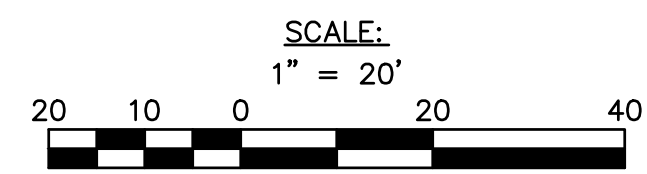
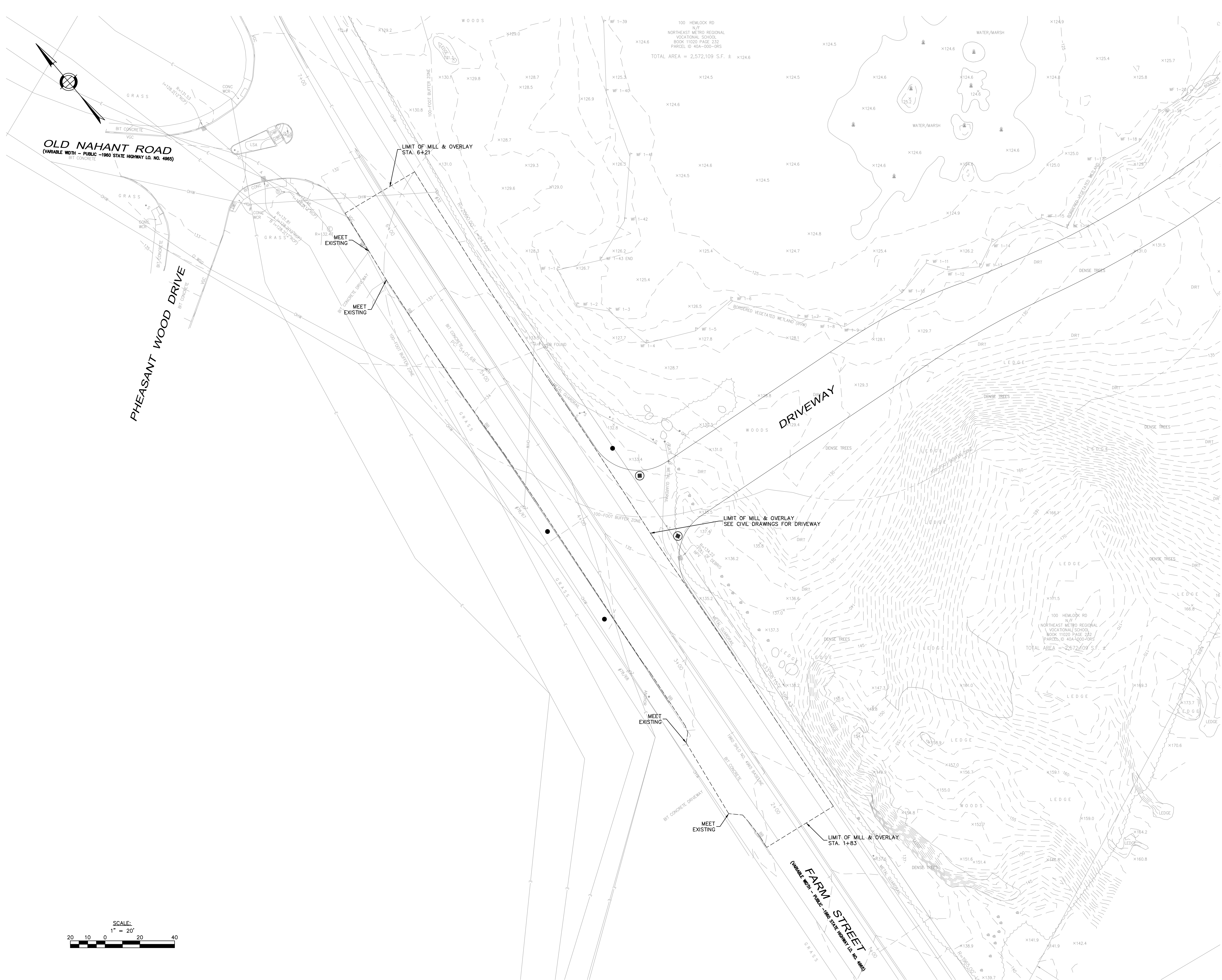


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100 HEMLOCK RD  
N/E  
NORTHEAST METRO REGIONAL  
VOCATIONAL SCHOOL  
BOOK 11020 PAGE 232  
PARCEL ID 40A-000-0RS  
TOTAL AREA = 2,572,109 S.F. ±

100 HEMLOCK RD  
N/E  
NORTHEAST METRO REGIONAL  
VOCATIONAL SCHOOL  
BOOK 11020 PAGE 232  
PARCEL ID 40A-000-0RS  
TOTAL AREA = 2,572,109 S.F. ±

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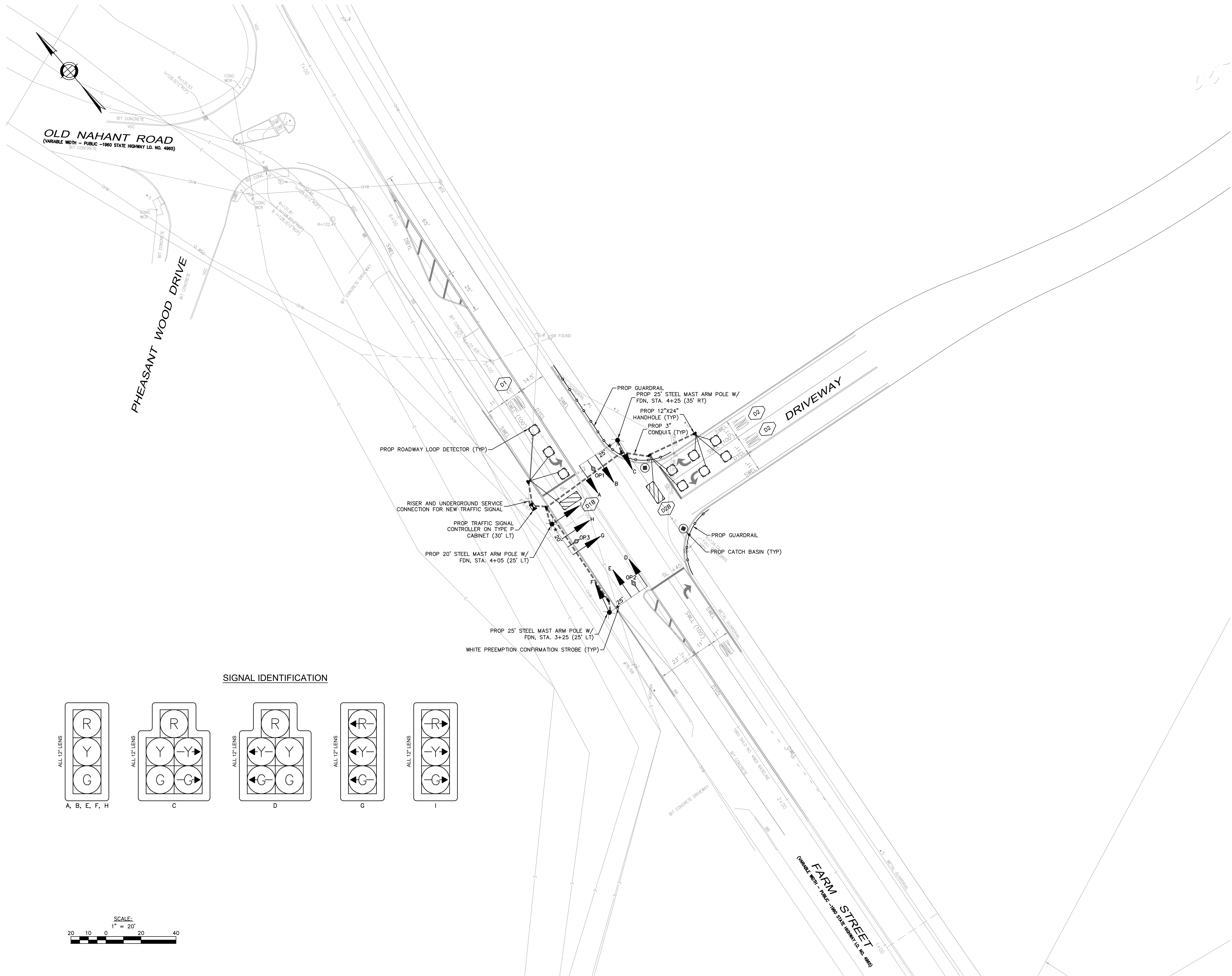
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August 4, 2022

CONSTRUCTION  
PLAN  
  
Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-001





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**TRAFFIC  
SIGNAL PLAN**

Scale: 1" = 20'-0"

Job No.: 13872.2

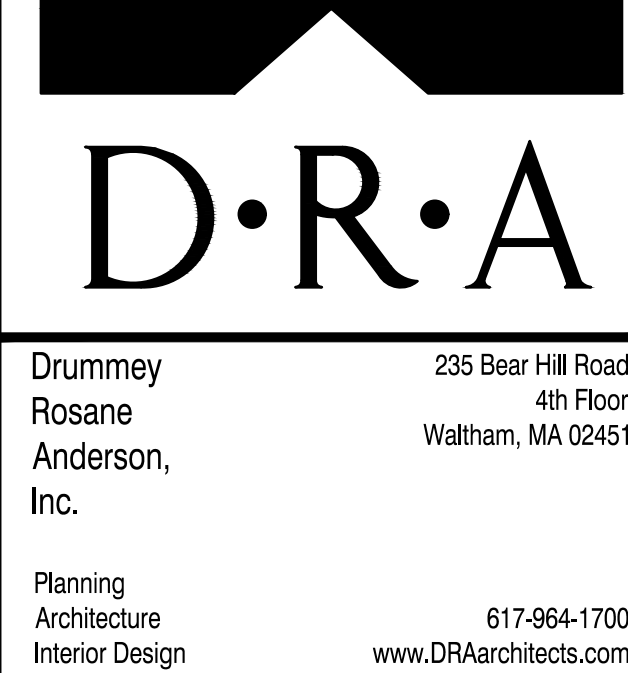
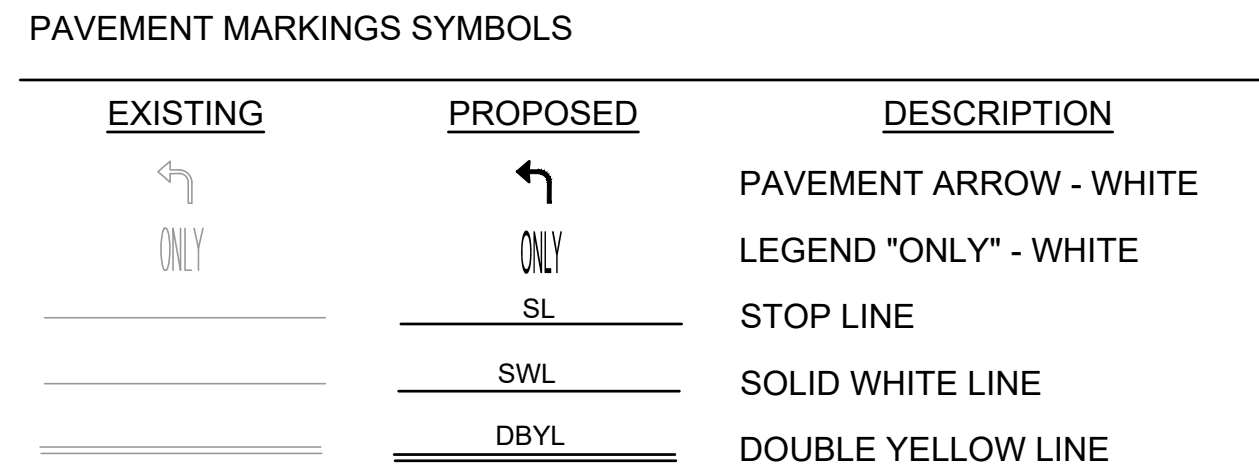
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Date: August 4, 2022

**TR-002**







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# PAVEMENT MARKING AND SIGNAGE PLAN

Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

**TR-004**

IDENTIFI- CATION NUMBER	SIZE OF SIGN (IN)		TEXT	DIMENSIONS (mm)			NUMBER OF SIGNS REQUIRED	COLOR			POST SIZE AND NUMBER REQUIRED	UNIT AREA IN SQUARE FEET	AREA IN SQUARE FEET
	WIDTH	HEIGHT		LETTER HEIGHT	VERTICAL SPACING	ARROW		BACK- GROUND	LEGEND	BORDER			
R3-7L	36	36	<div>LEFT LANE MUST TURN LEFT</div>	SEE 2003 MUTCD STANDARDS			1	SEE 2003 MUTCD STANDARDS			MTD ON SIGN POST	9.00	9.00
R3-7R	36	36	<div>RIGHT LANE MUST TURN RIGHT</div>				1				MTD ON SIGN POST	9.00	9.00
R10-6A	24	30	<div>STOP HERE ON RED</div>				3				MTD ON SIGN POST	5.00	15.00
R10-12A	30	36	<div>LEFT TURN YIELD ON FLASHING</div>				1				MTD ON MAST ARM	7.50	7.50

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SIGN  
SUMMARY

Scale: 1" = 20'-0"

