



240 Stockton Street, 3rd Floor
San Francisco, CA 94108
www.modusllc.com

October 08, 2021

Carrier: AT&T Mobility
Client Site Number: CRAN_RSFR_NOVA0_004
Site Address: 7123 Redwood Blvd
Novato, CA 94945

PROJECT DESCRIPTION:

The carrier proposes the following scope of work:

- Add new 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 (6th 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 $F_y = 33$ ksi
- Cohesive Soil Shear Strength of 1500 psf

REFERENCES:

- California Dept. of Transportation Revised Standard Plan ES-7A dated 2018
- Foundation Scan Report by Modus LLC dated 10/07/2021
- Construction Drawings prepared by Modus LLC
- Photos and Notes from Site Visit

RECOMMENDATIONS:

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

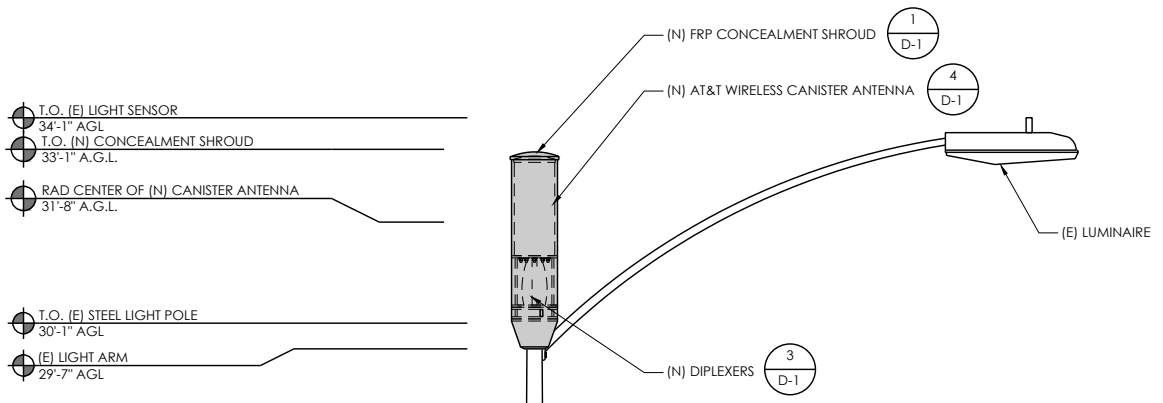
In some cases, a new pole is required for non-structural reasons. In those cases, the new pole will exceed the minimum design required, as shown in these calculations, and is therefore structurally acceptable.

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.

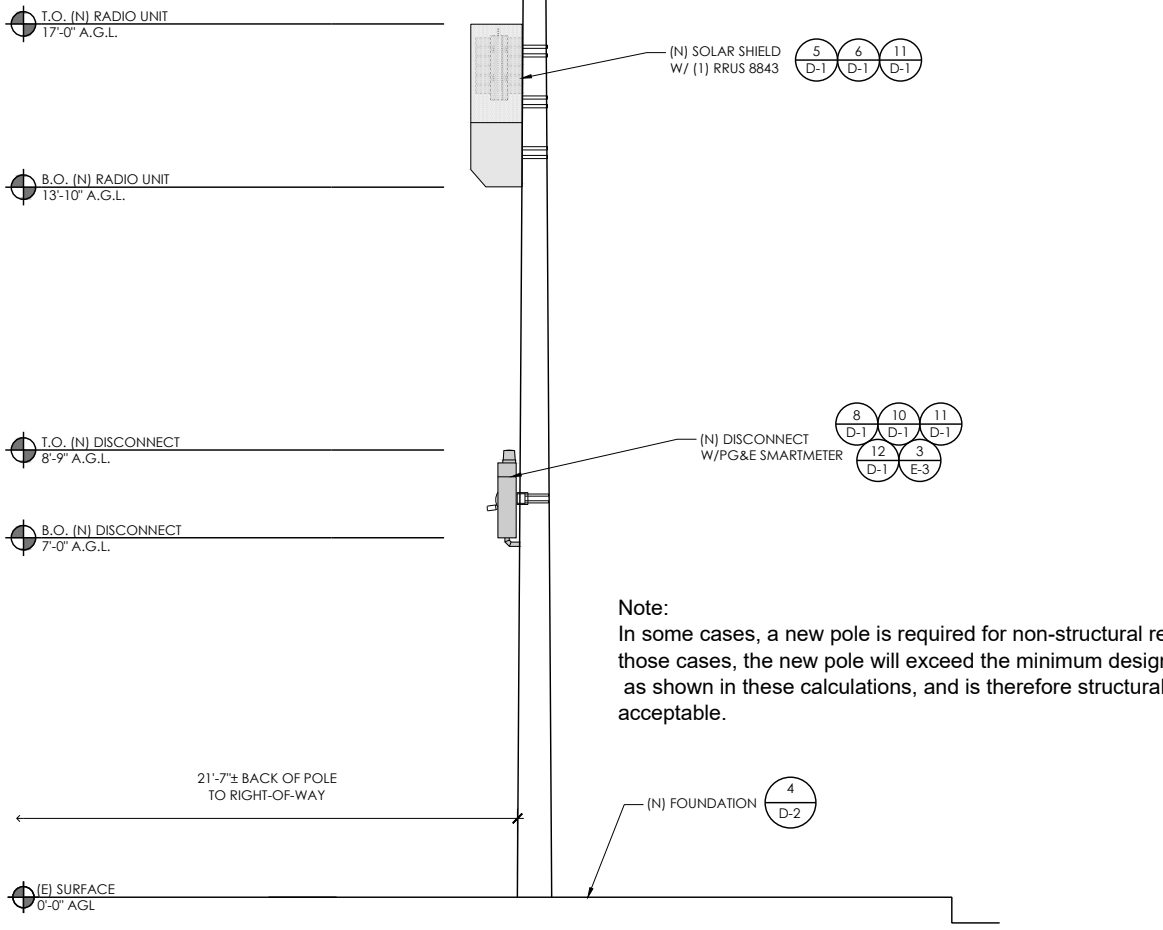




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(E) Novato Std Light Pole
based from CalTrans Type 15 Pole,
33 ksi, 11-gauge

