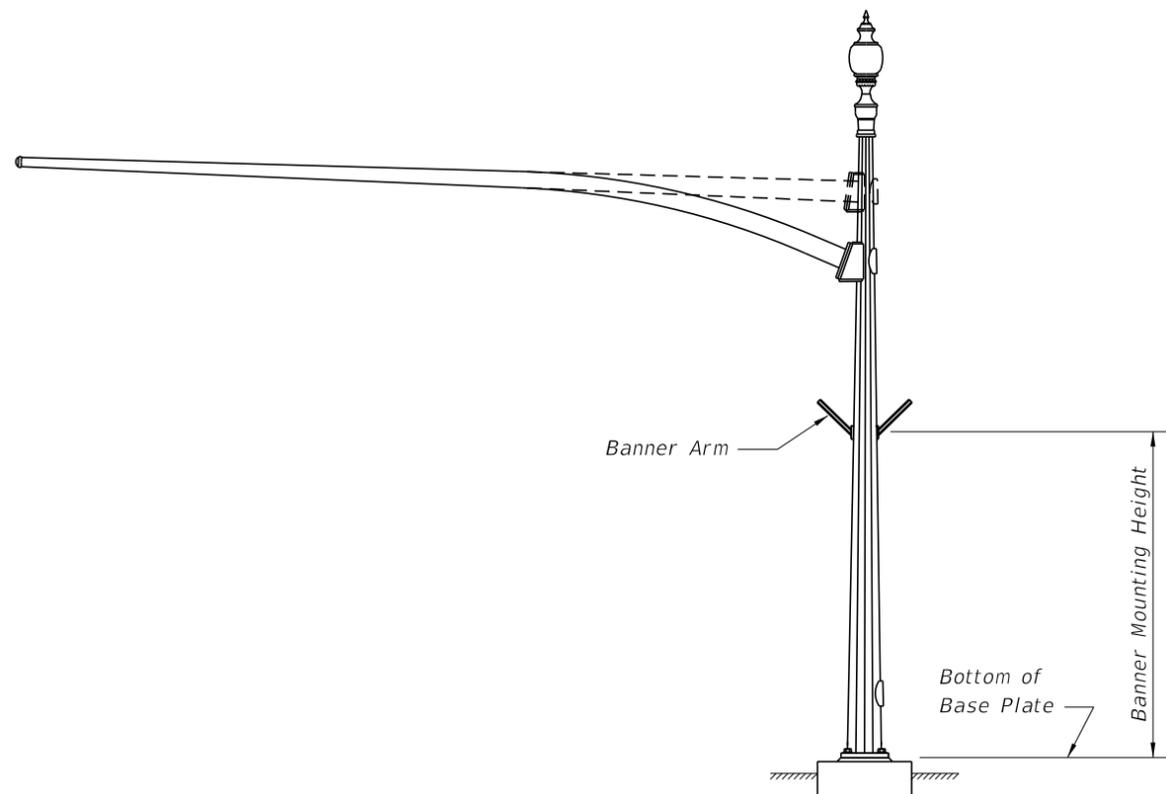


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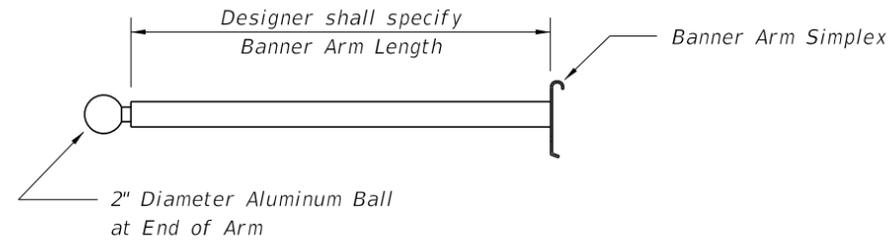
POLE TYPE 6
FLUTED POLE
STRAIGHT ARM



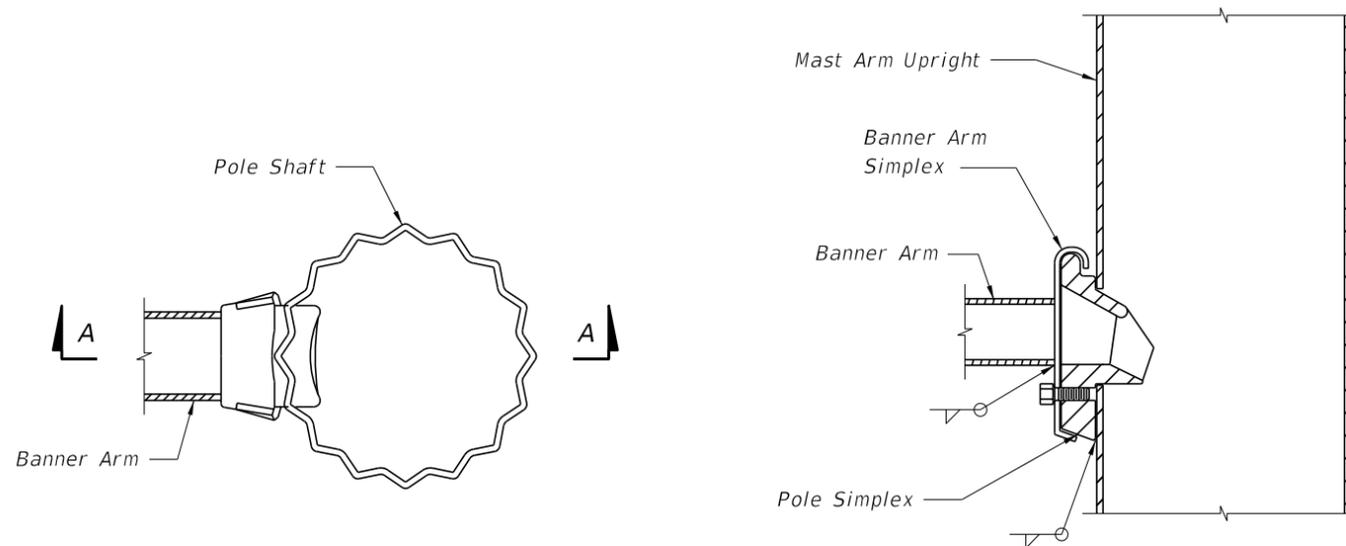
ELEVATION - BANNER TYPE 1



ELEVATION - BANNER TYPE 2



BANNER ARM



PLAN SECTION THROUGH CONNECTION

SECTION A-A

BANNER ARM ATTACHMENT DETAILS

NOTE:
 Designer must specify complete Banner Arm Details including:
 Banner Arm Type (Type 1, Type 2, or None),
 Banner Arm Location (inside, outside, or both sides),
 Banner Arm Mounting Height & Banner Arm Spacing,
 Banner Arm Length,
 Banner Arm Angle (Type 2 Banners only),
 and all special requirements
 Designer shall include appropriate notes & details as required.