Job No.: 13872.2

Drawn By: LB

Date: August 4, 2022

TR-005

# MASSACHUSETTS DEPARTMENT OF TRANSPORTATION HIGHWAY DIVISION

## INDEX

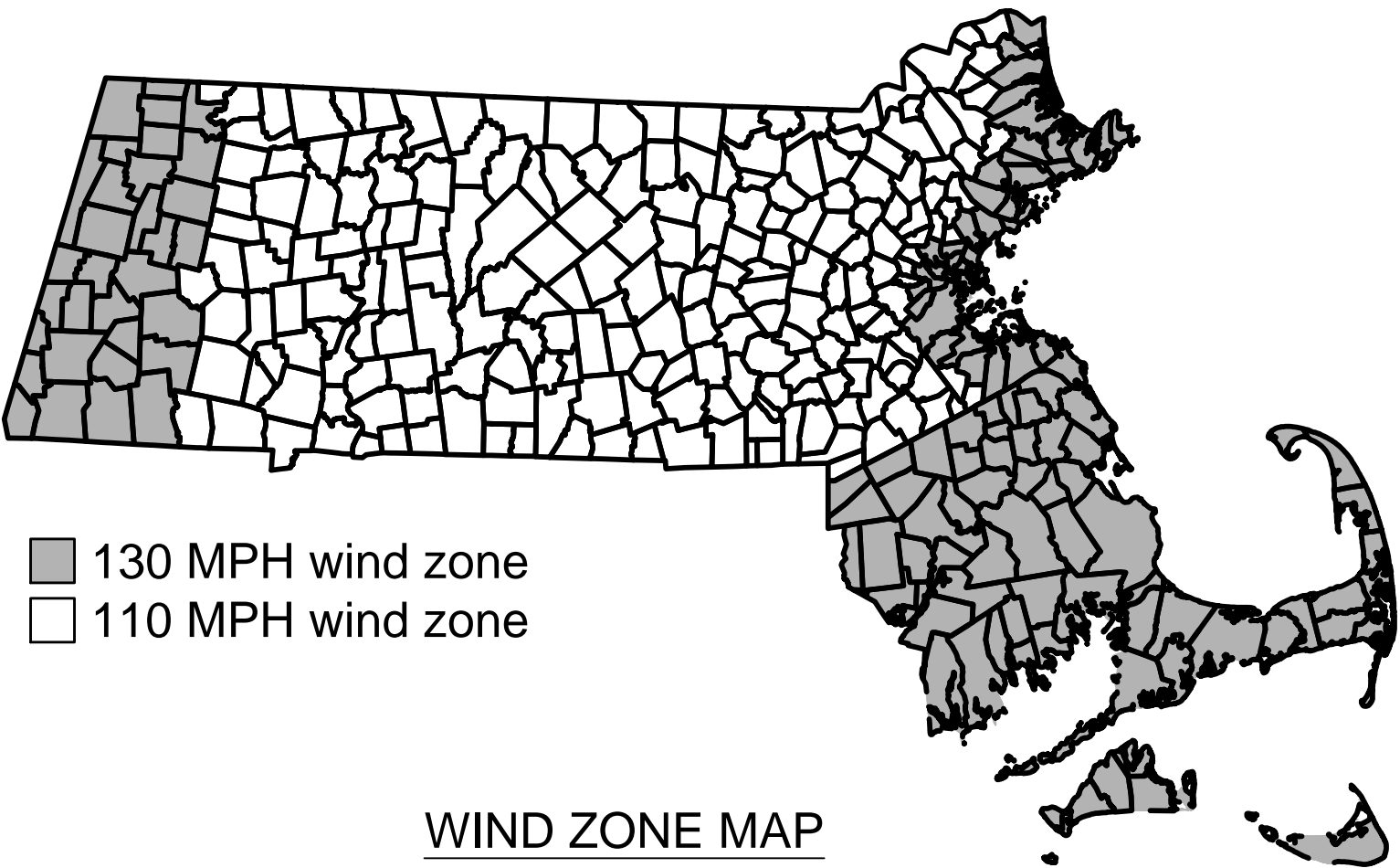
SHEET NO.	DESCRIPTION
1	Title Sheet
2	15' - 40' Arm Load Diagrams
3	45' - 60' Arm Load Diagrams
4	Mast Arm Details
5	Mast Arm Cored Pier Foundations
6	Span Wire Details
7	Span Wire Cored Pier Foundations


All work shall comply to the latest edition of the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* and the latest edition of the Massachusetts Department of Transportation - Highway Division Standard Specifications for Highways and Bridges, including the latest Supplemental and Interim Supplemental Specifications.

# OVERHEAD SIGNAL STRUCTURE & FOUNDATION Standard Drawings

## NOTES

- These drawings are intended to provide standard designs for mast arms and foundations or design standards that must be met for span wire assemblies or non-standard mast arms and their respective foundations.
- If a standard mast arm design is used the Design Engineer shall not propose overhead traffic signal components and signage that exceed the loading conditions depicted on Sheets 2 and 3 of this set.
- For non-standard mast arms, including but not limited to specialty mast arms or mast arms that have loading conditions that exceed what is depicted on Sheets 2 and 3 of this set, it shall be the responsibility of the Design Engineer to submit a design for the structure and foundation that conforms to the latest edition of the AASHTO *Standard Specifications for Strucutural Supports for Highway Signs, Luminaires, and Traffic Signals*.
- For span wire assemblies, the Design Engineer shall provide span length(s) and soil classification at proposed strain pole locations. The contractor shall provide the Design Engineer with shop drawings for the strain poles and foundations that conform to the latest edition of the AASHTO *Standard Specifications for Strucutral Supports for Highway Signs, Luminaires, and Traffic Signals* and are stamped and signed by a Massachusetts Professional Structural Engineer.
- The Design Engineer is responsible for providing soil classification for all overhead signal structures, regardless of type, and for selecting a foundation design for standard mast arms.
- Overhead signal structures and foundations located in the shaded region on the wind zone map shall use a Design Wind Speed of 130 MPH. This region includes all of Plymouth, Bristol, Barnstable, Dukes, Nantucket, Suffolk, and Berkshire counties, and coastal towns in Norfolk, Middlesex, and Essex counties as shown on the wind zone map. A Design Wind Speed of 110 MPH shall be used for all other regions.
- With the exception of Note 8, mast arm structures and strain poles shall have a 50 year Design Life using Fatigue Category No. 2, with truck wind gusts excluded.
- Overhead signal structures located at intersections with an AADT that exceeds 40,000 vehicles per day and a truck percentage of greater than 10% shall utilize a non-standard design. The Design Life shall be 50 years using Fatigue Category No. 1.






STANDARD DRAWINGS  
OVERHEAD SIGNAL STRUCTURE & FOUNDATION  
TITLE SHEET

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION  
HIGHWAY DIVISION  
10 PARK PLAZA BOSTON, MASS  
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SHEET 1 OF 7 SHEETS



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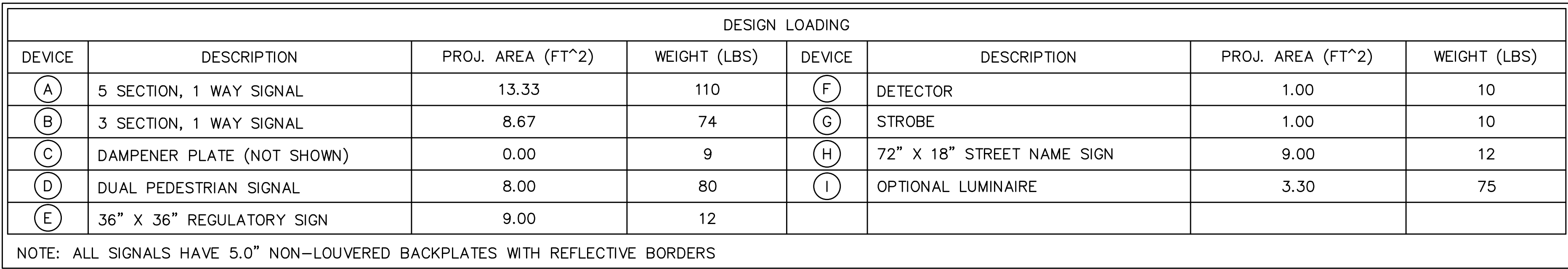
August 4, 2022

TRAFFIC AND  
SIGNALS  
DETAILS

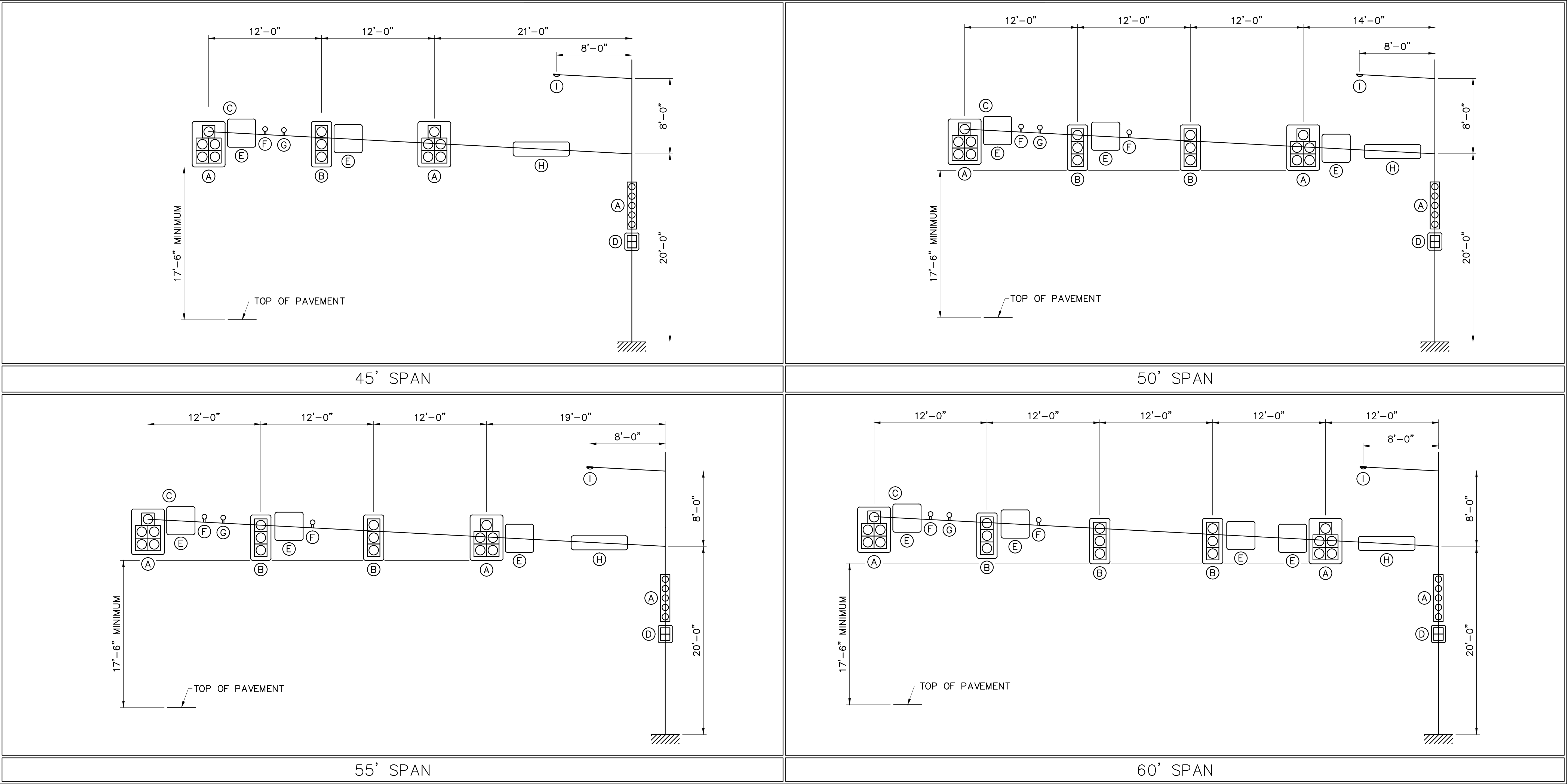
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Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-006






SHEET 2 OF 7 SHEETS




DESIGN LOADING						
DEVICE	DESCRIPTION	PROJ. AREA (FT^2)	WEIGHT (LBS)	DEVICE	DESCRIPTION	WEIGHT (LBS)
(A)	5 SECTION, 1 WAY SIGNAL	13.33	110	(F)	DETECTOR	10
(B)	3 SECTION, 1 WAY SIGNAL	8.67	74	(G)	STROBE	10
(C)	DAMPENER PLATE (NOT SHOWN)	0.00	9	(H)	72" X 18" STREET NAME SIGN	12
(D)	DUAL PEDESTRIAN SIGNAL	8.00	80	(I)	OPTIONAL LUMINAIRE	75
(E)	36" X 36" REGULATORY SIGN	9.00	12			

NOTE: ALL SIGNALS HAVE 5.0" NON-LOUVERED BACKPLATES WITH REFLECTIVE BORDERS



STANDARD DRAWINGS  
OVERHEAD SIGNAL STRUCTURE & FOUNDATION  
45' - 60' ARM  
LOAD DIAGRAMS  
MASSACHUSETTS DEPARTMENT OF TRANSPORTATION  
HIGHWAY DIVISION  
10 PARK PLAZA BOSTON, MASS  
DECEMBER, 2015

