



240 Stockton Street, 3<sup>rd</sup> Floor  
San Francisco, CA 94108  
www.modusllc.com

September 14, 2021

Revised November 18, 2021

Carrier: AT&T Mobility  
Client Site Number: CRAN\_RSFR\_NOVA0\_008  
Site Address: 1553 S Novato Blvd  
(Across From 1556 S Novato Blvd)  
Novato, CA 94947

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**PROJECT DESCRIPTION:**

The carrier proposes the following scope of work:

- Add new pole and foundation
- Add 4G canister antenna and shroud to the pole
- Add radio(s) and disconnect to the pole
- Add entry ports as required in the pole

**ANALYSIS:**

The purpose of this analysis is to determine if the pole and foundation is structurally adequate to support the proposed loading. The pole has been analyzed in accordance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (6<sup>th</sup> Edition 2013).

**RESULTS:**

Based on our review of the structure with the proposed loading, we have determined the following:

<i>Pole</i>	<i>OK *</i>
<i>Foundation</i>	<i>OK *</i>

\* See Recommendations Section



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#### **ASSUMPTIONS:**

- The pole is plumb, undamaged, and not deteriorated in any way that would compromise 100% of design capacity
- Pole material is 11-gauge steel with yield strength  $F_y = 55$  ksi
- Cohesive Soil Shear Strength of 1500 psf

#### **REFERENCES:**

- California Dept. of Transportation Revised Standard Plan ES-6A dated 2018
- Foundation Scan Report by Modus LLC dated 08/25/2021
- Construction Drawings prepared by Modus LLC
- Photos and Notes from Site Visit

#### **RECOMMENDATIONS:**

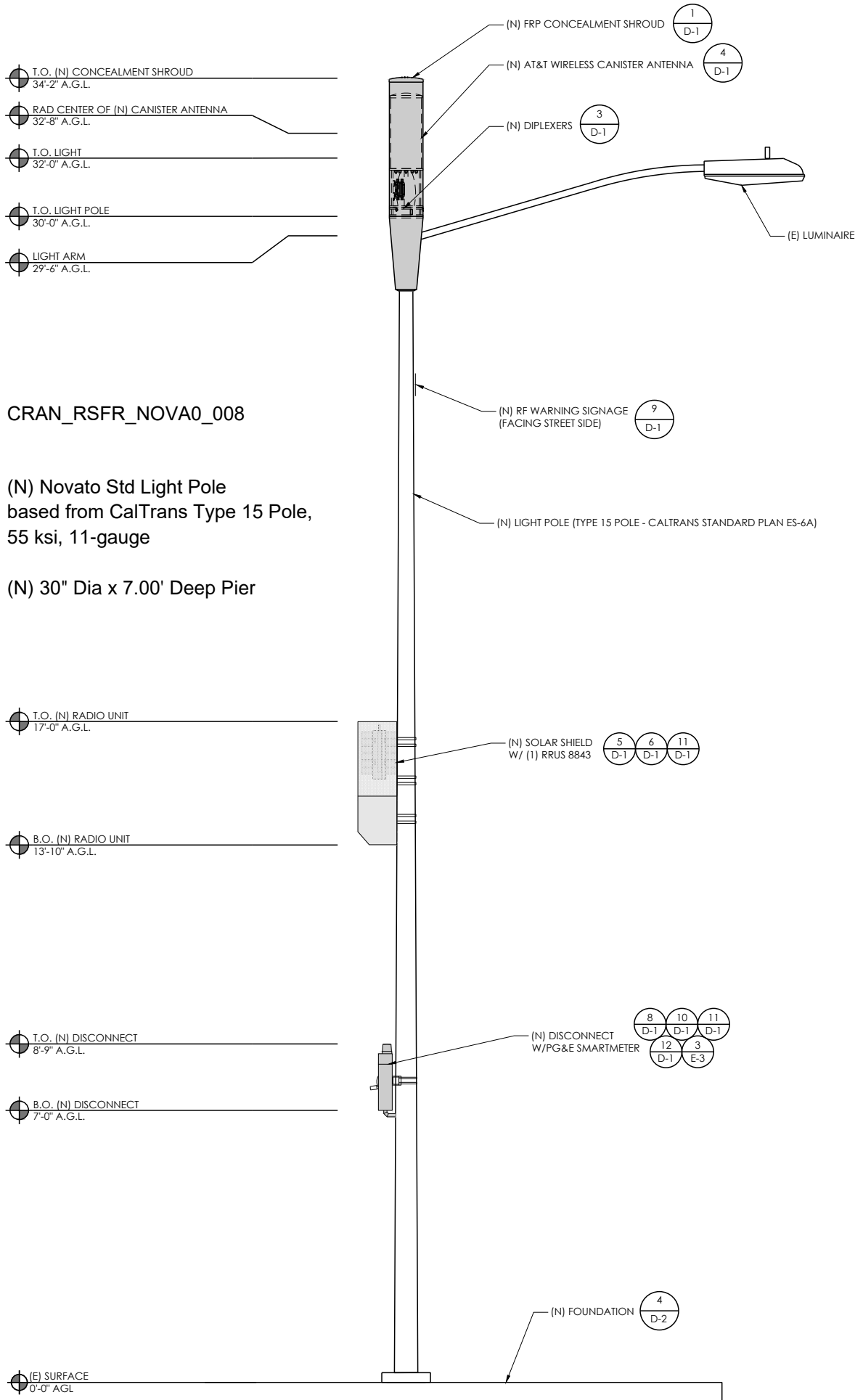
The proposed pole and proposed foundation can safely support the proposed scope of work.