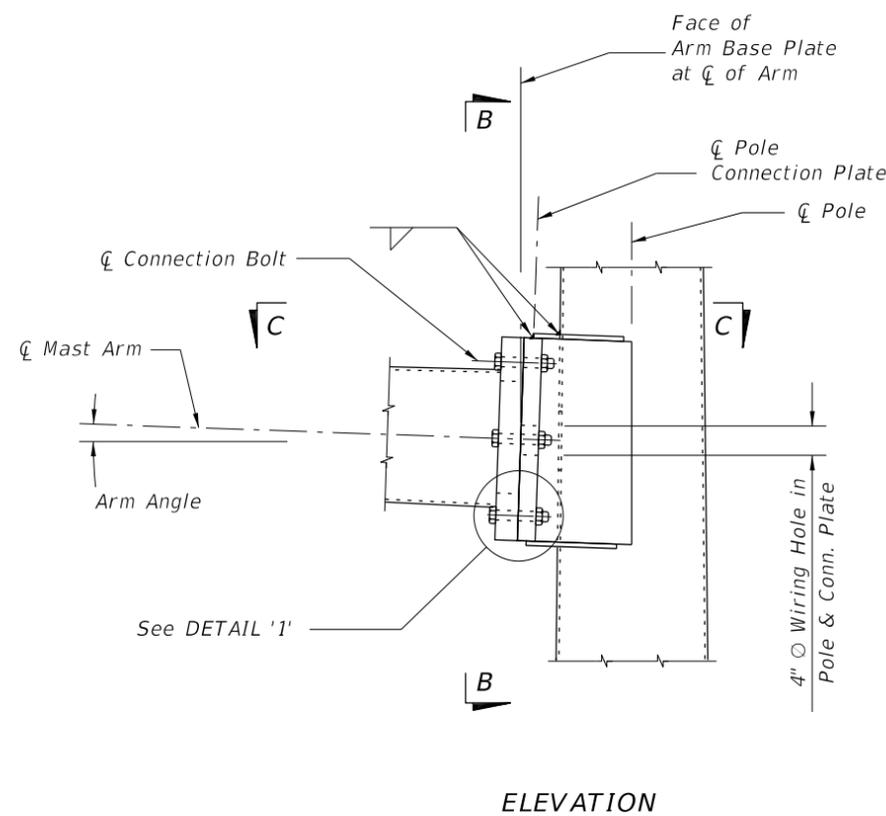
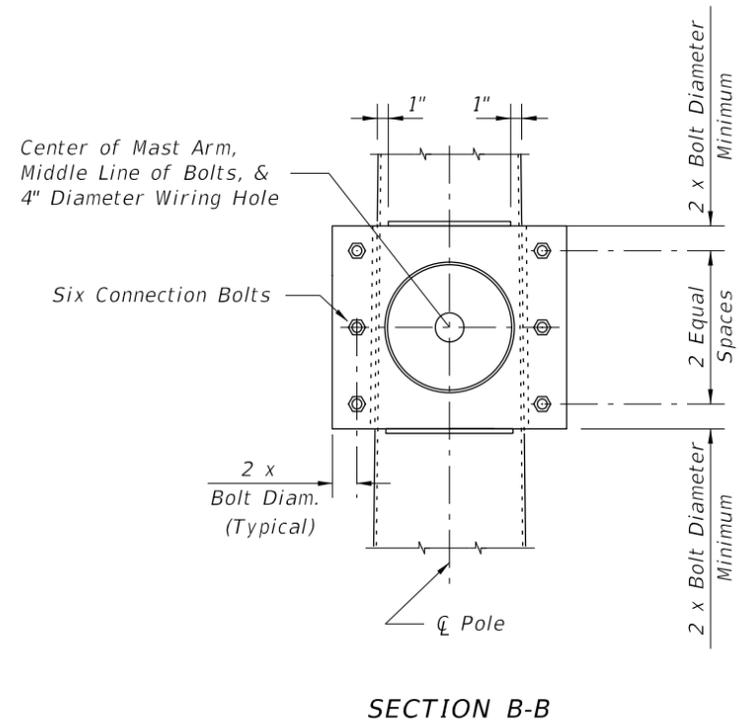
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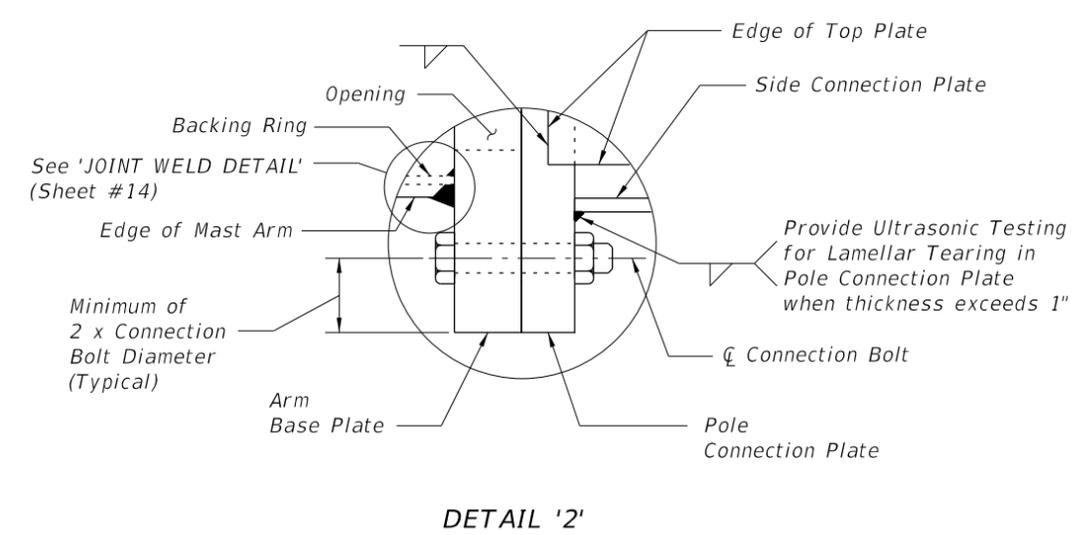
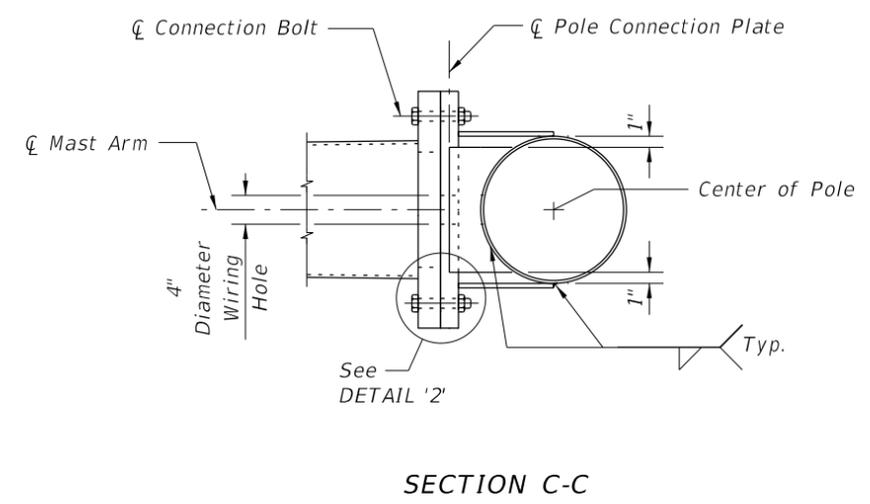
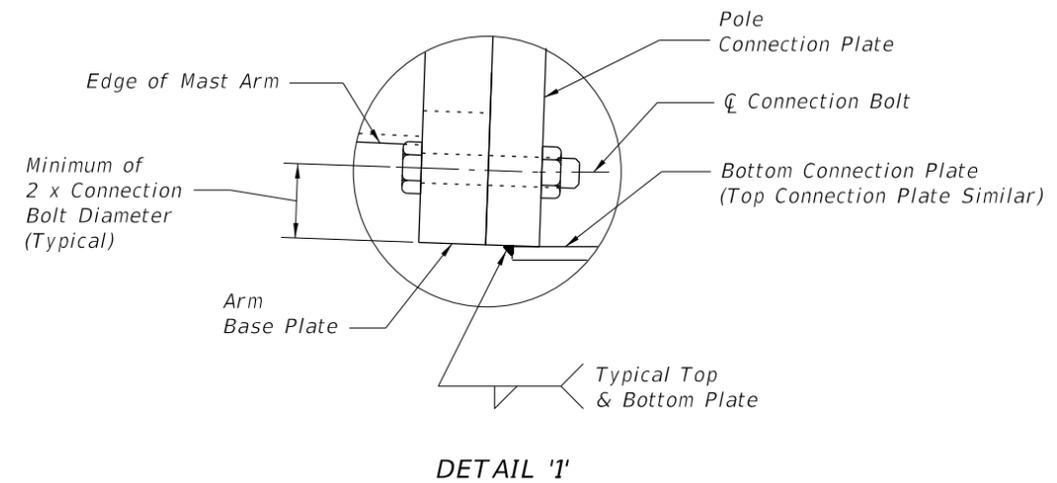
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BANNER DETAILS