(N) 30" Dia x 7.00' Deep Pier



Note:
In some cases, a new pole is required for non-structural reasons. In those cases, the new pole will exceed the minimum design required, as shown in these calculations, and is therefore structurally acceptable.

21'-7"± BACK OF POLE
TO RIGHT-OF-WAY



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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
Basic Wind Speed V_{3-sec} :	85	mph AASHTO LTS-6 section 3.8.2
Exposure Category:	C	ASCE7-10 Section 26.7
α : 9.5	z_g : 900 ft	K_{zmin} : 0.87

AASHTO LTS-6 section C3.8.4

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

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
Design Wind Pressure $P_z =$		20.97	psf							
Pole (Round)	E	13.16	14.61	R	1.02	14.90	312	4110	0	0
Luminaire Arm	E	31.48	4.34	R	1.10	4.78	100	3154	6.79	680
Luminaire	E	34.08	N/A	R	N/A	0.60	13	429	16.0	201
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
Base Normal Wind Reactions Total (ASD):							565	10423	882	

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 +	EPA -	W ASD #s	M W ASD ft-#s
Design Wind Pressure P_z =		20.97	<i>psf</i>						
Shroud Skirt Pole Masking	P	29.25	0.47	R	1.02	0.00	-0.48	-10	-297
Base Normal Signage and Masking Wind Reactions Total (ASD):								Shear -10	Moment -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
Design Wind Pressure $P_z =$		20.97	psf						
Pole (Round)	E	13.16	14.61	R	1.02	14.90	0.00	312	4110
Luminaire Arm	E	31.48	1.31	R	1.10	1.44	0.00	30	952
Luminaire	E	34.08	N/A	R	N/A	0.30	0.00	6	214
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
Base Transverse Wind Reactions Total (ASD):								460	7469

Shear Moment

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

92 1494



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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)	E	13.16	220	0.00	0
Luminaire Arm	E	31.48	77	6.79	524
Luminaire	E	34.08	20	16.00	320
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
Base Dead Reactions Total (ASD):			492	844	

Vertical Concentrated Load at Pole Top P_T :

197

 #s

(Luminaire, Arm, and Antenna + Shroud)

Weight of Pole D_p :

295

 #s

Coefficient of Amplification C_A :

0.96

AASHTO LTS-6 Formula 4.8.1-1



Light Pole Stresses

Pole Material: Novato City Specs (CalTrans Type 15)
 F_y: ksi Novato City Specs (CalTrans Type 15)

Bending

F_b = 1.33x0.66F_y: ksi AASHTO LTS-6 Table 3.4-1 Group II Loading + AASHTO LTS-6 Table 5.6-1 Round .66F_y
 Outside Base Diameter d: in Novato City Specs (CalTrans Type 15)
 Wall Thickness t: in Novato City Specs (CalTrans Type 15)
 Inner Base Diameter d_i = d-2t: in
 Section Modulus S = π(d⁴-d_i⁴)/32d: in³
 Service Moment Dead M_D: in-#s
 Service Moment Wind M_W: in-#s
 Service Moment Combined M_S = (M_W² + M_D²)^{1/2}: in-#s
 f_b = M_S/S: ksi
 Bending stress ratio = f_b/C_AF_b:

Shear and Torsion

F_v = 1.33x0.33F_y: ksi AASHTO LTS-6 Table 3.4-1 Group II Loading + AASHTO LTS-6 Formula 5.11-1
 A = π(d²-d_i²)/4: in²
 Service Shear V_S: #s
 f_v = V_S/A: ksi
 Polar moment of inertia J = π(d⁴-d_i⁴)/32: in⁴
 Radius r = d/2: in
 Service Torque T_S: in-#s
 τ = T_S/J: ksi
 Shear stress ratio [(f_v+τ)/F_v]²:

Axial

F_a = 0.6F_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/F_b + f_a/F_a + f_v/C_AF_b + [(f_v+τ)/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_S/V_S: ft

Access Port Area Removed / Area Added by Welded 1-1/2" L x 1-1/2" STD Pipe Reinforcing
in²

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	psf	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 (1.33x.7xc/1000) c _F :	1.397	ksf	
Overload Factor:	2		CalTrans 7/19/2017 Standard Plans User Guide
	V		
	<i>kips</i>		
Base Service Loads:	0.647		
	V_F		
	<i>kips</i>		
Base Factored Loads (2xService):	1.294		AASHTO LTS-6 equations C13.6.1.1-1 and -2
Shear Effective Height H:	18.013	ft	
Pier Diameter D:	2.5	ft	
$q = V_F / (9c_F D)$:	0.041	ft	AASHTO LTS-6 equation C13.6.1.1-5
Embedment Depth Required L _r :	5.69	ft	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	ft	New Pier Depth
L _p >= L _r :	OK		