All assumptions listed above to be verified prior to the installation of the equipment as listed in the project description.

Sincerely,

Jim Burrows, P.E.

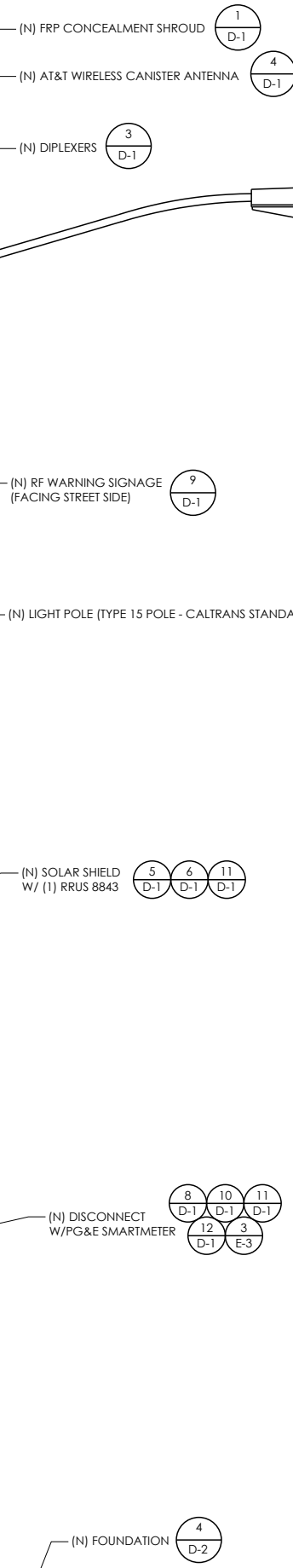
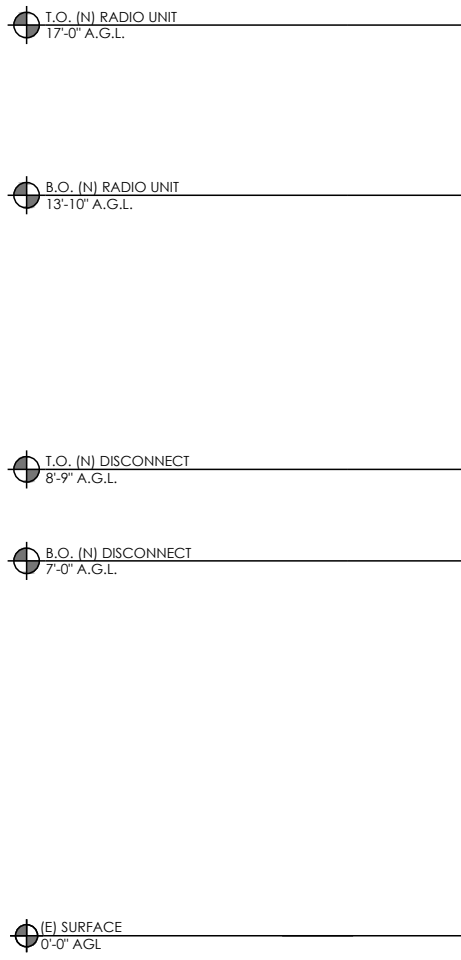