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NOTE:
Details drawn for round pole,
Details for fluted pole similar.

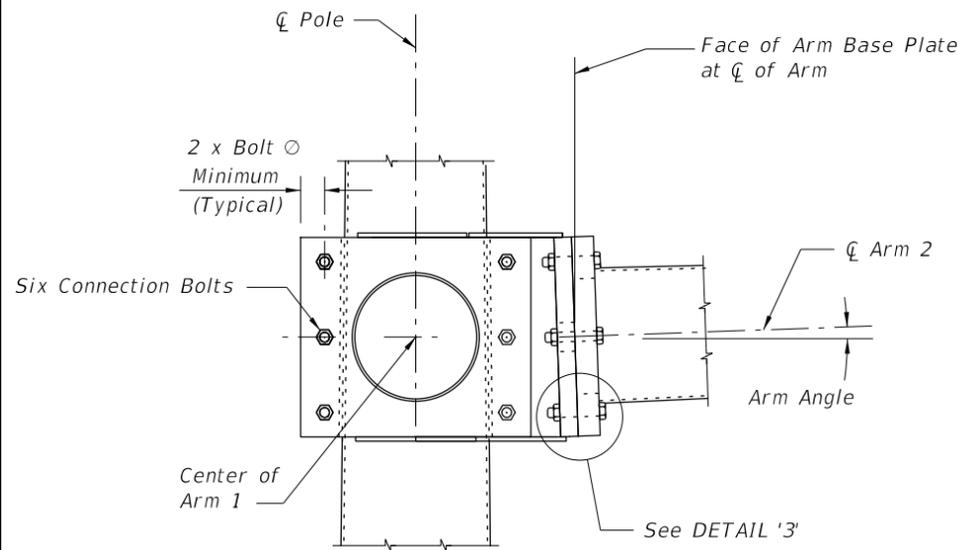


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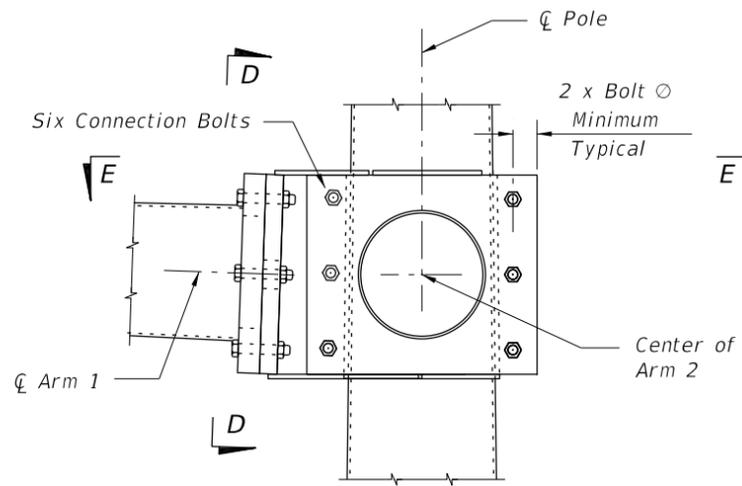


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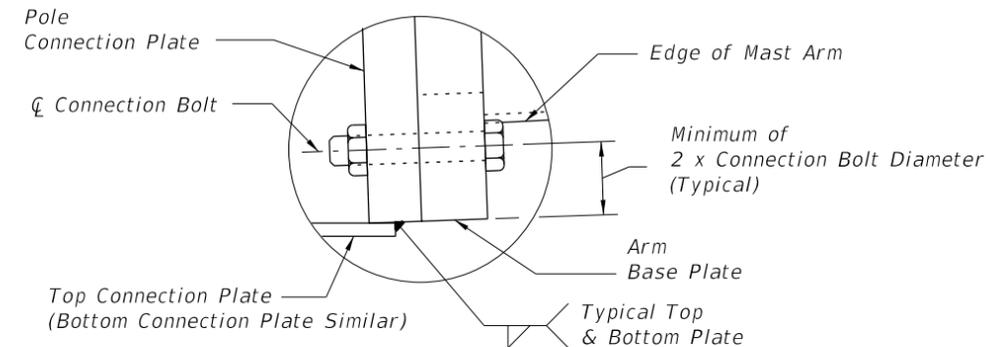
ARM-TO-POLE CONNECTION
SINGLE ARM