SHEET 3 OF 7 SHEETS



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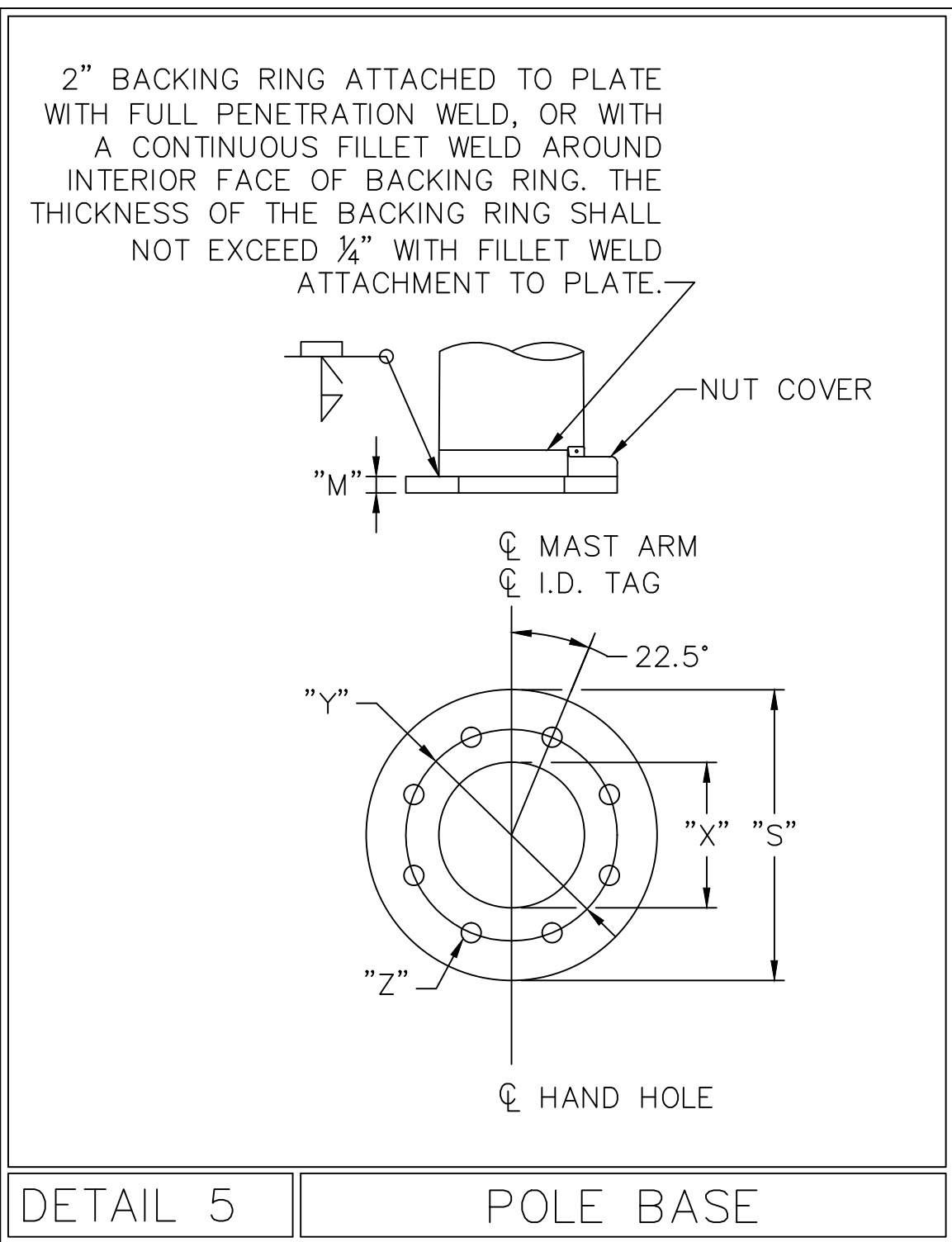
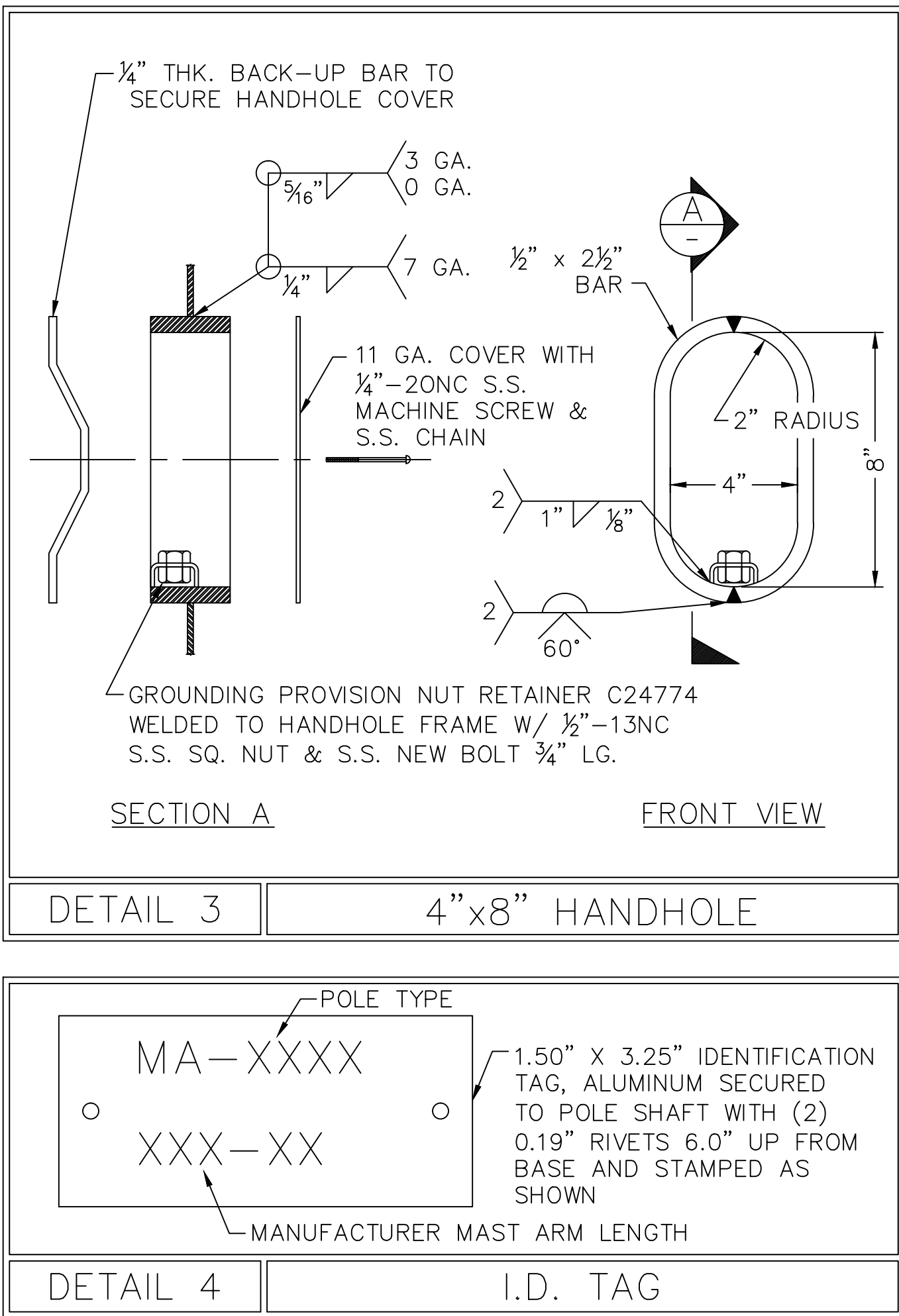
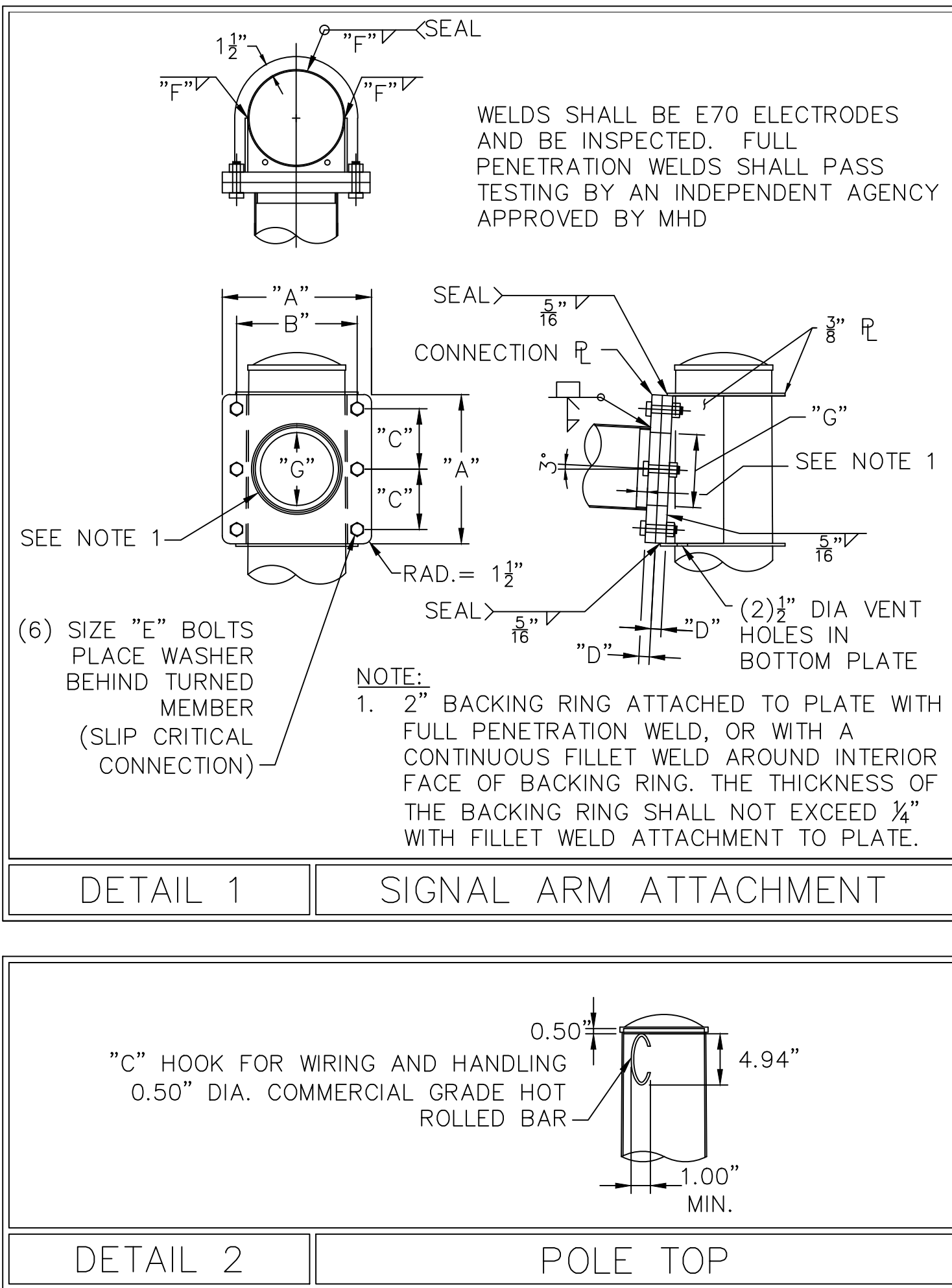
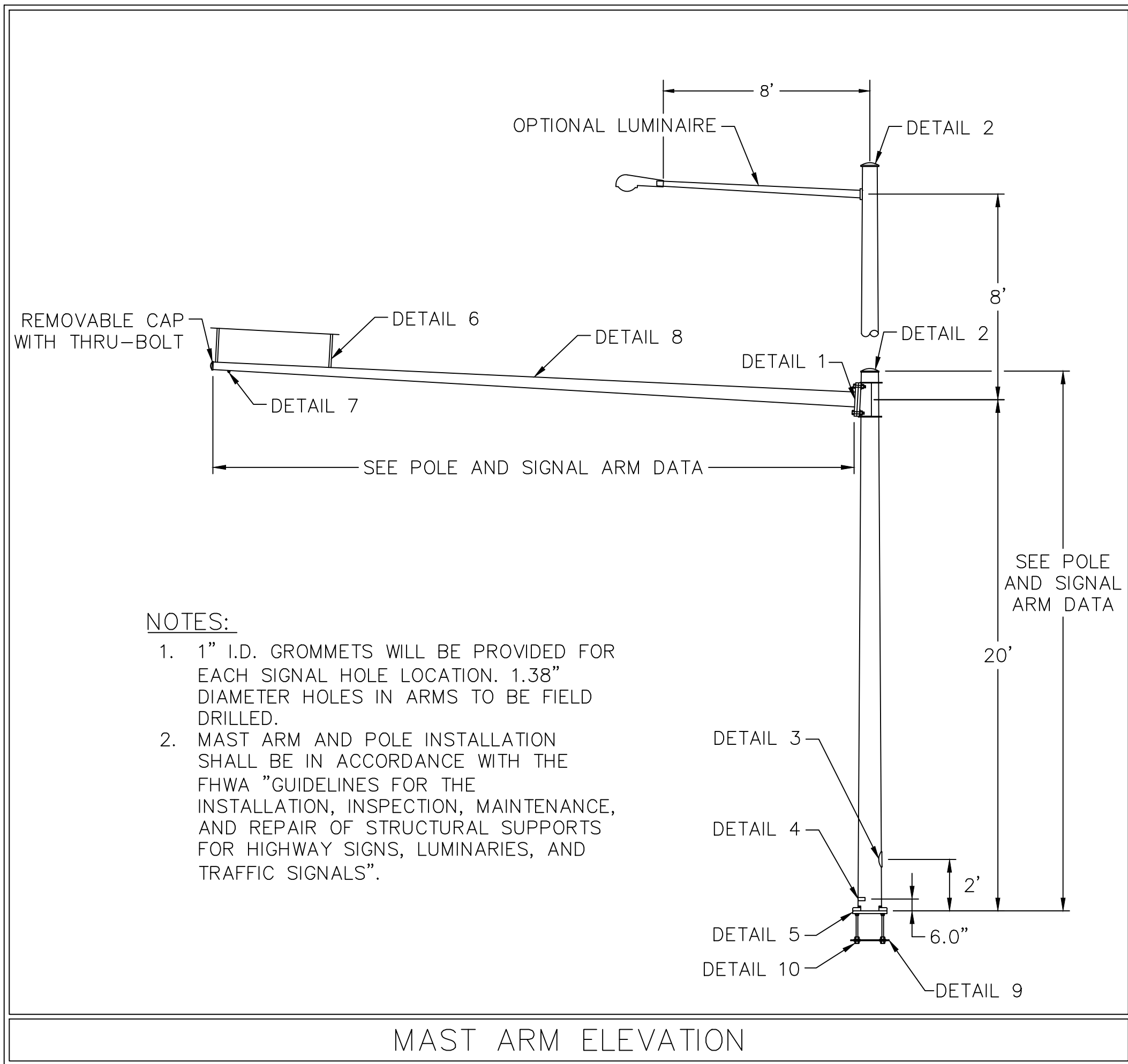
August 4, 2022