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(N) Novato Std Light Pole  
based from CalTrans Type 15 Pole,  
55 ksi, 11-gauge

(N) 30" Dia x 7.00' Deep Pier





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**Design Criteria**

Design Standard:	2013 AASHTO LTS-6	
Wind Speed:	85	mph AASHTO LTS-6 section 3.8.2
Wind Exposure:	C	ASCE7-10 Section 26.7
Cohesive Soil Shear Strength:	1500	psf CalTrans 2017 Standard Plans User Guide

**Wind Load on Highway Signs and Light Standards**

Pole Top Antenna Shroud  
Example Calc

AASHTO LTS-6 Section 3

Wind Importance Factor $I_f$ :	1.00	AASHTO LTS-6 tables 3.8.3-1 and 3.8.3-2 based on a Design Life of 50 years
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Basic Wind Speed $V_{3-sec}$ :	85	mph AASHTO LTS-6 section 3.8.2
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Exposure Category:	C	ASCE7-10 Section 26.7
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$\alpha$ :	9.5	$z_g$ :	900	ft	$K_{zmin}$ :	0.87
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AASHTO LTS-6 section C3.8.4

Centroid Highest Appurtenance $z$ AGL:	31.79	ft
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Exposure Coefficient $K_z = 2.01(z/z_g)^{2/\alpha}$ :	0.99	AASHTO LTS-6 equation C3.8.4-1
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Gust Factor:	1.14	AASHTO LTS-6 section 3.8.5
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Design Wind Pressure $P_z = .00256K_zGV^2I_f$ :	20.97	psf AASHTO LTS-6 equation 3.8.3-1
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Wind Drag Coefficient $C_d$ :	0.48	AASHTO LTS-6 table 3.8.6-1
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Projected Area $A$ :	3.14	ft <sup>2</sup>
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Effective Projected Area $EPA = C_dA$ :	1.49	ft <sup>2</sup>
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$W = P_zEPA$ :	31	#s
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**ASD**



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**Service Light Pole Loading (Normal Wind Load)**

Item	Existing or Proposed	Centroid AGL ft	Projected Area sq ft	Shape	Drag Coefficient $C_d$	EPA  sq ft	W ASD #s	M Wind ASD ft-#s	Centroid Horizontal ft	Torque ASD ft-#s
<b>Design Wind Pressure <math>P_z =</math></b>		<b>20.97</b>	<b>psf</b>							
Pole (Round)	P	13.16	14.61	R	1.02	14.90	312	4110	0	0
Luminaire Arm	E	30.69	1.52	R	1.10	1.68	35	1078	2.84	100
Luminaire	E	32.00	N/A	R	N/A	0.60	13	403	7.0	88
Antenna Shroud	P	31.79	3.14	R	0.48	1.49	31	995	0	0
Antenna Shroud Skirt	P	29.25	1.31	R	0.48	0.62	13	383	0	0
Radio / Solar Shield	P	15.42	3.17	S	1.20	3.80	80	1229	0	0
Disconnect Switch	P	7.89	0.62	S	1.20	0.75	16	124	0	0
<b>Base Normal Wind Reactions Total (ASD):</b>							<b>500</b>	<b>8321</b>	<b>188</b>	