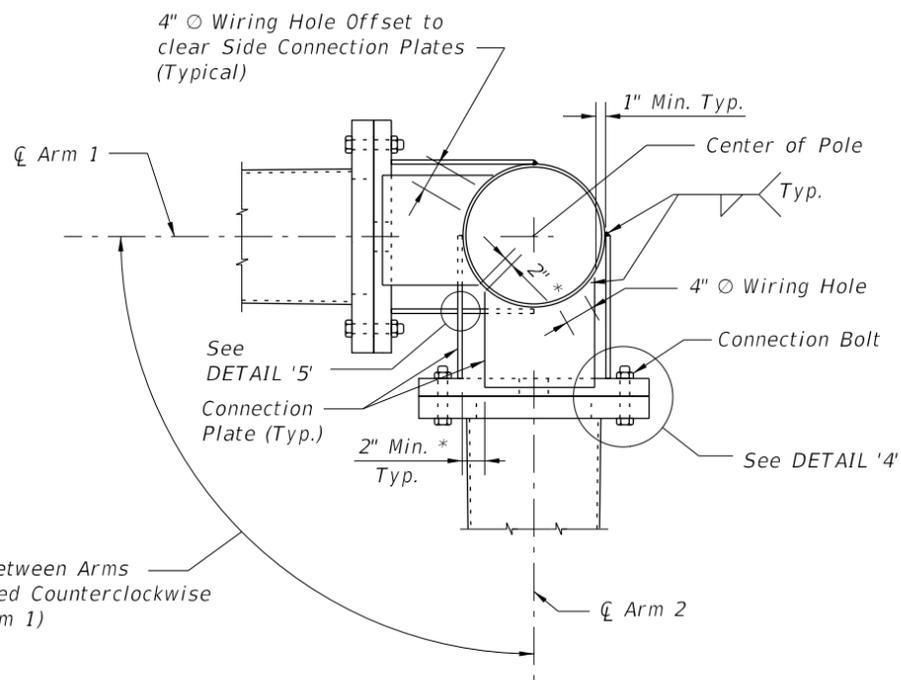
SECTION D-D



ELEVATION

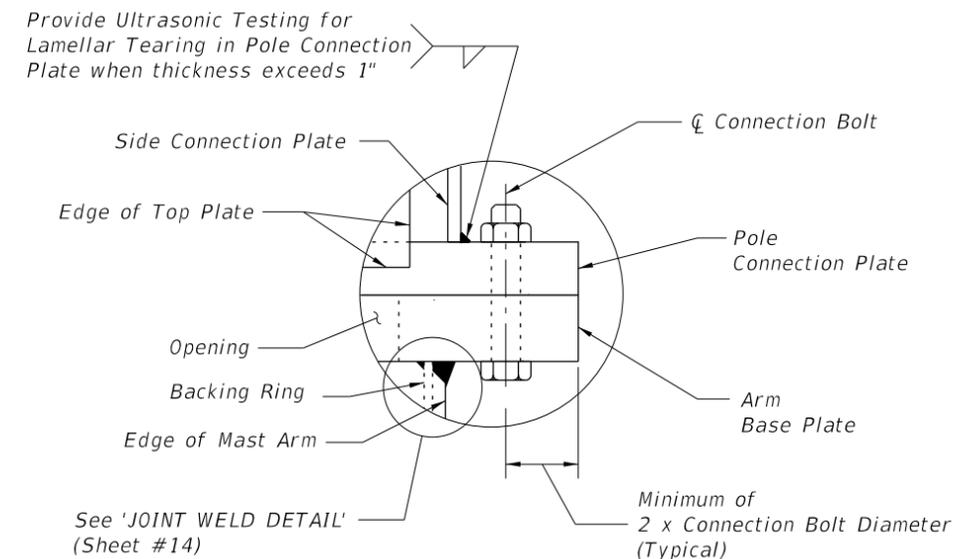


DETAIL '3'

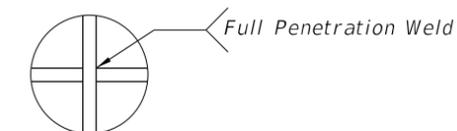


SECTION E-E

* Adjust width of top & bottom Connection Plates to maintain clearance shown



DETAIL '4'



DETAIL '5'

NOTE:
Details drawn for round pole,
Details for fluted pole similar.

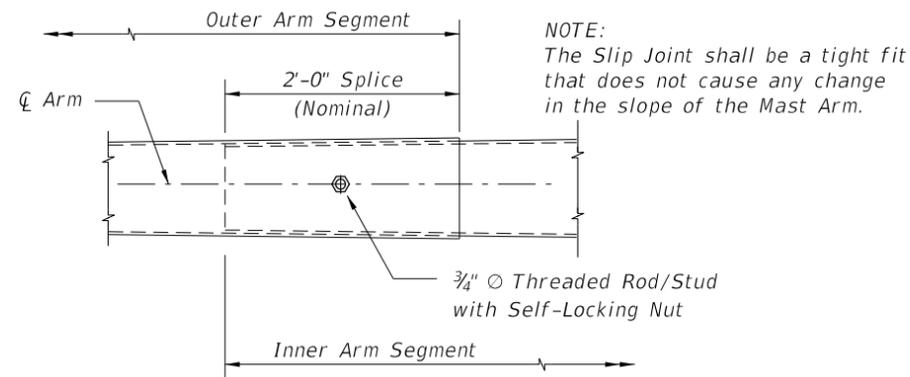
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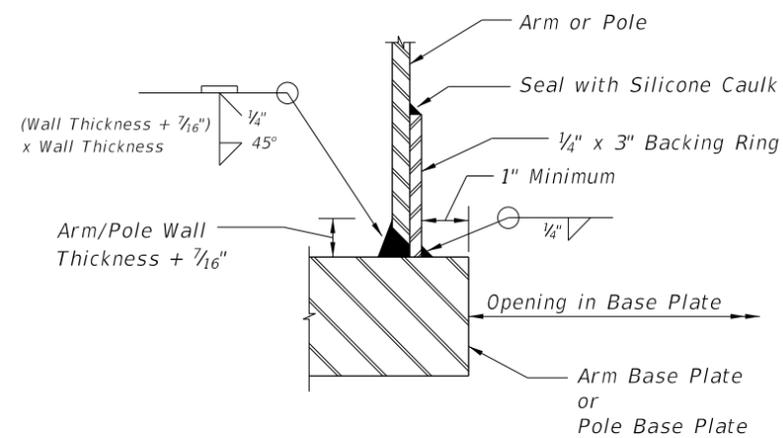
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ARM-TO-POLE CONNECTION
DOUBLE ARM