TRAFFIC AND  
SIGNALS  
DETAILS

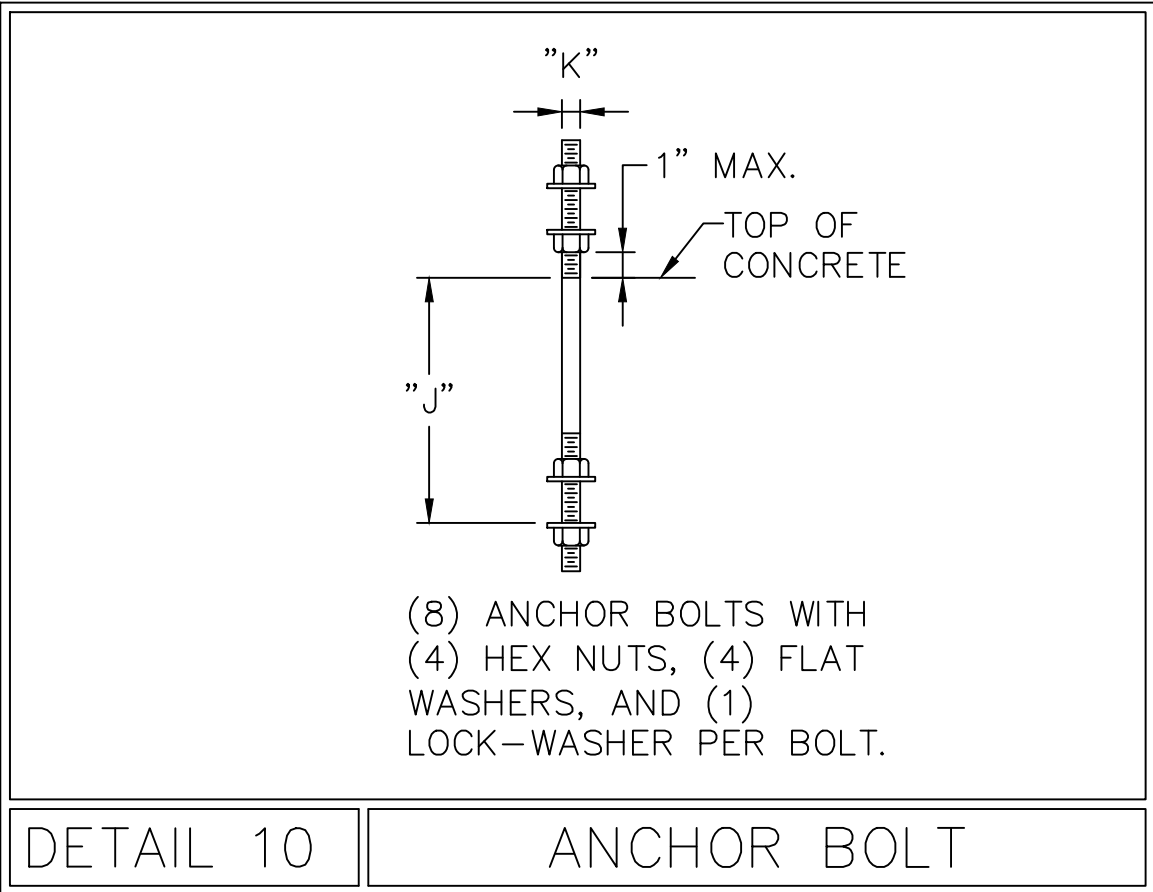
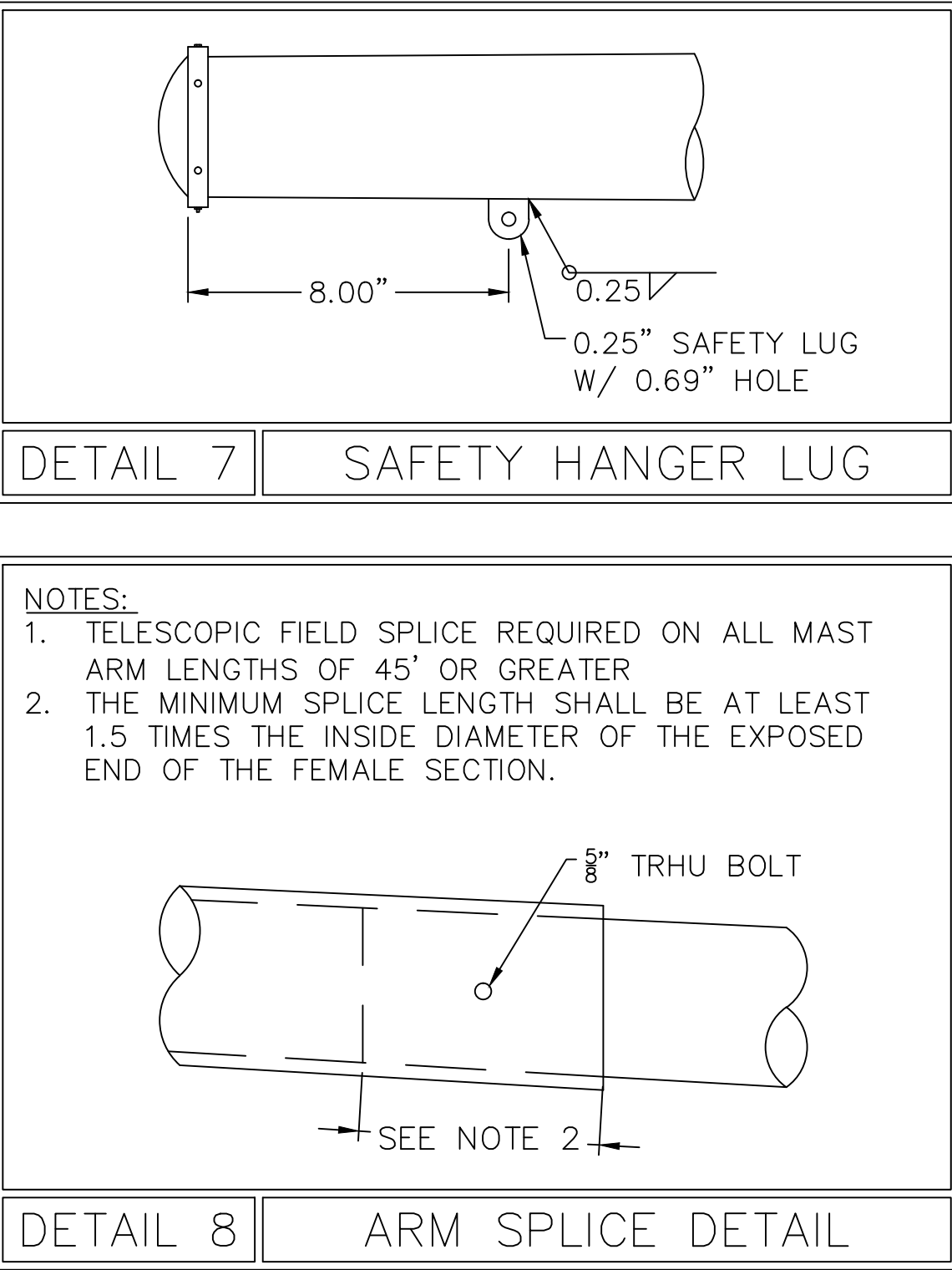
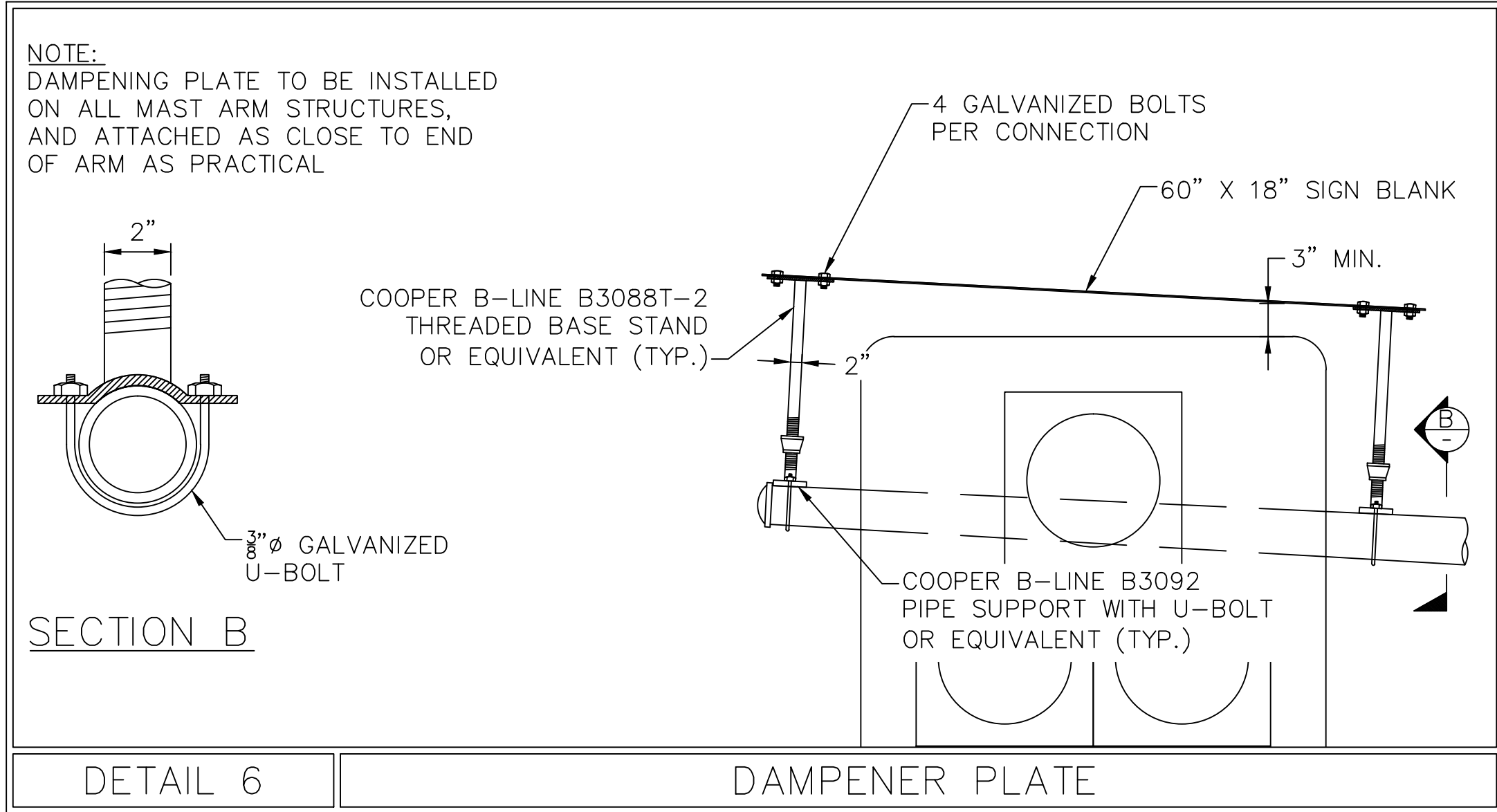
Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-008

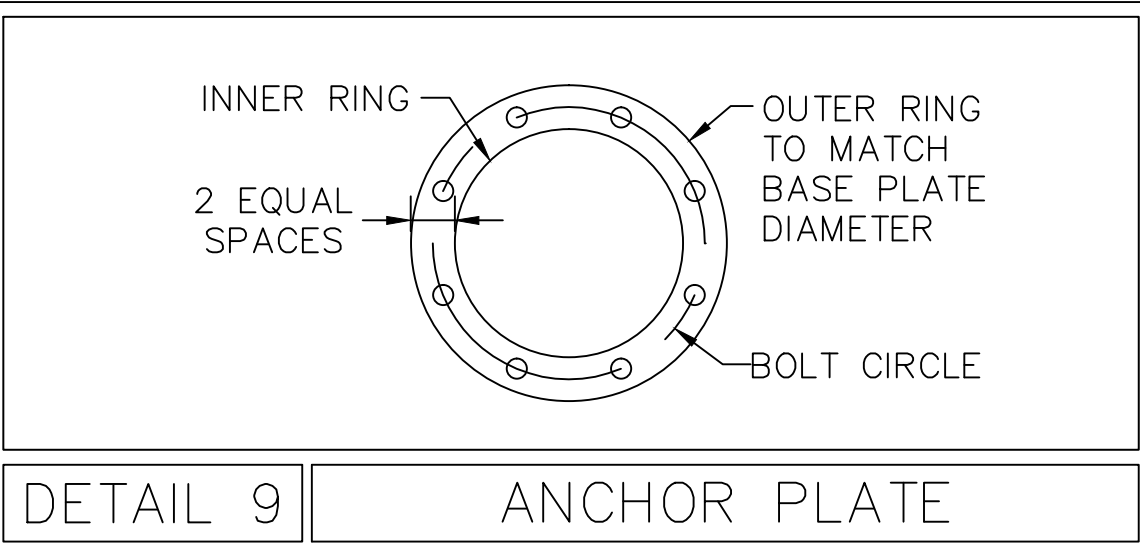




MATERIAL DATA		
COMPONENT	DESIGNATION	YIELD (KSI)
POLE TUBE	ASTM A595 GR. A	55
POLE BASE PLATE	AASHTO M270, OR ASTM A709	50
ANCHOR BOLTS	AASHTO M314, OR ASTM A307 GR. C	55
GALVANIZING	AASHTO M111 OR M232	
ARM TUBE	ASTM A595 GR. A	55
ARM CONNECTION PLATE	AASHTO M270, OR ASTM A709	50
ARM CONNECTING BOLTS	AASHTO M164, OR ASTM A325 **	
** BOLTS WHICH ACCUMULATE RUST OR DIRT SHALL BE DISCARDED.		



POLE AND SIGNAL ARM DATA																		
LOCATIONS	SIGNAL ARM TUBE				POLE TUBE				POLE BASE					ANCHOR BOLT				
	SPAN (FT)	FIXED END DIA. (IN)	FREE END DIA. (IN)	WALL THK.	BASE DIA. (IN)	TOP DIA. (IN)	LENGTH (FT)	WALL THK.	PLATE CIRCLE "S" (IN)	BOLT CIRCLE "Y" (IN)	THK. "M" (IN)	HOLE "Z" (IN)	HOLE "X" (IN)	DIA. "K" (IN)	EMBED. LENGTH "J" (IN)	"A" (IN)	"B" (IN)	"C" (IN)
	15.00	9.00	6.90	7 GA.	13.00	9.92	22.00	7 GA.	24.00	19.00	2.00	1.50	10.00	1.25	36.00	17.25	14.00	7.00
	20.00	9.00	6.20	7 GA.	13.00	9.92	22.00	3 GA.	27.00	22.00	2.00	1.75	10.00	1.50	36.00	17.75	14.50	7.25
	25.00	10.00	6.50	7 GA.	13.00	9.92	22.00	3 GA.	27.00	22.00	2.00	1.75	10.00	1.50	36.00	18.25	15.00	7.50
	30.00	11.00	6.80	7 GA.	13.50	10.42	22.00	3 GA.	27.00	22.00	2.00	1.75	10.50	1.50	36.00	18.75	15.50	7.75
	35.00	12.00	7.10	3 GA.	15.00	11.92	22.00	3 GA.	27.00	22.00	2.00	1.75	12.50	1.50	36.00	20.25	17.00	8.50
	40.00	13.00	7.40	3 GA.	16.00	12.92	22.00	3 GA.	29.00	24.00	2.00	2.00	12.00	1.75	36.00	21.25	18.00	9.00
	45.00	13.50	7.20	3 GA.	17.50	14.42	22.00	3 GA.	29.00	24.00	2.00	2.00	12.00	1.75	48.00	22.25	19.00	9.50
	50.00	14.50	7.50	3 GA.	17.00	13.92	22.00	0 GA.	29.00	24.00	2.00	2.00	12.00	1.75	48.00	22.75	19.50	9.75
	55.00	16.00	8.30	3 GA.	18.00	14.92	22.00	0 GA.	31.00	26.00	2.00	2.25	12.00	2.00	48.00	23.75	20.00	10.00
	60.00	16.00	8.00	0 GA.	19.50	16.42	22.00	0 GA.	31.00	26.00	2.00	2.25	14.00	2.00	48.00	25.75	22.00	11.00



**massDOT**  
Highway Division  
STANDARD DRAWINGS  
OVERHEAD SIGNAL STRUCTURE & FOUNDATION  
MAST ARM DETAILS

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION  
HIGHWAY DIVISION  
10 PARK PLAZA BOSTON, MASS

DECEMBER, 2015

SHEET 4 OF 7 SHEETS

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**TRAFFIC AND SIGNALS DETAILS**

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Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