Notes:

This calculation accounts for pole, luminaire arm(s), luminaire(s), and Carrier proposed equipment only  
See next sheet for additional calculation for site specific signage, banners, etc, if applicable



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**Service Light Pole Sign Moment & Pole Masking (Normal Wind Load)**

Item	Existing or Proposed	Centroid AGL ft	Projected Area sq ft	Shape	Drag Coefficient $C_d$	EPA + sq ft	EPA - sq ft	W ASD #s	M W ASD ft-#s
<b>Design Wind Pressure <math>P_z</math> =</b>		20.97	<i>psf</i>						
Shroud Skirt Pole Masking	P	29.25	0.47	R	1.02	0.00	-0.48	-10	-297
<b>Base Normal Signage and Masking Wind Reactions Total (ASD):</b>								<b>Shear</b> -10	<b>Moment</b> -297

**Notes:** Pole masking accounts for pole surface area masked by Signs or Equipment



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**Service Light Pole Loading (Transverse Wind Load)**

Includes Pole Masking as Applicable

Item	Existing or Proposed	Centroid AGL ft	Projected Area sq ft	Shape	Drag Coefficient $C_d$	EPA + sq ft	EPA - sq ft	W ASD #s	M Wind ASD ft-#s
<b>Design Wind Pressure <math>P_z =</math></b>		<b>20.97</b>	<b>psf</b>						
Pole (Round)	P	13.16	14.61	R	1.02	14.90	0.00	312	4110
Luminaire Arm	E	30.69	0.47	R	1.10	0.52	0.00	11	332
Luminaire	E	32.00	N/A	R	N/A	0.30	0.00	6	201
Antenna Shroud	P	31.79	3.14	R	0.48	1.49	0.00	31	995
Antenna Shroud Skirt	P	29.25	1.31	R	0.48	0.62	-0.48	3	86
Radio / Solar Shield	P	15.42	3.96	F	1.20	4.75	-1.56	67	1032
Disconnect Switch	P	7.89	1.24	F	1.19	1.47	-1.00	10	79
<b>Base Transverse Wind Reactions Total (ASD):</b>								<b>441</b>	<b>6835</b>

Shear      Moment

AASHTO LTS-6 3.93 Transverse x .2 (Load Case 1):

88      1367



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**Service Light Pole Loading (Dead Load)**

Item	Existing or Proposed	Centroid AGL ft	Axial D ASD #s	Centroid Horizontal ft	M Dead ASD ft-#s
Pole (Round)	P	13.16	220	0.00	0
Luminaire Arm	E	30.69	27	2.84	76
Luminaire	E	32.00	20	7.00	140
Antenna Shroud w/ Interior Components	P	31.79	100	0.00	0
Radio / Solar Shield	P	15.42	72	0.00	0
Disconnect Switch	P	7.89	3	0.00	0
<b>Base Dead Reactions Total (ASD):</b>			<b>441</b>	<b>216</b>	

**Vertical Concentrated Load at Pole Top  $P_T$ :**

**147** #s

(Luminaire, Arm, and Antenna + Shroud)

**Weight of Pole  $D_p$ :**

**295** #s

**Coefficient of Amplification  $C_A$ :**

**0.97**

AASHTO LTS-6 Formula 4.8.1-1





Light Pole Stresses

Pole Material:  CalTrans Type 15  
 $F_y$ :  ksi CalTrans Type 15

**Bending**

$F_b = 1.33 \times 0.66 F_y$ :  ksi AASHTO LTS-6 Table 3.4-1 Group II Loading + AASHTO LTS-6 Table 5.6-1 Round .66Fy  
 Outside Base Diameter  $d$ :  in CalTrans Type 15  
 Wall Thickness  $t$ :  in CalTrans Type 15  
 Inner Base Diameter  $d_i = d - 2t$ :  in  
 Section Modulus  $S = \pi(d^4 - d_i^4)/32d$ :  in<sup>3</sup>  
 Service Moment Dead  $M_D$ :  in-#s  
 Service Moment Wind  $M_W$ :  in-#s  
 Service Moment Combined  $M_g = (M_W^2 + M_D^2)^{1/2}$ :  in-#s  
 $f_b = M_g/S$ :  ksi  
 Bending stress ratio  $= f_b/C_A F_b$ :