SHEET
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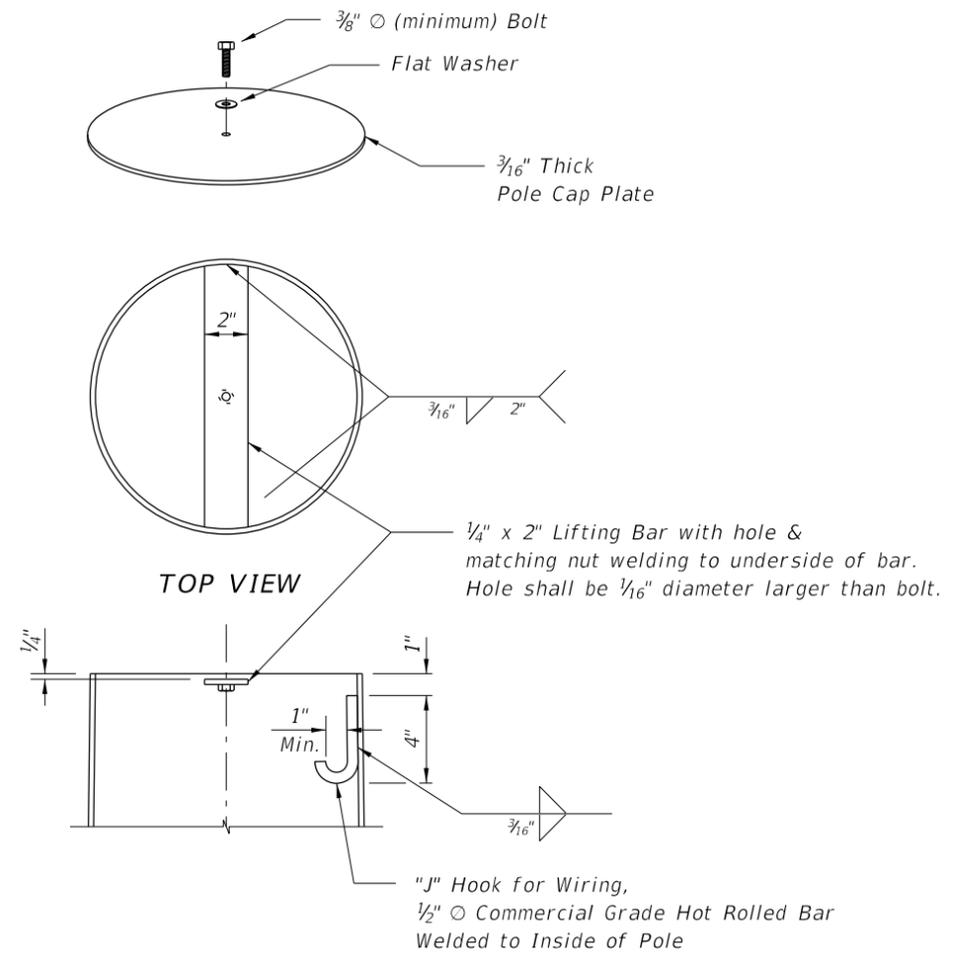


ARM SPLICE DETAIL

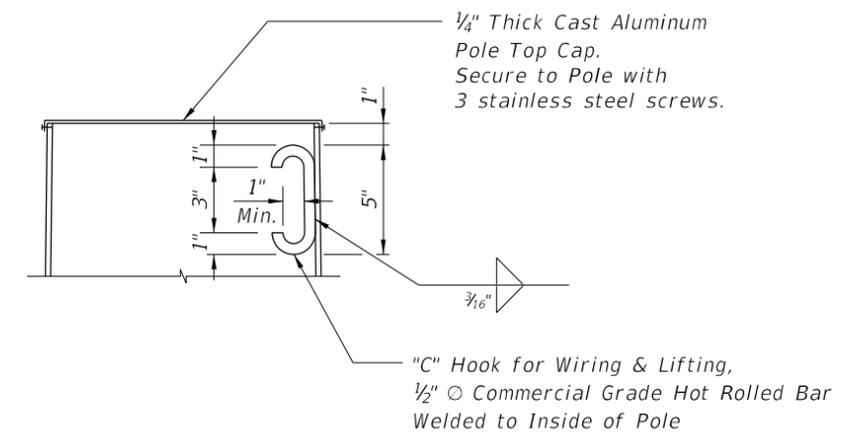


JOINT WELD DETAIL

Arm To Connection Plate & Pole To Base Plate



OPTION "A"



OPTION "B"

TOP OF POLE DETAILS

NOTE:

Any combination of the details shown in the two options may be used, provided both lifting and wiring are accommodated.

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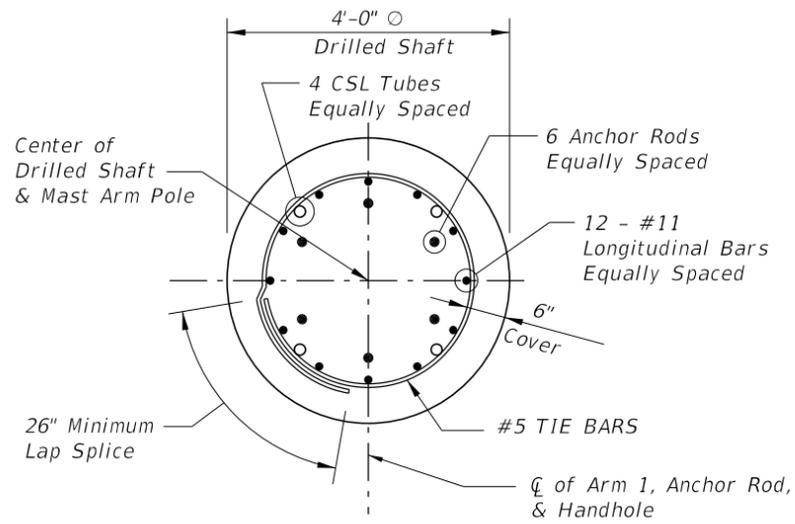