**TR-009**

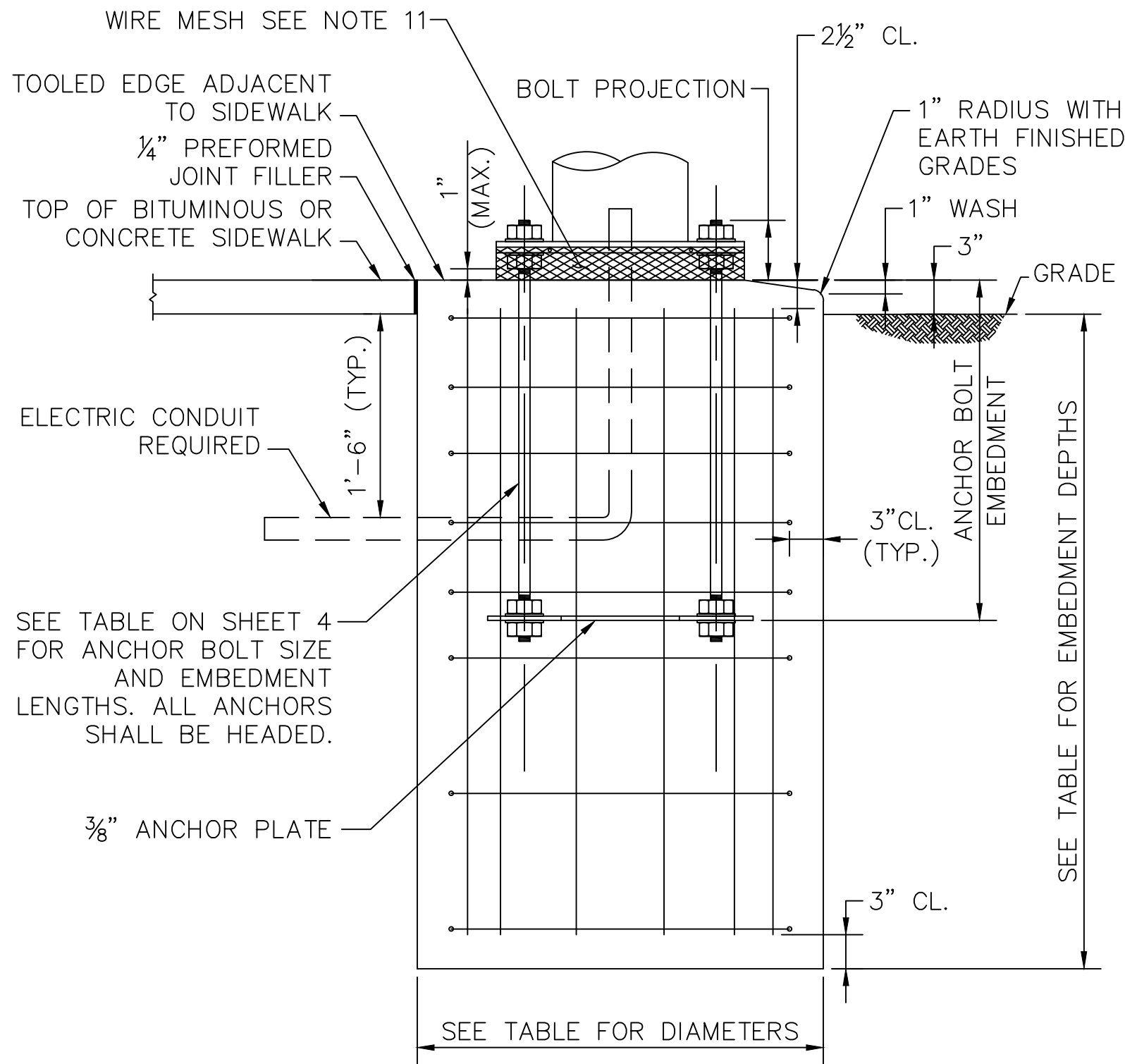
PIER FOUNDATIONS FOR 110 MPH WIND SPEED ZONE																				
SOIL TYPE	15' & 20' MAST ARMS				25' & 30' MAST ARMS				35' & 40' MAST ARMS				45' & 50' MAST ARMS				55' & 60' MAST ARMS			
	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS
DRY SAND (LOOSE)	3'-6"	8'-6"	18-#8	#5 @ 12"	3'-6"	9'-0"	18-#8	#5 @ 12"	3'-6"	11'-6"	18-#8	#5 @ 9"	4'-0"	12'-0"	18-#9	#5 @ 9"	4'-6"	13'-0"	18-#10	#5 @ 6"
DRY SAND (DENSE)	3'-6"	7'-6"	18-#8	#5 @ 12"	3'-6"	7'-6"	18-#8	#5 @ 12"	3'-6"	8'-6"	18-#8	#5 @ 9"	4'-0"	9'-0"	18-#9	#5 @ 9"	4'-6"	9'-6"	18-#10	#5 @ 6"
WET SAND (LOOSE)	3'-6"	9'-6"	18-#8	#5 @ 12"	3'-6"	11'-6"	18-#8	#5 @ 12"	3'-6"	14'-6"	18-#8	#5 @ 9"	4'-0"	15'-6"	18-#9	#5 @ 9"	4'-6"	16'-6"	18-#10	#5 @ 6"
WET SAND (DENSE)	3'-6"	8'-6"	18-#8	#5 @ 12"	3'-6"	9'-0"	18-#8	#5 @ 12"	3'-6"	10'-6"	18-#8	#5 @ 9"	4'-0"	11'-6"	18-#9	#5 @ 9"	4'-6"	12'-0"	18-#10	#5 @ 6"
CLAY (SOFT TO MEDIUM STIFF)	3'-6"	12'-0"	18-#8	#5 @ 12"	3'-6"	12'-0"	18-#8	#5 @ 12"	3'-6"	13'-0"	18-#8	#5 @ 9"	4'-0"	14'-0"	18-#9	#5 @ 9"	4'-6"	15'-6"	18-#10	#5 @ 6"
CLAY (STIFF)	3'-6"	10'-6"	18-#8	#5 @ 12"	3'-6"	10'-6"	18-#8	#5 @ 12"	3'-6"	11'-0"	18-#8	#5 @ 9"	4'-0"	12'-0"	18-#9	#5 @ 9"	4'-6"	13'-6"	18-#10	#5 @ 6"

PIER FOUNDATIONS FOR 130 MPH WIND SPEED ZONE																				
SOIL TYPE	15' & 20' MAST ARMS				25' & 30' MAST ARMS				35' & 40' MAST ARMS				45' & 50' MAST ARMS				55' & 60' MAST ARMS			
	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS	DIAMETER	DEPTH	VERT. BARS	TIE BARS
DRY SAND (LOOSE)	3'-6"	10'-0"	18-#8	#5 @ 12"	3'-6"	10'-6"	18-#8	#5 @ 12"	3'-6"	13'-6"	18-#8	#5 @ 8"	4'-0"	14'-6"	18-#9	#5 @ 6"	4'-6"	15'-6"	18-#10	#5 @ 5"
DRY SAND (DENSE)	3'-6"	8'-6"	18-#8	#5 @ 12"	3'-6"	9'-0"	18-#8	#5 @ 12"	3'-6"	10'-0"	18-#8	#5 @ 8"	4'-0"	11'-0"	18-#9	#5 @ 6"	4'-6"	11'-6"	18-#10	#5 @ 5"
WET SAND (LOOSE)	3'-6"	11'-6"	18-#8	#5 @ 12"	3'-6"	13'-6"	18-#8	#5 @ 12"	3'-6"	17'-0"	18-#8	#5 @ 8"	4'-0"	18'-6"	18-#9	#5 @ 6"	4'-6"	19'-6"	18-#10	#5 @ 5"
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CLAY (SOFT TO MEDIUM STIFF)	3'-6"	12'-6"	18-#8	#5 @ 12"	3'-6"	13'-0"	18-#8	#5 @ 12"	3'-6"	14'-0"	18-#8	#5 @ 8"	4'-0"	16'-0"	18-#9	#5 @ 6"	4'-6"	17'-6"	18-#10	#5 @ 5"
CLAY (STIFF)	3'-6"	11'-0"	18-#8	#5 @ 12"	3'-6"	11'-0"	18-#8	#5 @ 12"	3'-6"	12'-0"	18-#8	#5 @ 8"	4'-0"	13'-0"	18-#9	#5 @ 6"	4'-6"	14'-0"	18-#10	#5 @ 5"

BASIS OF DESIGN			
ALL MAST ARM STRUCTURES AND FOUNDATIONS ARE DESIGNED IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, SIXTH EDITION 2013, AND THE FOLLOWING PARAMETERS:			
OVERTURNING DESIGN	FOUNDATIONS ARE SIZED TO RESIST OVERTURNING ACCORDING TO BROMS' DESIGN METHOD WITH A SAFETY FACTOR THAT INCLUDES AN OVERLOAD FACTOR OF 2.0 AND A SOIL UNDERSTRENGTH FACTOR OF 0.7.		
SOIL PARAMETERS	LOOSE DRY SAND:	UNIT WEIGHT $\gamma = 102$ PCF	FRICTION ANGLE $\phi = 33^\circ$
	DENSE DRY SAND:	$\gamma = 116$ PCF	$\phi = 39^\circ$
	LOOSE WET SAND:	$\gamma = 125$ PCF	$\phi = 33^\circ$
	DENSE WET SAND:	$\gamma = 135$ PCF	$\phi = 39^\circ$
	SOFT TO MEDIUM STIFF CLAY:	UNIT WEIGHT $\gamma = 113$ PCF	SHEAR STRENGTH $S_u = 1.0$ KSF
DEFLECTION LIMITS	STIFF CLAY:	$\gamma = 120$ PCF	$S_u = 1.9$ KSF
		MAXIMUM LATERAL DEFLECTION AT TOP OF MAST ARM FOUNDATION SHAFTS: $\frac{1}{8}"$	

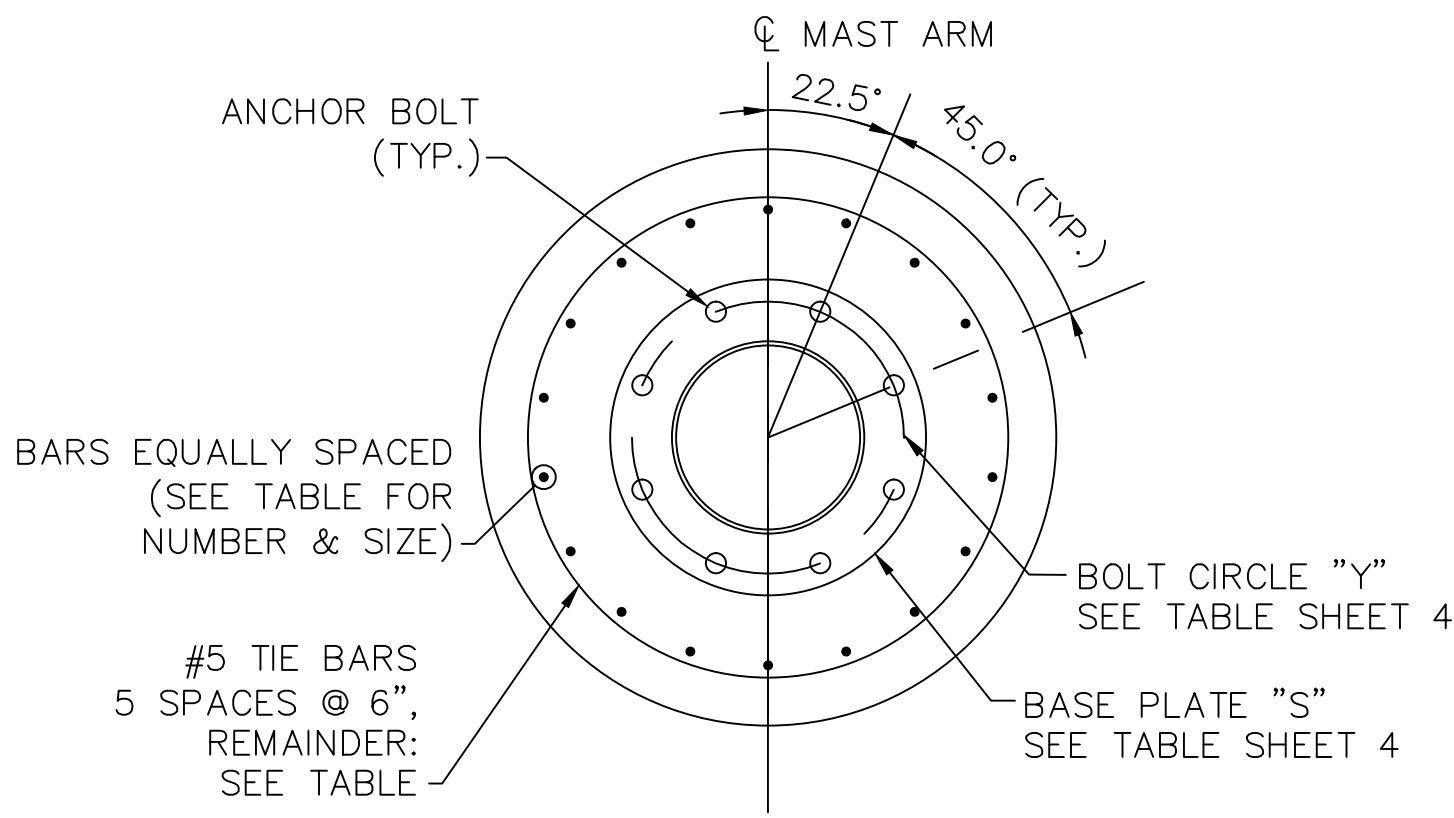
NOTES:

- FOUNDATIONS SHALL BE 4000 PSI, 565 MASSDOT APPROVED MIX DESIGN.
- FOUNDATIONS SHALL BE INSTALLED IN ACCORDANCE WITH MASSDOT STANDARD SPECIFICATIONS ITEM 945 – DRILLED SHAFTS
- REINFORCEMENT SHALL BE ASTM A615 GRADE 60.
- ANCHOR BOLTS SHALL BE SET BY TEMPLATE.
- PROVIDE FOR ELECTRICAL CONDUIT.
- EXCAVATION SHALL BE BY THE AUGER METHOD TO THE NEAT LINES OF THE OUTSIDE DIMENSION OF THE FOUNDATIONS WITHOUT DISTURBING THE SOIL AROUND AND BELOW THE PROPOSED FOUNDATION BOTTOM. ALTERNATE METHODS OF EXCAVATION MAY BE SUBMITTED TO MASSDOT FOR APPROVAL IF THEY MEET THE REQUIREMENTS LISTED IN NOTES 6, 7, AND 8.
- THE EARTH WALLS OF THE FOUNDATION SHALL BE ADEQUATELY AND SECURELY PROTECTED AT ALL TIMES AGAINST CAVE-INS, DISPLACEMENT OF THE SURROUNDING EARTH AND FOR THE EXCLUSION OF GROUND WATER. THIS MAY BE DONE BY THE USE OF STEEL CYLINDER LINERS OR CASINGS THAT ARE APPROVED BY MASSDOT. IF LINERS ARE USED THEY MAY BE RECLAIMED PROVIDED THAT THEY ARE WITHDRAWN AS THE CONCRETE IS BEING PLACED, MAINTAINING A SUFFICIENT HEAD OF CONCRETE WITHIN THE LINER TO PREVENT REDUCTION IN THE FOUNDATION DIAMETER AND TO PREVENT EXTRANEQOUS MATERIAL FROM FALLING IN FROM THE SIDES AND MIXING WITH THE CONCRETE.
- IF THE SOIL IS DISTURBED OR REMOVED BEYOND THE NEAT LINES OF THE OUTSIDE DIMENSION OF THE FOUNDATION, IT SHALL BE REPLACED WITH CONCRETE. ANY ADDITIONAL COST FOR THE CONCRETE SHALL BE PAID FOR BY THE CONTRACTOR.
- SPECIAL CARE SHOULD BE GIVEN TO AREAS WHERE WET SOIL IS ENCOUNTERED, TO INSURE THAT THE PREAUGERED HOLE DOES NOT COLLAPSE. THIS MAY REQUIRE THE USE OF STEEL CYLINDER LINERS OR CASINGS TO HOLD THE SOIL IN PLACE UNTIL READY FOR CONCRETE PLACEMENT, UPON APPROVAL FROM THE MASSDOT. THE STEEL CYLINDERS OR CASINGS SHALL BE WITHDRAWN AS THE FOUNDATION CONCRETE IS PLACED.
- IF LEDGE OR UNSUITABLE SOIL IS ENCOUNTERED (i.e. ONE WHICH DOES NOT APPLY TO THE DESIGN TABLES SHOWN ON THIS SHEET), AN ALTERNATIVE DESIGN SHALL BE PROVIDED BY THE DESIGN ENGINEER. IF UTILITIES OR OTHER UNDERGROUND OBSTRUCTIONS ARE ENCOUNTERED, THE CONTRACTOR SHALL BACKFILL THE AREA TO ITS ORIGINAL CONDITION UNTIL AN ALTERNATE DESIGN HAS BEEN PROVIDED BY THE DESIGN ENGINEER AND APPROVED BY MASSDOT. SPECIAL FOUNDATIONS SHALL BE DESIGNED IN ACCORDANCE WITH BASIS OF DESIGN TABLE ABOVE.
- A GALVANIZED WIRE MESH SCREEN SHALL BE INSTALLED AT BASE OF POLE. SCREEN SHALL BE PRESS-FORMED OF 3 OR 4 MESH, 21 GAGE OR HEAVIER, STAINLESS STEEL OR HOT DIPPED GALVANIZED WIRE SCREEN OR APPROVED EQUIVALENT. SCREEN SHALL BE SCREWED INTO POLE BASE PLATE, AND SHALL BE FLUSH WITH THE TOP OF THE PIER FOUNDATION.
- SANDY SOILS WITH STANDARD PENETRATION VALUES GREATER THAN 20 BLOWS PER FOOT SHALL BE CLASSIFIED AS DENSE DRY SAND AND DENSE WET SAND. SANDY SOILS WITH STANDARD PENETRATION VALUES RANGING FROM 6 TO 20 BLOWS PER FOOT SHALL BE CLASSIFIED LOOSE DRY SAND AND LOOSE WET SAND. SANDY SOILS WITH FEWER THAN 6 BLOWS PER FOOT SHALL REQUIRE SPECIAL FOUNDATION DESIGNS BY THE DESIGN ENGINEER AND APPROVED BY MASSDOT. SPECIAL FOUNDATIONS SHALL BE DESIGNED IN ACCORDANCE WITH BASIS OF DESIGN TABLE ABOVE.
- CLAYS WITH STANDARD PENETRATION VALUES GREATER THAN 6 BLOWS PER FOOT SHALL BE CLASSIFIED AS STIFF CLAY. CLAYS WITH STANDARD PENETRATION VALUES RANGING FROM 2 TO 6 BLOWS PER FOOT SHALL BE CLASSIFIED AS SOFT TO MEDIUM STIFF CLAY. CLAYS WITH FEWER THAN 2 BLOWS PER FOOT SHALL REQUIRE SPECIAL FOUNDATION DESIGNS BY THE DESIGN ENGINEER AND APPROVED BY MASSDOT. SPECIAL FOUNDATIONS SHALL BE DESIGNED IN ACCORDANCE WITH BASIS OF DESIGN TABLE ABOVE.
- A SANDY SOIL SHALL ONLY BE CLASSIFIED AS 'DRY' IF THE ENTIRE DRY SAND SHAFT LENGTH SITS ABOVE WET SOILS ACCORDING TO THE BORING LOGS. IF ANY PART OF THE SHAFT LENGTH IS CAST AT OR BELOW THE GROUNDWATER LEVEL, THE SOIL SHALL BE CLASSIFIED AS 'WET'.
- WHERE THE PREDOMINATING SOIL TYPE IS INORGANIC SILT, THE SOIL SHOULD BE TREATED AS CLAY OR WET LOOSE SAND, WHICHEVER LEADS TO A MORE CONSERVATIVE FOUNDATION. INORGANIC SILTS WITH STANDARD PENETRATION N-VALUES LESS THAN 2 BLOWS PER FOOT, ORGANIC SILTS, AND PEAT SHALL REQUIRE SPECIAL FOUNDATION DESIGNS BY THE DESIGN ENGINEER AND APPROVED BY MASSDOT. SPECIAL FOUNDATIONS SHALL BE DESIGNED IN ACCORDANCE WITH BASIS OF DESIGN TABLE ABOVE.
- WHERE FILL CONTAINS CLAY OR SILT, IT SHOULD BE TREATED AS SOFT CLAY.
- MAST ARM FOUNDATIONS ARE DESIGNED TO SUPPORT MAST ARMS WITH OR WITHOUT OPTIONAL LUMINAIRE.
- CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT FOUNDATION DIAMETER IS AT LEAST 17.5" GREATER THAN BOLT CIRCLE DIAMETER FOR ALL STRUCTURES
- IN ORDER TO CREATE A FLUSH SURFACE, CONTRACTOR SHALL REFER TO THE FINAL ELEVATIONS SHOWN ON THE DESIGN PLANS WHEN INSTALLING FOUNDATIONS IMMEDIATELY ADJACENT TO OR WITHIN A SIDEWALK AREA.




PIER FOUNDATION DETAIL

NO SCALE



PIER FOUNDATION PLAN

NO SCALE




STANDARD DRAWINGS

OVERHEAD SIGNAL STRUCTURE & FOUNDATION  
MAST ARM CORED PIER FOUNDATIONS

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION  
HIGHWAY DIVISION  
10 PARK PLAZA BOSTON, MASS

DECEMBER, 2015

SHEET 5 OF 7 SHEETS



Drummey  
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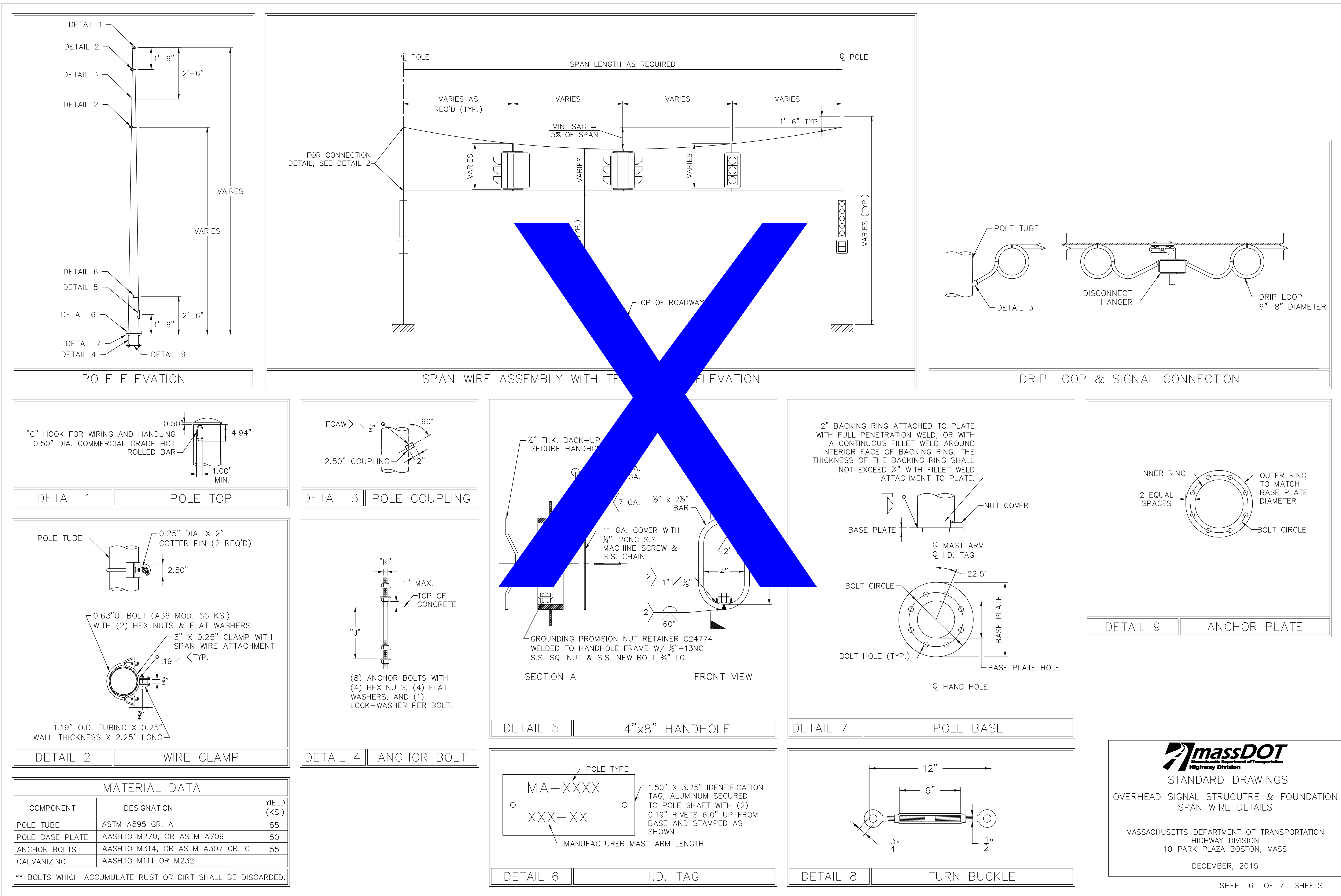
August 4, 2022

TRAFFIC AND  
SIGNALS  
DETAILS

Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-010





**NORTHEAST  
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Massachusetts



MSBA DESIGN  
DEVELOPMENT  
SUBMISSION

August 4, 2022

**TRAFFIC AND  
SIGNALS  
DETAILS**

Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-011



SOIL TYPE: DRY SAND (LOOSE)						
MOMENT AT BASE OF POLE (KIP-FT.)	DIA. (B) = 3'-0"		DIA. (B) = 3'-6"		DIA. (B) = 4'-0"	
	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS
100 OR LESS	11'-6"	18 - #8	10'-6"	18 - #8	10'-0"	18 - #9
150	12'-0"	18 - #8	11'-6"	18 - #8	11'-0"	18 - #9
200	13'-0"	18 - #8	12'-6"	18 - #8	12'-0"	18 - #9
250	13'-6"	18 - #8	13'-0"	18 - #8	12'-6"	18 - #9
300	-	-	13'-6"	18 - #8	13'-0"	18 - #9
350	-	-	14'-0"	18 - #8	13'-6"	18 - #9
400	-	-	14'-6"	18 - #8	14'-0"	18 - #9
450	-	-	15'-0"	18 - #8	14'-6"	18 - #9
500	-	-	15'-6"	18 - #8	15'-0"	18 - #9
550	-	-	16'-0"	18 - #8	15'-0"	18 - #9
600	-	-	16'-6"	18 - #8	15'-6"	18 - #9
650	-	-	-	-	16'-0"	18 - #9
700	-	-	-	-	16'-6"	18 - #9

SOIL TYPE: WET SAND (LOOSE)						
MOMENT AT BASE OF POLE (KIP-FT.)	DIA. (B) = 3'-0"		DIA. (B) = 3'-6"		DIA. (B) = 4'-0"	
	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS
100 OR LESS	13'-6"	18 - #8	12'-6"	18 - #8	12'-0"	18 - #9
150	14'-6"	18 - #8	13'-6"	18 - #8	13'-0"	18 - #9
200	15'-6"	18 - #8	14'-6"	18 - #8	14'-0"	18 - #9
250	16'-0"	18 - #8	15'-6"	18 - #8	14'-6"	18 - #9
300	-	-	16'-0"	18 - #8	15'-6"	18 - #9
350	-	-	16'-6"	18 - #8	16'-0"	18 - #9
400	-	-	17'-0"	18 - #8	16'-6"	18 - #9
450	-	-	18'-0"	18 - #8	17'-0"	18 - #9
500	-	-	18'-0"	18 - #8	17'-6"	18 - #9
550	-	-	18'-6"	18 - #8	18'-0"	18 - #9
600	-	-	19'-0"	18 - #8	18'-6"	18 - #9
650	-	-	-	-	18'-6"	18 - #9
700	-	-	-	-	19'-0"	18 - #9