**Shear and Torsion**

$F_v = 1.33 \times 0.33 F_y$ :  ksi AASHTO LTS-6 Table 3.4-1 Group II Loading + AASHTO LTS-6 Formula 5.11-1  
 $A = \pi(d^2 - d_i^2)/4$ :  in<sup>2</sup>  
 Service Shear  $V_S$ :  #s  
 $f_v = V_S/A$ :  ksi  
 Polar moment of inertia  $J = \pi(d^4 - d_i^4)/32$ :  in<sup>4</sup>  
 Radius  $r = d/2$ :  in  
 Service Torque  $T_S$ :  in-#s  
 $\tau = T_S/r/J$ :  ksi  
 Shear stress ratio  $[(f_v + \tau)/F_v]^2$ :

**Axial**

$F_a = 0.6 F_y$ :  ksi AASHTO LTS-6 Formula 5.12.1-1  
 Service Axial  $P_S$ :  #s  
 $f_a = P_S/A$ :  ksi  
 Axial stress ratio  $f_a/F_a$ :

Combined Bending, Axial, and Shear  $f_b/1.6F_y + f_v/C_A F_b + [(f_v + \tau)/F_v]^2$ :   AASHTO LTS-6 Formula 5.12.1-1

Base Reaction Input Loads for Pier Analysis

Base Service Moment and Shear ASD:  kip-ft  kips  
 Pedestal Height  $H_p$ :  ft Shear Effective Height  $H = H_p + M_g/V_S$ :  ft

Access Port Area Removed / Area Added by Welded 1-1/2" L x 1-1/2" STD Pipe Reinforcing

$in^2$   
 11 Gauge 2" dia Port .239 / .435:  <1.00  
 7 Gauge 2" dia Port .359 / .435:  <1.00

**Pole Access Ports OK**



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**Light Pole Pier Embedment Broms' Method Cohesive Soil**

AASHTO LTS-6 Section 13.6.1.1

Soil Shear Strength $c$ :	1500	<i>psf</i>	CalTrans 7/19/2017 Standard Plans User Guide
Soil Undercapacity Factor:	0.7		CalTrans 7/19/2017 Standard Plans User Guide
ASD Allowable Stress Increase:	1.33		AASHTO LTS-6 table 3.4-1 for D+W
Factored Soil Shear Strength $(1.33 \times 7xc/1000) c_f$ :	1.397	<i>ksf</i>	
Overload Factor:	2		CalTrans 7/19/2017 Standard Plans User Guide
	<b>V</b>		
	<i>kips</i>		
Base Service Loads:	0.578		
	<b>V<sub>F</sub></b>		
	<i>kips</i>		
Base Factored Loads $(2 \times \text{Service})$ :	1.156		AASHTO LTS-6 equations C13.6.1.1-1 and -2
Shear Effective Height $H$ :	16.256	<i>ft</i>	
Pier Diameter $D$ :	2.5	<i>ft</i>	
$q = V_F / (9c_F D)$ :	0.037	<i>ft</i>	AASHTO LTS-6 equation C13.6.1.1-5
Embedment Depth Required $L_r$ :	5.50	<i>ft</i>	AASHTO LTS-6 equation C13.6.1.1-3
	$L = 1.5D + q[1 + \sqrt{2 + (4H + 6D)/q}]$		
Embedment Depth Provided $L_p$ :	7.00	<i>ft</i>	<b>New Pier Depth</b>
$L_p \geq L_r$ :	OK		