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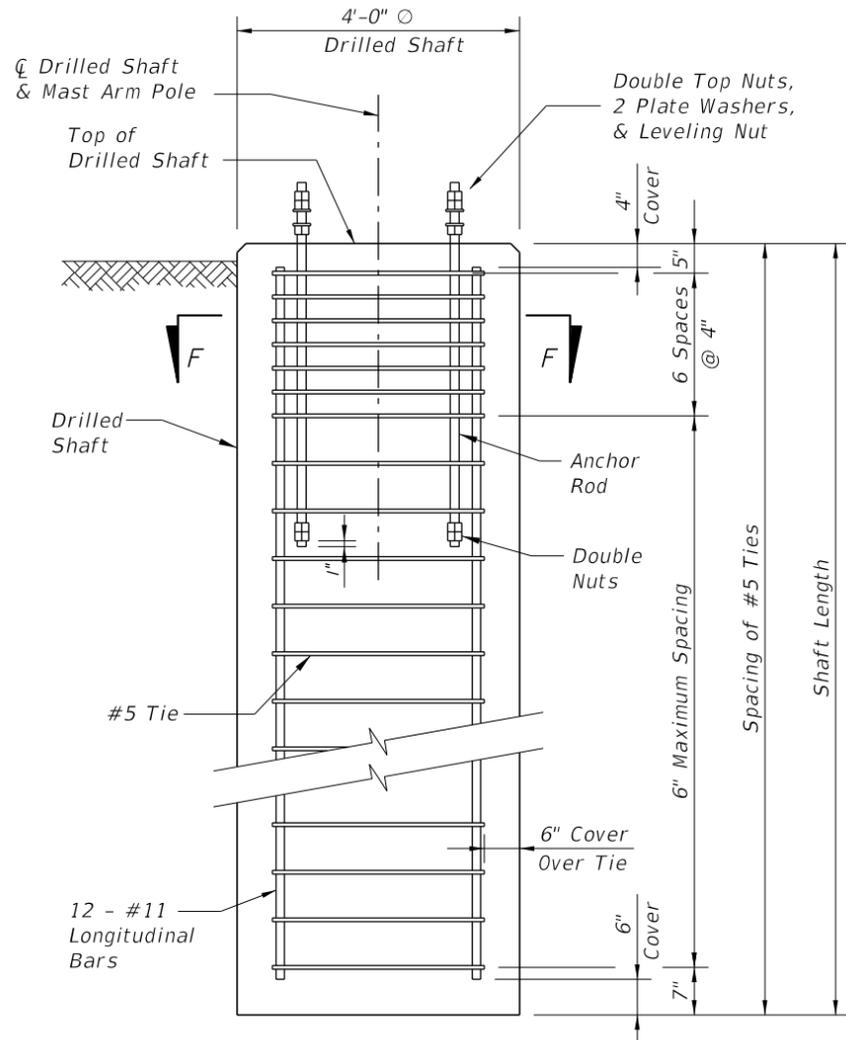
MAST ARM DETAILS

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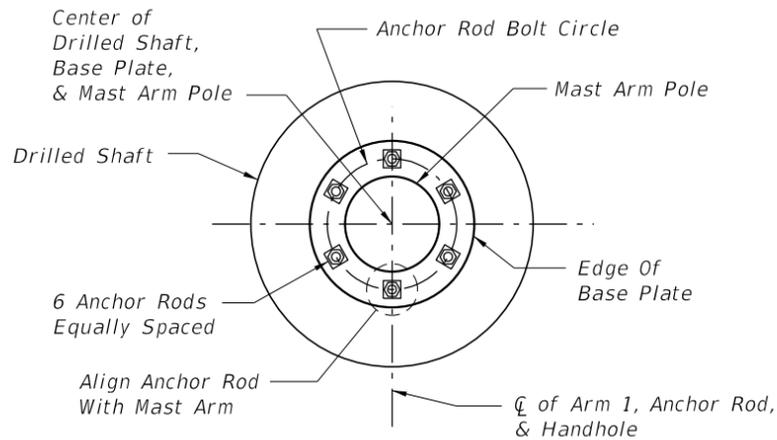


SECTION F-F
(Conduits Not Shown)

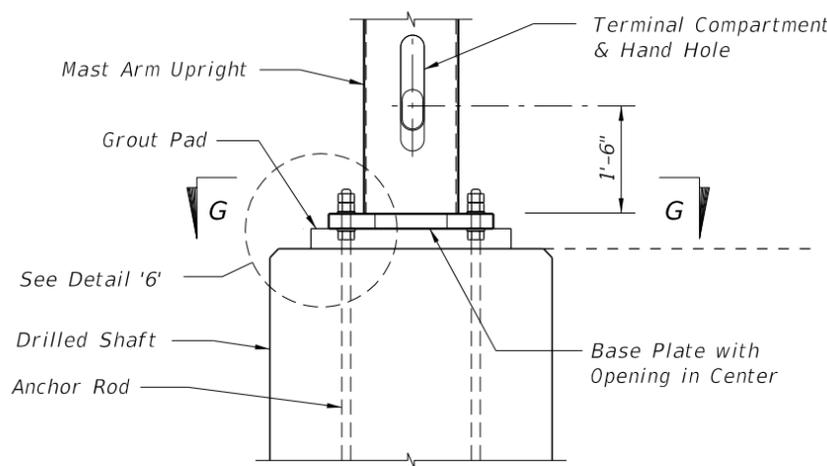


ELEVATION - DRILLED SHAFT
(CSL Tubes & Conduits Not Shown)

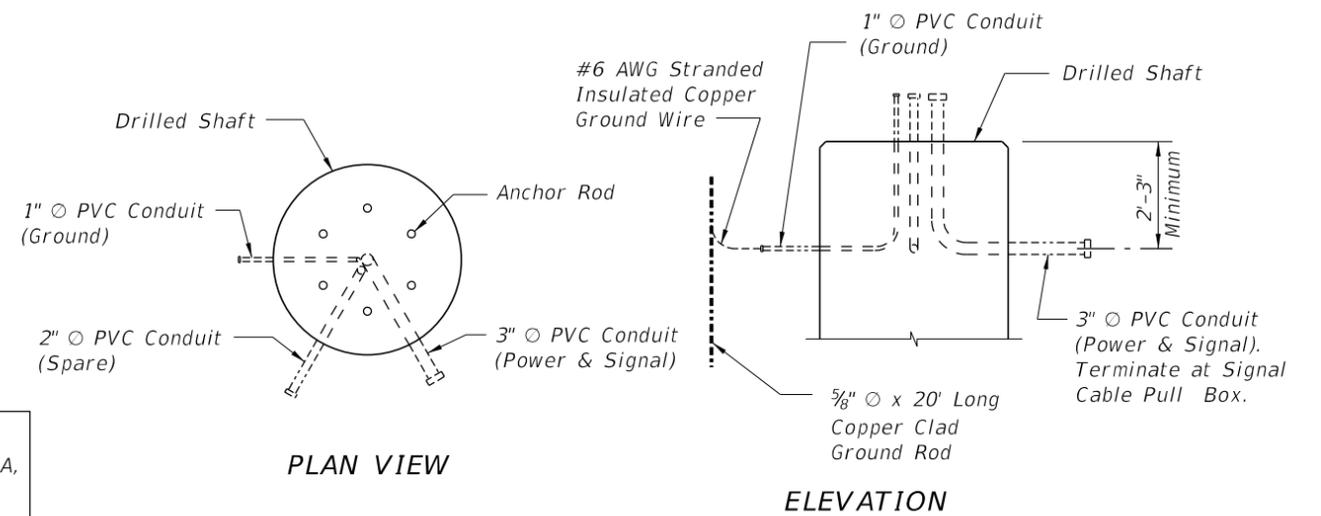
NOTE:
See MAST ARM STRUCTURAL DESIGN CRITERIA, Note #5 on Sheet #3 for restriction on diameter of Anchor Rod Bolt Circle.