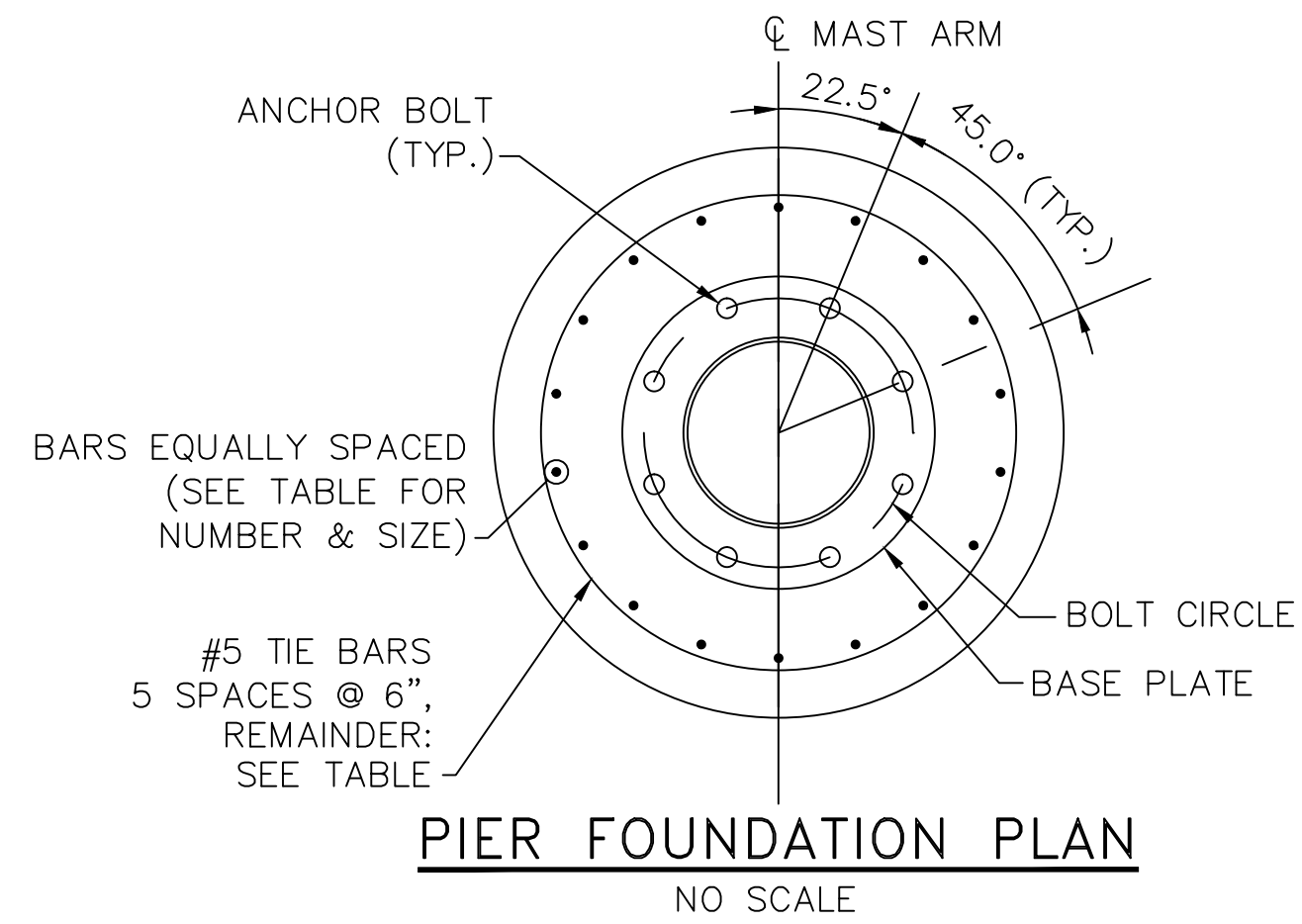
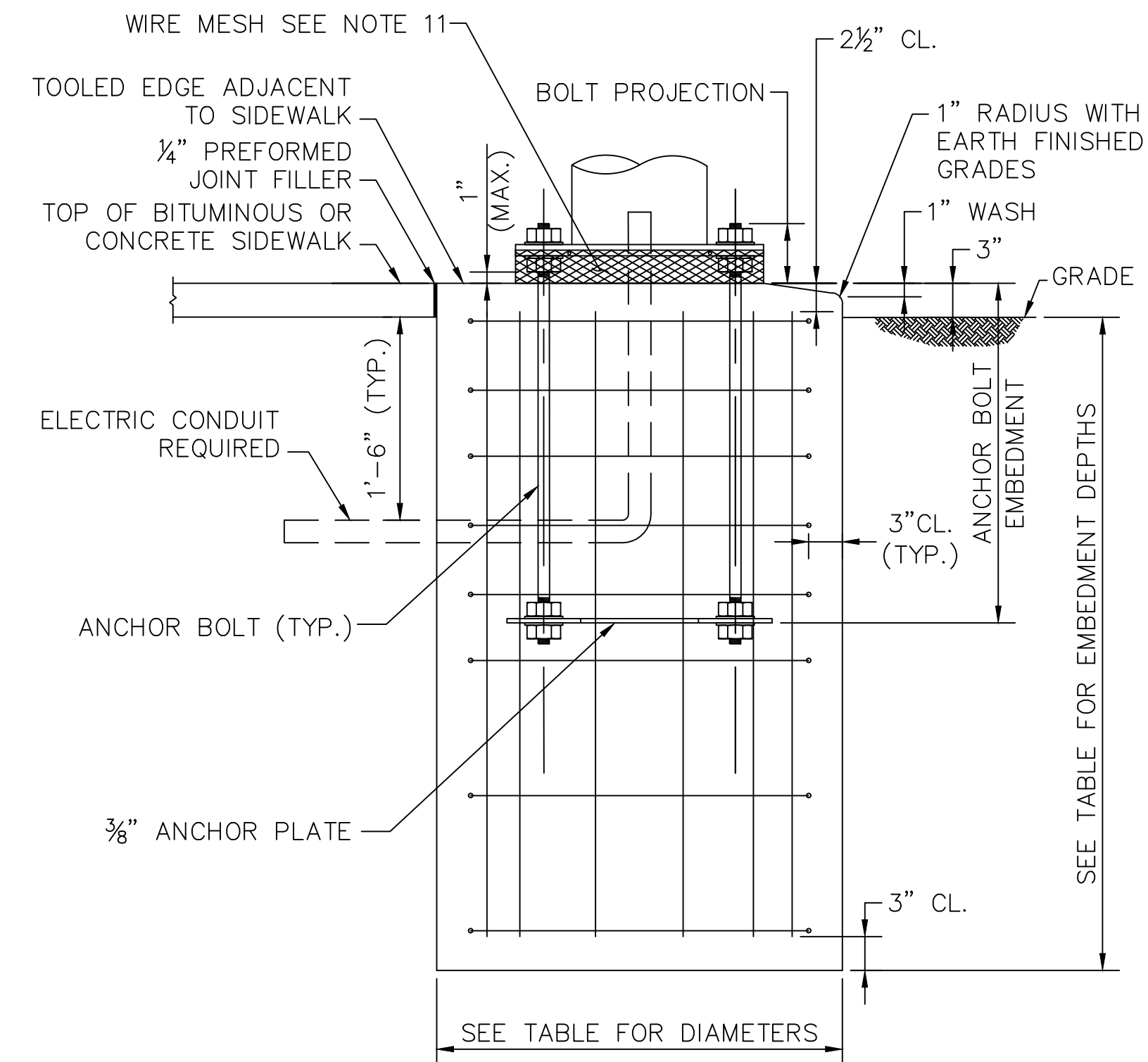
SOIL TYPE: CLAY (SOFT TO MEDIUM STIFF)						
MOMENT AT BASE OF POLE (KIP-FT.)	DIA. (B) = 3'-0"		DIA. (B) = 3'-6"		DIA. (B) = 4'-0"	
	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS
100 OR LESS	14'-6"	18 - #8	14'-6"	18 - #8	15'-0"	18 - #9
150	15'-6"	18 - #8	15'-6"	18 - #8	16'-0"	18 - #9
200	16'-6"	18 - #8	16'-6"	18 - #8	17'-0"	18 - #9
250	17'-6"	18 - #8	17'-6"	18 - #8	17'-6"	18 - #9
300	-	-	18'-6"	18 - #8	18'-6"	18 - #9
350	-	-	19'-0"	18 - #8	19'-0"	18 - #9
400	-	-	20'-0"	18 - #8	20'-0"	18 - #9
450	-	-	20'-6"	18 - #8	20'-6"	18 - #9
500	-	-	21'-6"	18 - #8	21'-0"	18 - #9
550	-	-	22'-0"	18 - #8	21'-6"	18 - #9
600	-	-	22'-6"	18 - #8	22'-6"	18 - #9
650	-	-	-	-	23'-0"	18 - #9
700	-	-	-	-	23'-6"	18 - #9

SOIL TYPE: DRY SAND (DENSE)						
MOMENT AT BASE OF POLE (KIP-FT.)	DIA. (B) = 3'-0"		DIA. (B) = 3'-6"		DIA. (B) = 4'-0"	
	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS
100 OR LESS	10'-0"	18 - #8	9'-6"	18 - #8	9'-0"	18 - #9
150	10'-6"	18 - #8	10'-0"	18 - #8	10'-0"	18 - #9
200	11'-6"	18 - #8	11'-0"	18 - #8	10'-6"	18 - #9
250	12'-0"	18 - #8	11'-6"	18 - #8	11'-0"	18 - #9
300	-	-	12'-0"	18 - #8	11'-6"	18 - #9
350	-	-	12'-6"	18 - #8	12'-0"	18 - #9
400	-	-	13'-0"	18 - #8	12'-6"	18 - #9
450	-	-	13'-6"	18 - #8	13'-0"	18 - #9
500	-	-	13'-6"	18 - #8	13'-0"	18 - #9
550	-	-	14'-0"	18 - #8	13'-6"	18 - #9
600	-	-	14'-6"	18 - #8	14'-0"	18 - #9
650	-	-	-	-	14'-0"	18 - #9
700	-	-	-	-	14'-6"	18 - #9

SOIL TYPE: WET SAND (DENSE)						
MOMENT AT BASE OF POLE (KIP-FT.)	DIA. (B) = 3'-0"		DIA. (B) = 3'-6"		DIA. (B) = 4'-0"	
	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS
100 OR LESS	11'-6"	18 - #8	10'-6"	18 - #8	10'-6"	18 - #9
150	12'-6"	18 - #8	11'-6"	18 - #8	11'-6"	18 - #9
200	13'-6"	18 - #8	12'-6"	18 - #8	12'-0"	18 - #9
250	14'-0"	18 - #8	13'-6"	18 - #8	13'-0"	18 - #9
300	-	-	13'-6"	18 - #8	13'-6"	18 - #9
350	-	-	14'-0"	18 - #8	14'-0"	18 - #9
400	-	-	14'-6"	18 - #8	14'-6"	18 - #9
450	-	-	15'-6"	18 - #8	15'-6"	18 - #9
500	-	-	16'-0"	18 - #8	16'-0"	18 - #9
550	-	-	16'-6"	18 - #8	16'-6"	18 - #9
600	-	-	16'-6"	18 - #8	16'-6"	18 - #9
650	-	-	-	-	16'-6"	18 - #9
700	-	-	-	-	16'-6"	18 - #9

SOIL TYPE: CLAY (STIFF)						
MOMENT AT BASE OF POLE (KIP-FT.)	DIA. (B) = 3'-0"		DIA. (B) = 3'-6"		DIA. (B) = 4'-0"	
	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS	DEPTH (D)	VERTICAL BARS
100 OR LESS	12'-0"	18 - #8	12'-0"	18 - #8	12'-6"	18 - #9
150	12'-6"	18 - #8	13'-0"	18 - #8	13'-6"	18 - #9
200	13'-6"	18 - #8	13'-6"	18 - #8	14'-0"	18 - #9
250	14'-0"	18 - #8	14'-6"	18 - #8	14'-6"	18 - #9
300	-	-	15'-0"	18 - #8	15'-0"	18 - #9
350	-	-	15'-6"	18 - #8	16'-0"	18 - #9
400	-	-	16'-0"	18 - #8	16'-6"	18 - #9
450	-	-	16'-6"	18 - #8	16'-6"	18 - #9
500	-	-	17'-0"	18 - #8	17'-0"	18 - #9
550	-	-	17'-6"	18 - #8	17'-6"	18 - #9
600	-	-	18'-0"	18 - #8	18'-0"	18 - #9
650	-	-	-	-	18'-6"	18 - #9
700	-	-	-	-	19'-0"	18 - #9

NOTES:  
SEE NOTES SHEET 5 OF 7



STANDARD DRAWINGS

OVERHEAD SIGNAL STRUCTURE & FOUNDATION  
SPAN WIRE CORED PIER FOUNDATIONS

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION  
HIGHWAY DIVISION  
10 PARK PLAZA BOSTON, MASS

DECEMBER, 2015

SHEET 7 OF 7 SHEETS

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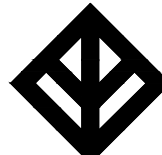
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SUBMISSION

August 4, 2022

TRAFFIC AND  
SIGNALS  
DETAILS

Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-012

CONDUIT CROSSING ROADWAY  
NOT TO SCALE

CONDUIT UNDER GRASS AREAS  
NOT TO SCALE

CONDUIT UNDER SIDEWALK  
NOT TO SCALE

GALVANIZED STEEL POST CAP

ALUMINUM SIGN PANEL

OFFSET TO EOP  
1" (MIN.)

DIE-PUNCHED KNOCKOUT HOLES  
( $\frac{7}{16}$ "±DIA) ON 1" CENTERS ON ALL FOUR  
SIDES PUNCHED, BUT NOT REMOVED.

2" SQ. GALVANIZED STEEL POST

FINISH GRADE

EARTH

3000 PSI CONCRETE FOOTING

10"±

4"

7'-0"

3'-0"

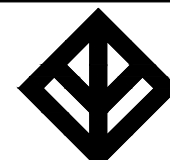
SIGNS SHALL BE SET AT RIGHT  
ANGLES TO THE DIRECTION,  
AND FACING, THE TRAFFIC  
INTENDED TO SERVE.

**SIGN POST SETTING DETAIL**

NOT TO SCALE  
(SIGN PANEL UNDER 10 SF IN AREA)

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Wakefield,  
Massachusetts



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SUBMISSION

August 4, 2022

## TRAFFIC AND SIGNALS DETAILS

Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-013



NOTES:

- ALL TEMPORARY TRAFFIC CONTROL WORK SHALL CONFORM TO THE LATEST EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) AND ALL REVISIONS, UNLESS SUPERCEDED BY THESE PLANS.
- ALL SIGN LEGENDS, BORDERS, AND MOUNTING SHALL BE IN ACCORDANCE WITH THE MUTCD.
- TEMPORARY CONSTRUCTION SIGNING AND ALL OTHER TRAFFIC CONTROL DEVICES SHALL BE IN PLACE PRIOR TO THE START OF ANY WORK.
- TEMPORARY CONSTRUCTION SIGNING, BARRICADES, AND ALL OTHER NECESSARY WORK ZONE TRAFFIC CONTROL DEVICES SHALL BE REMOVED FROM THE HIGHWAY OR COVERED WHEN THEY ARE NOT REQUIRED FOR CONTROL OF TRAFFIC.
- SIGNS AND SIGN SUPPORTS LOCATED ON OR NEAR THE TRAVELED WAY, CHANNELIZING DEVICES, BARRIERS, AND CRASH ATTENUATORS MUST PASS THE CRITERIA SET FORTH IN NCHRP REPORT 350, "RECOMMENDED PROCEDURES FOR THE SAFETY PERFORMANCE EVALUATION OF HIGHWAY FEATURES" AND/OR "MANUAL FOR ASSESSING SAFETY HARDWARE" (MASH).
- CONTRACTORS SHALL NOTIFY EACH ABUTTER AT LEAST 24 HOURS IN ADVANCE OF THE START OF ANY WORK THAT WILL REQUIRE THE TEMPORARY CLOSURE OF ACCESS, SUCH AS CONDUIT INSTALLATION, EXISTING PAVEMENT EXCAVATION, TEMPORARY DRIVEWAY PAVEMENT PLACEMENT, AND SIMILAR OPERATIONS.
- THE FIRST TEN PLASTIC DRUMS OF A TAPER SHALL BE MOUNTED WITH TYPE A LIGHTS.
- THE ADVISORY SPEED LIMIT, IF REQUIRED, SHALL BE DETERMINED BY THE ENGINEER.
- DISTANCES ARE A GUIDE AND MAY BE ADJUSTED IN THE FIELD BY THE ENGINEER.
- MAXIMUM SPACING OF TRAFFIC DEVICES IN A TAPER (DRUMS OR CONES) IS EQUAL IN FEET TO THE SPEED LIMIT IN MPH.
- MINIMUM LANE WIDTH IS TO BE 11 FEET (3.3m) UNLESS OTHERWISE SHOWN. MINIMUM LANE WIDTH TO BE MEASURED FROM THE EDGE OF DRUMS OR MEDIAN BARRIER.
- ALL SIGNS SHALL BE MOUNTED ON THEIR OWN STANDARD SIGN SUPPORTS.

LEGEND:

- REFLECTORIZED PLASTIC DRUM OR 36" CONE

P/F POLICE/FLAGGER DETAIL

▨ TYPE III BARRICADE

□ CHANGEABLE MESSAGE SIGN

➡ ARROW BOARD
- ▨ WORK ZONE

➡ DIRECTION OF TRAFFIC

▨ IMPACT ATTENUATOR

▨ MEDIAN BARRIER

▨ MEDIAN BARRIER WITH WARNING LIGHTS
- 🚚 WORK VEHICLE

▨ TRUCK MOUNTED ATTENUATOR

➡ TRAFFIC OR PEDESTRIAN SIGNAL

● SIGN

THE IDEAL CAPACITY OF A MAJOR HIGHWAY IS GENERALLY CONSIDERED TO BE 1900 PASSENGER CARS PER HOUR PER LANE (PCPHPL). IN WORK ZONES ON A MULTI-LANE DIVIDED HIGHWAY, THE FOLLOWING VOLUME GUIDELINES HAVE BEEN SUGGESTED:

MEASURED AVERAGE WORK ZONE CAPACITIES

NUMBER OF LANES		NUMBER OF STUDIES	AVERAGE CAPACITY	
NORMAL (EXISTING)	OPEN (TO TRAFFIC)		VPH	VPHPL
3	1	7	1,170	1,170
2	1	8	1,340	1,340
4	2	8	2,740	1,370
5	2	4	2,960	1,490
3	2	9	2,980	1,490
4	3	4	4,560	1,520

Source: Dudek, C., *Notes on Work Zone Capacity and Level of Service*. Texas Transportation Institute, Texas A&M University, College Station, Texas (1984)

BY OBTAINING HOURLY TRAFFIC COUNTS FOR A PARTICULAR ROADWAY (WITH A MINIMUM OF A 48-HOUR AUTOMATIC TRAFFIC RECORDER (ATR) COUNT), THIS WILL HELP TO DETERMINE AT WHAT TIMES OF THE DAY OR NIGHT A CERTAIN NUMBER OF LANES MAY BE CLOSED.