SECTION G-G
(CSL Tubes, & Conduits Not Shown)



BASE PLATE & ANCHORAGE ELEVATION
(Shaft Reinforcing, CSL Tubes & Conduits Not Shown)



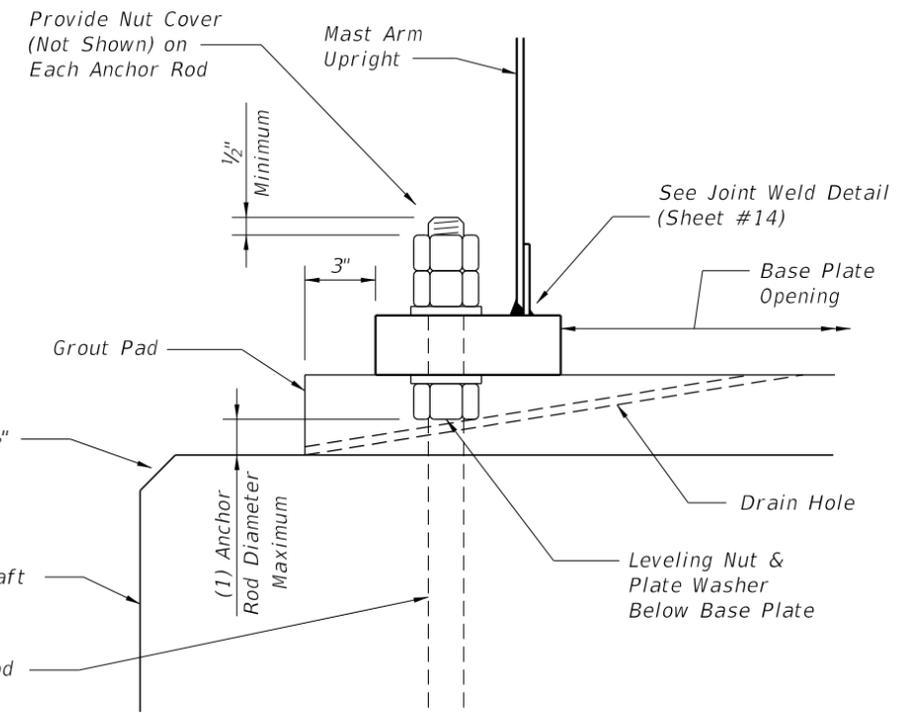
PLAN VIEW

ELEVATION

FOUNDATION CONDUIT DETAIL

Conduit Notes:

1. Details shown are schematic.
2. Adjust Conduit Orientation as required to clear Anchor Rods, Drilled Shaft Reinforcing, and CSL tubes.
3. Extend Conduits to 1" below bottom of Mast Arm Handhole.



DETAIL '6'
PARTIAL SECTION THROUGH BASE PLATE
AT CENTER OF BASE PLATE
(Shaft Reinforcing, CSL Tubes, & Conduits Not Shown)

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FOUNDATION DETAILS
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TABLE NOTES

- The Moment and Torsion Capacities are Service Load (Unfactored) Capacities. The values in the Table of Foundation Capacities are limited to:
 Overturning Moment: 225 kip*ft
 Torsion: 225 kip*ft
- The foundation information and details shown are for foundations meeting specific soil properties:
 Internal Angle of Friction (Phi Angle)
 Soil Effective Unit Weight (saturated unit weight minus water unit weight)
 SPT Blow Count (blows per foot)
 These parameters are assumed to exist for the entire embedded depth of the drilled shaft.
- The information provided in the Table of Foundation Capacities is only valid if all of the following conditions are met:
 - The existing soil conditions meet all of the parameters listed for the standard soil type (see GEOTECHNICAL REQUIREMENTS & SOILS DATA LETTER, Note #6 on Sheet 2 for exception).
 - The ground surface slope is 4:1 (Horizontal to Vertical) or flatter for a minimum of 8 feet from the center of the foundation in all directions.
 - The foundations are constructed in accordance with these standards.
 If any of these conditions are not met, then the foundation information and details shown herein do not apply and a special foundation must be designed. See Sheet 2 for foundation design and submittal requirements.
- If the Base Moment or Base Torsion exceed the values shown in the Table of Foundation Capacities, then a special foundation must be designed. See requirements this sheet and Sheet 2 for foundation design criteria and submittal requirements.
- See Sheet 2 for additional notes.

FOUNDATION CAPACITY CRITERIA

- The Drilled Shaft Moment and Torsion Capacities are determined in accordance with the FDOT Structures Manual (January 2015 Edition) with parameters and modifications as listed herein.
- Design Parameters:
 Factor of Safety Against Overturning: 2.0
 Factor of Safety Against Torsion: 1.0
 Horizontal Shear (Applied at Top of Drilled Shaft): 7.0
 Coefficient of Friction (Concrete Against Soil): 67% x tan(phi)
- The foundation capacity assumes that:
 - The top of the foundation extends 6" above grade
 - The top 18" of soil is loose or disturbed
 To account for these assumptions, the top 2'-0" of the shaft length is considered to provide no contribution to the overturning or torsion resistance and therefore the soil within that limit is totally neglected.
- Torsion resistance from the bottom of the drilled shaft is computed assuming that the drilled shaft concrete weighs 87.6 pcf (150 pcf - 62.4 pcf) and neglecting any contribution from the self-weight of the mast arm itself.