CONVENTIONAL ROADWAY- A STREET OR HIGHWAY OTHER THAN A LOW-VOLUME ROAD, EXPRESSWAY, OR FREEWAY.

EXPRESSWAY- A DIVIDED HIGHWAY WITH PARTIAL CONTROL OF ACCESS.

FREEWAY- A DIVIDED HIGHWAY WITH FULL CONTROL OF ACCESS.

LOW-VOLUME ROAD- A FACILITY LYING OUTSIDE OF BUILT-UP AREAS OF CITIES, TOWNS, AND COMMUNITIES, AND IT SHALL HAVE A TRAFFIC VOLUME OF LESS THAN 400 AADT. IT SHALL NOT BE A FREEWAY, EXPRESSWAY, INTERCHANGE RAMP, FREEWAY SERVICE ROAD OR A ROAD ON A DESIGNATED STATE HIGHWAY SYSTEM.

Source: MUTCD LATEST EDITION

TAPER LENGTH CRITERIA FOR TEMPORARY TRAFFIC CONTROL ZONES

TYPE OF TAPER	TAPER LENGTH (L)*
MERGING TAPER	AT LEAST L
SHIFTING TAPER	AT LEAST 0.5L
SHOULDER TAPER	AT LEAST 0.33L
ONE-LANE, TWO-WAY TRAFFIC TAPER	50 FT MIN.(15 m) 100 FT(30 m) MAX.
DOWNSTEAM TAPER	50 FT MIN.(15 m) 100 FT MAX.(30 m) PER LANE

Source: Table 6C-3 MUTCD LATEST EDITION

FORMULAS FOR DETERMINING TAPER LENGTHS

SPEED LIMIT (S)	TAPER LENGTH (L) FEET	SPEED LIMIT (S)	TAPER LENGTH (L) Meters
40 MPH OR LESS	$L = \frac{WS^2}{60}$	60 KM/H OR LESS	$L = \frac{WS^2}{155}$
45 MPH OR MORE	$L = WS$	70 KM/H OR MORE	$L = \frac{WS}{1.6}$

WHERE: L = TAPER LENGTH IN FEET (METERS)

W = WIDTH OF OFFSET IN FEET (METERS)

S = POSTED SPEED LIMIT, OR OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED IN MPH (KM/H)

Source: Table 6C-4 MUTCD LATEST EDITION

SUGGESTED WORK ZONE WARNING SIGN SPACING

ROAD TYPE	DISTANCE BETWEEN SIGNS **		
	A	B	C
LOCAL OR LOW VOLUME ROADWAYS*	350 (100)	350 (100)	350 (100)
MOST OTHER ROADWAYS*	500 (150)	500 (150)	500 (150)
FREEWAYS AND EXPRESSWAYS*	1,000 (300)	1,500 (450)	2,640 (800)

\* ROAD TYPE TO BE DETERMINED BY MASSDOT OFFICE OF TRANSPORTATION PLANNING.

\*\* DISTANCES ARE SHOWN IN FEET (METERS). THE COLUMN HEADINGS A, B, AND C ARE THE DIMENSIONS SHOWN IN THE DETAIL/ TYPICAL SETUP FIGURES. THE A DIMENSION IS THE DISTANCE FROM THE TRANSITION OR POINT OF RESTRICTION TO THE FIRST SIGN. THE B DIMENSION IS THE DISTANCE BETWEEN THE FIRST AND SECOND SIGNS. THE C DIMENSION IS THE DISTANCE BETWEEN THE SECOND AND THIRD SIGNS. (THE "THIRD" SIGN IS THE FIRST ONE TYPICALLY ENCOUNTERED BY A DRIVER APPROACHING A TEMPORARY TRAFFIC CONTROL (TTC) ZONE.)

THE "THIRD" SIGN ABOVE IS TYPICALLY REFERRED TO AS AN "ADVANCE WARNING" SIGN ON THE TTCOP SETUPS. THESE ADVANCE WARNING SIGNS ARE LOCATED PRIOR TO THE PROJECT LIMITS ON ALL APPROACHES (I.E. THE W20-1 SERIES (ROAD WORK XX FT) SIGNS), AND USUALLY REMAIN FOR THE DURATION OF THE PROJECT. ADDITIONAL SIGNS (I.E. "RIGHT LANE CLOSED 1 MILE" AND "LEFT LANE CLOSED 1 MILE") HAVE BEEN SHOWN IN SOME FIGURES AS EXAMPLES OF REINFORCEMENT SIGN PLACEMENT BUT ARE USED IN RARE OCCASIONS.

THE FIRST AND SECOND WARNING SIGNS ABOVE ARE REFERRED TO AS THE OPERATIONAL (DAY-TO-DAY) WORK ZONE SIGNS AND MAY BE MOVED DEPENDING ON WHERE THE SPECIFIC ROADWAY WORK FOR THAT DAY IS LOCATED.

R2-10a SIGNS SHALL BE PLACED BETWEEN THE SECOND AND THIRD SIGNS AS DESCRIBED ABOVE.

R2-10a, R2-10e, AND W20-1 SERIES SIGNS ARE TO BE INCLUDED ON ALL DETAILS/TYPICAL SETUPS.

Based on: Table 6C-1 MUTCD LATEST EDITION

STOPPING SIGHT DISTANCE AS A FUNCTION OF SPEED

SPEED* (km/h)	DISTANCE (m)
30	35
40	50
50	65
60	85
70	105
80	130
90	160
100	185
110	220
120	250

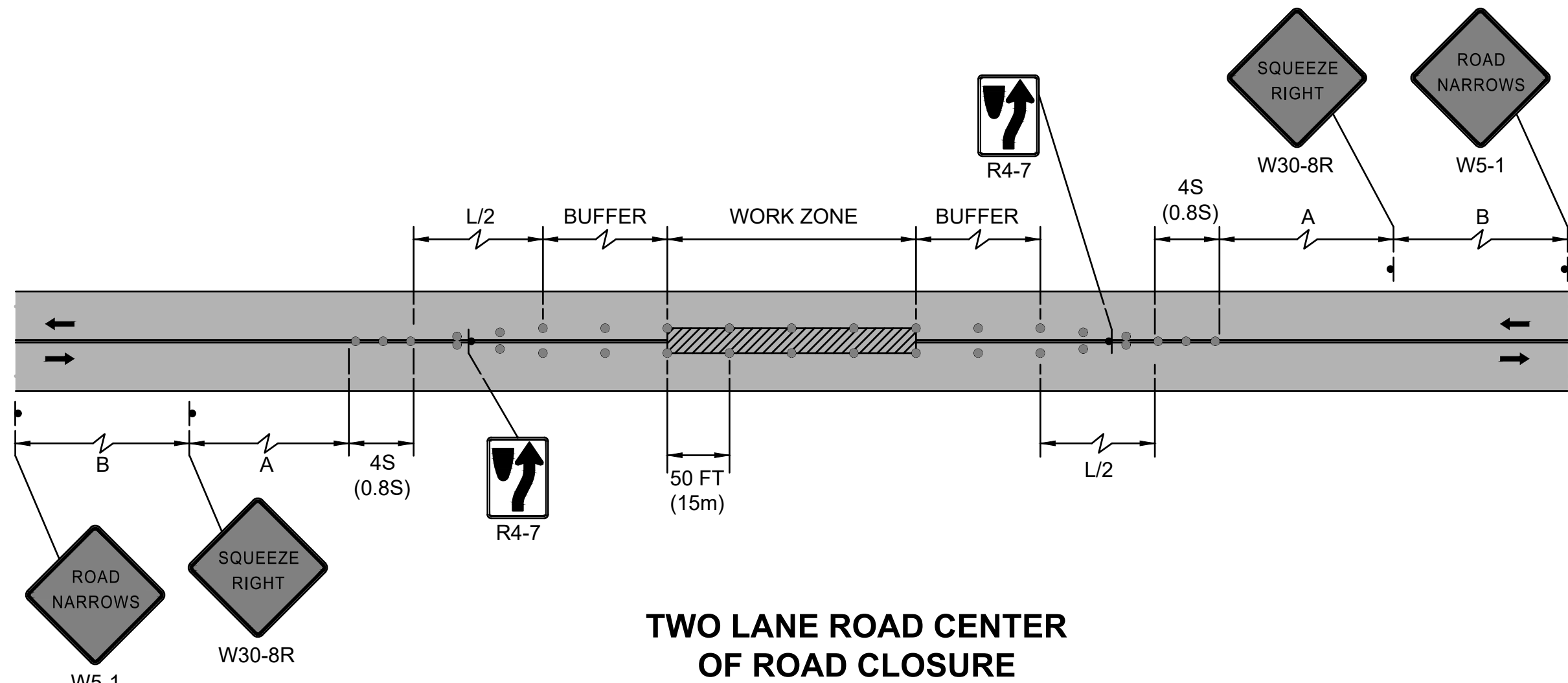
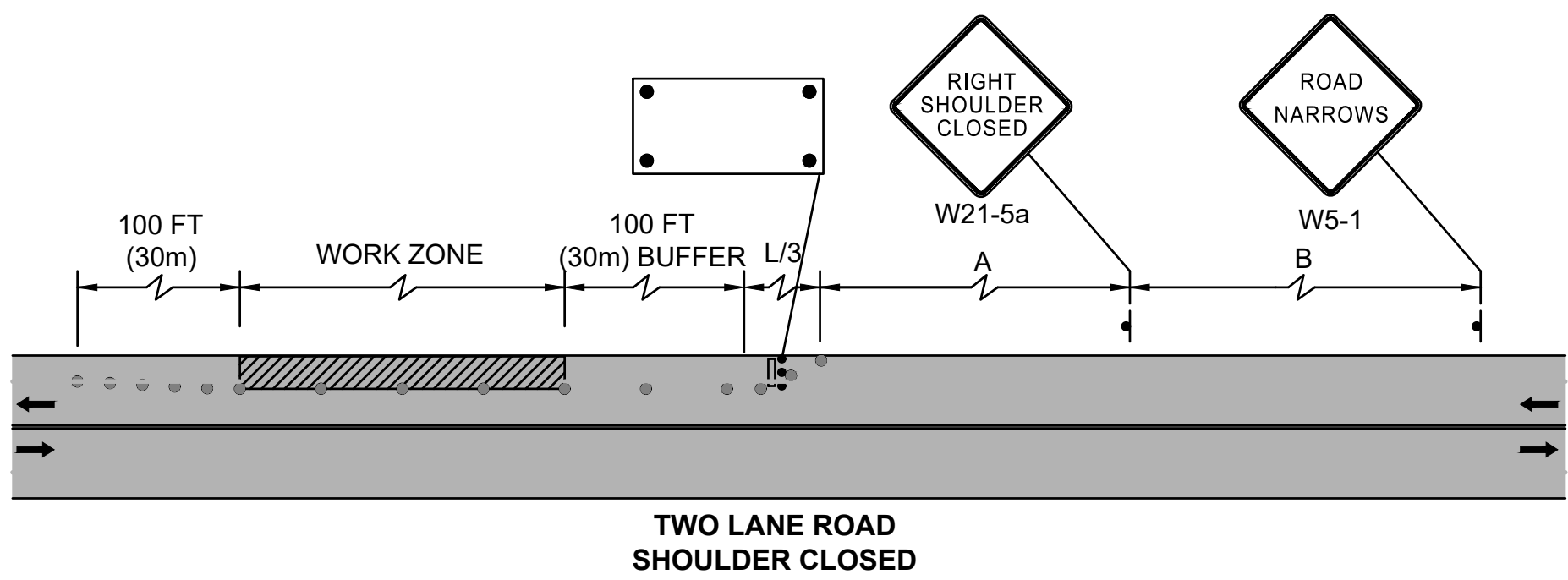
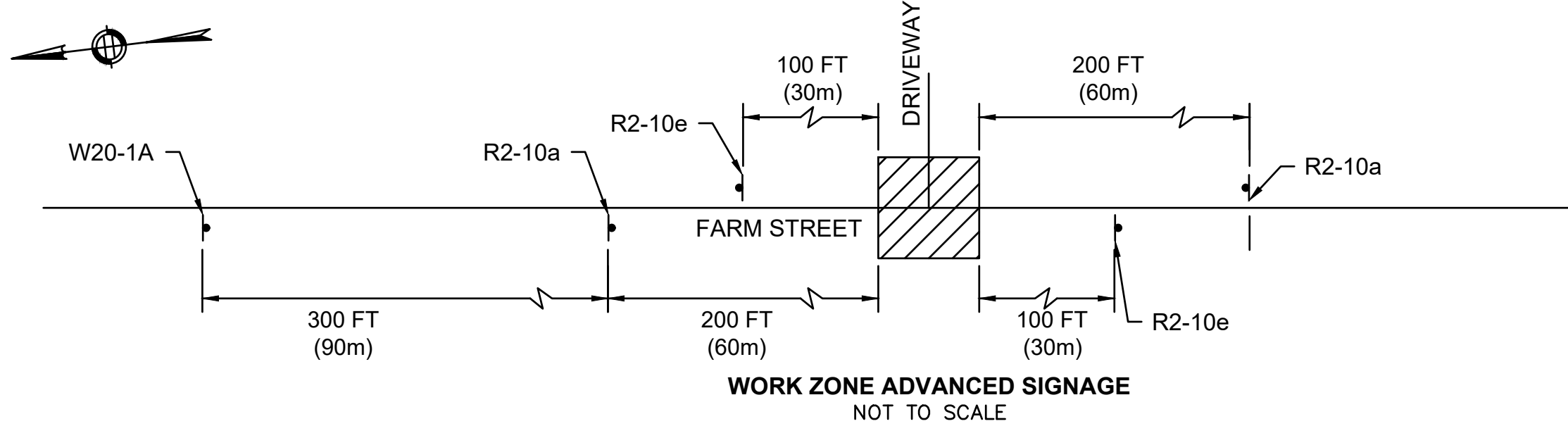
SPEED* (mph)	DISTANCE (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730
75	820

\*POSTED SPEED, OFF-PEAK 85TH-PERCENTILE SPEED PRIOR TO WORK STARTING, OR THE ANTICIPATED OPERATING SPEED

THESE VALUES MAY BE USED TO DETERMINE THE LENGTH OF LONGITUDINAL BUFFER SPACES.

THE DISTANCES IN THE ABOVE CHART REPRESENT THE MINIMAL VALUES FOR BUFFER SPACING.

Source: Table 6C-2 MUTCD LATEST EDITION



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August 4, 2022

TEMPORARY  
TRAFFIC  
CONTROL  
DETAILS

Scale: 1" = 20'-0"  
Job No.: 13872.2  
Drawn By: LB  
Date: August 4, 2022

TR-014