TABLE OF FOUNDATION CAPACITIES

SOIL TYPE: 28-40-06	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
Φ: 28 DEGREES γ: 40 PCF N: 9 ≥ 6	MOMENT (KIP*FEET)	26	55	92	136	188	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	35	42	50	58	66	76	86	96	107	119	131	144	157
SOIL TYPE: 28-40-09	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
Φ: 28 DEGREES γ: 40 PCF N: 12 > N ≥ 9	MOMENT (KIP*FEET)	26	55	92	136	188	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	50	60	71	83	96	110	124	140	156	173	191	210	225
SOIL TYPE: 28-40-12	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21			
Φ: 28 DEGREES γ: 40 PCF N: 15 > N ≥ 12	MOMENT (KIP*FEET)	26	55	92	136	188	225	225	225	225	225			
	TORSION (KIP*FEET)	66	79	93	109	126	144	163	183	205	225			
SOIL TYPE: 28-40-15	LENGTH (FEET)	12	13	14	15	16	17	18	19					
Φ: 28 DEGREES γ: 40 PCF N: N ≥ 15	MOMENT (KIP*FEET)	26	55	92	136	188	225	225	225					
	TORSION (KIP*FEET)	81	97	115	134	155	177	201	225					
SOIL TYPE: 28-50-06	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
Φ: 28 DEGREES γ: 50 PCF N: 9 ≥ 6	MOMENT (KIP*FEET)	53	91	138	195	225	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	43	51	61	70	81	93	105	118	132	146	161	177	194
SOIL TYPE: 28-50-09	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22		
Φ: 28 DEGREES γ: 50 PCF N: 12 > N ≥ 9	MOMENT (KIP*FEET)	53	91	138	195	225	225	225	225	225	225	225		
	TORSION (KIP*FEET)	62	74	88	102	118	135	153	172	193	214	225		
SOIL TYPE: 28-50-12	LENGTH (FEET)	12	13	14	15	16	17	18	19					
Φ: 28 DEGREES γ: 50 PCF N: 15 > N ≥ 12	MOMENT (KIP*FEET)	53	91	138	195	225	225	225	225					
	TORSION (KIP*FEET)	81	97	115	134	155	177	201	225					
SOIL TYPE: 28-50-15	LENGTH (FEET)	12	13	14	15	16	17	18						
Φ: 28 DEGREES γ: 50 PCF N: N ≥ 15	MOMENT (KIP*FEET)	53	91	138	195	225	225	225						
	TORSION (KIP*FEET)	99	120	142	166	192	220	225						
SOIL TYPE: 28-60-06	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
Φ: 28 DEGREES γ: 60 PCF N: 9 ≥ 6	MOMENT (KIP*FEET)	81	128	185	225	225	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	50	60	71	83	96	110	124	140	156	173	191	210	225
SOIL TYPE: 28-60-09	LENGTH (FEET)	12	13	14	15	16	17	18	19	20				
Φ: 28 DEGREES γ: 60 PCF N: 12 > N ≥ 9	MOMENT (KIP*FEET)	81	128	185	225	225	225	225	225	225				
	TORSION (KIP*FEET)	73	88	104	121	140	160	182	205	225				
SOIL TYPE: 28-60-12	LENGTH (FEET)	12	13	14	15	16	17	18						
Φ: 28 DEGREES γ: 60 PCF N: 15 > N ≥ 12	MOMENT (KIP*FEET)	81	128	185	225	225	225	225						
	TORSION (KIP*FEET)	96	115	137	160	185	211	225						
SOIL TYPE: 28-60-15	LENGTH (FEET)	12	13	14	15	16								
Φ: 28 DEGREES γ: 60 PCF N: N ≥ 15	MOMENT (KIP*FEET)	81	128	185	225	225								
	TORSION (KIP*FEET)	118	143	169	198	225								

TABLE LEGEND
 Φ: Soil Internal Angle of Friction (Phi Angle)
 γ: Soil Effective Unit Weight
 N: SPT Blow Count (Blows per Foot)

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FOUNDATION CAPACITIES
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TABLE OF FOUNDATION CAPACITIES

SOIL TYPE: 30-40-06 Φ: 30 DEGREES γ: 40 PCF N: 9 ≥ 6	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
	MOMENT (KIP*FEET)	35	67	107	155	213	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	36	43	50	58	67	76	86	97	108	120	132	145	158
SOIL TYPE: 30-40-09 Φ: 30 DEGREES γ: 40 PCF N: 12 > N ≥ 9	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
	MOMENT (KIP*FEET)	35	67	107	155	213	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	51	61	72	84	97	110	125	140	157	174	192	211	225
SOIL TYPE: 30-40-12 Φ: 30 DEGREES γ: 40 PCF N: 15 > N ≥ 12	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21			
	MOMENT (KIP*FEET)	35	67	107	155	213	225	225	225	225	225			
	TORSION (KIP*FEET)	66	79	94	109	126	144	163	184	206	225			
SOIL TYPE: 30-40-15 Φ: 30 DEGREES γ: 40 PCF N: N ≥ 15	LENGTH (FEET)	12	13	14	15	16	17	18	19					
	MOMENT (KIP*FEET)	35	67	107	155	213	225	225	225					
	TORSION (KIP*FEET)	81	97	115	135	156	178	202	225					
SOIL TYPE: 30-50-06 Φ: 30 DEGREES γ: 50 PCF N: 9 ≥ 6	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
	MOMENT (KIP*FEET)	65	106	158	220	225	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	43	52	61	71	82	93	106	119	132	147	162	178	195
SOIL TYPE: 30-50-09 Φ: 30 DEGREES γ: 50 PCF N: 12 > N ≥ 9	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22		
	MOMENT (KIP*FEET)	65	106	158	220	225	225	225	225	225	225	225		
	TORSION (KIP*FEET)	62	75	88	103	119	136	154	173	193	215	225		
SOIL TYPE: 30-50-12 Φ: 30 DEGREES γ: 50 PCF N: 15 > N ≥ 12	LENGTH (FEET)	12	13	14	15	16	17	18	19					
	MOMENT (KIP*FEET)	65	106	158	220	225	225	225	225					
	TORSION (KIP*FEET)	81	97	115	135	156	178	202	225					
SOIL TYPE: 30-50-15 Φ: 30 DEGREES γ: 50 PCF N: N ≥ 15	LENGTH (FEET)	12	13	14	15	16	17	18						
	MOMENT (KIP*FEET)	65	106	158	220	225	225	225						
	TORSION (KIP*FEET)	100	120	142	167	193	221	225						
SOIL TYPE: 30-60-06 Φ: 30 DEGREES γ: 60 PCF N: 9 ≥ 6	LENGTH (FEET)	12	13	14	15	16	17	18	19	20	21	22	23	24
	MOMENT (KIP*FEET)	94	146	209	225	225	225	225	225	225	225	225	225	225
	TORSION (KIP*FEET)	51	61	72	84	97	110	125	140	157	174	192	211	225
SOIL TYPE: 30-60-09 Φ: 30 DEGREES γ: 60 PCF N: 12 > N ≥ 9	LENGTH (FEET)	12	13	14	15	16	17	18	19	20				
	MOMENT (KIP*FEET)	94	146	209	225	225	225	225	225	225				
	TORSION (KIP*FEET)	74	88	104	122	141	161	183	206	225				
SOIL TYPE: 30-60-12 Φ: 30 DEGREES γ: 60 PCF N: 15 > N ≥ 12	LENGTH (FEET)	12	13	14	15	16	17	18						
	MOMENT (KIP*FEET)	94	146	209	225	225	225	225						
	TORSION (KIP*FEET)	96	116	137	160	185	212	225						
SOIL TYPE: 30-60-15 Φ: 30 DEGREES γ: 60 PCF N: N ≥ 15	LENGTH (FEET)	12	13	14	15	16								
	MOMENT (KIP*FEET)	94	146	209	225	225								
	TORSION (KIP*FEET)	119	143	170	198	225								

NOTE:
See Sheet 16 for Table Notes & Criteria used for Foundation Capacities.

TABLE LEGEND
 Φ: Soil Internal Angle of Friction (Phi Angle)
 γ: Soil Effective Unit Weight
 N: SPT Blow Count (Blows per Foot)

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