Edge
Consulting Engineers, Inc.

2101 Highway 13 W
Burnsville, MN 55337

608.644.1449 phone
608.644.1549 fax

August 29, 2018

Zayo
5005 Cheshire Parkway
Suite 1
Plymouth, MN 55446
Contact: David Bushaw
Phone: (952) 230-9662

SUBJECT: POLE REVIEW AND FOUNDATION DESIGN REPORT
SMALL CELL INSTALLATION
FREDDIES [MS90XSU69] **- CANDIDATE M**
MAPLE GROVE, MINNESOTA
EDGE PROJECT #17270

Mr. Bushaw:

Edge Consulting Engineers, Inc. has been asked to complete a pole review and foundation design for the above mentioned site per your Small Cell installation request. One loading scenario was considered in the analysis. This loading condition takes into account the existing loading along with the proposed loading The proposed primary equipment elevation is at 32 feet above ground level on this 40 foot tall pole. The results of the pole review show that under the proposed loading only, the stress ratio of the pole's controlling element is approximately 39%.

For this analysis, the loads were calculated in accordance with the Minnesota Building Code (IBC 2012) and all of its referenced standards. The capacities of the pole were calculated in accordance with the current LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (AASHTO 2015) and all of its referenced standards. See the Antenna Wind Load Calculations and pole design drawing attachments for further details.

EQUIPMENT INFORMATION

#	Appurtenance	Status
1	**Alpha AW3613-S1-G**	**Proposed**
1	**Airspan iR460-SPB-ST-1-P-0 w/ Side Arm**	**Proposed**
1	**Airspan AirHarmony 4400 w/ Mount & Sunshield**	**Proposed**
1	**Tallysman GPS-ANT-3**	**Proposed**
1	**Transector 1101-1207-1012**	**Proposed**
1	**Schneider DU221RB**	**Proposed**
1	**Milbank U4801-XL-5TP**	**Proposed**
1	LED Light	Existing

Utilizing the Valmont MN353359P1 pole design without the T-base option dated 1/6/2017, it was determined that the applied reactions and stresses at the base of the pole from the proposed equipment loading condition are less than the Valmont calculated design capacities. Therefore, it was determined that the structure **is capable of safely supporting** the proposed loading. The anchor rods are to be provided by Valmont, and have been sized accordingly to the demand required.

It is proposed to install the pole on a new cast-in-place foundation constructed with normal weight concrete having a minimum f'c of 4,000psi and ASTM A615 Grade 60 rebar. The proposed foundation is a 10'-0" long x 2'-6" diameter concrete pier that is to be flush with the ground. The foundation is to have twelve (12) #7 vertical reinforcing bars and eleven (11) #4 horizontal shear reinforcing bars with two shear ties in the top 5 inches of the pier and the ties evenly spaced thereafter. See the Drilled Pier Foundation Calculations attachment for further details.

If the proposed loading condition is altered from that analyzed or it is determined that any of the assumptions are not accurate, this analysis shall be deemed obsolete and further analysis will be required.

Refer to the Freddies Construction Drawings created by Edge Consulting Engineers for all applicable plan work, notes, and details.

Please feel free to contact us if you have any questions or concerns.

Sincerely,

Edge Consulting Engineers, Inc.

Tyler A. Clausen
Structural Engineer
(3) Attachments

PROFESSIONAL ENGINEER
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota

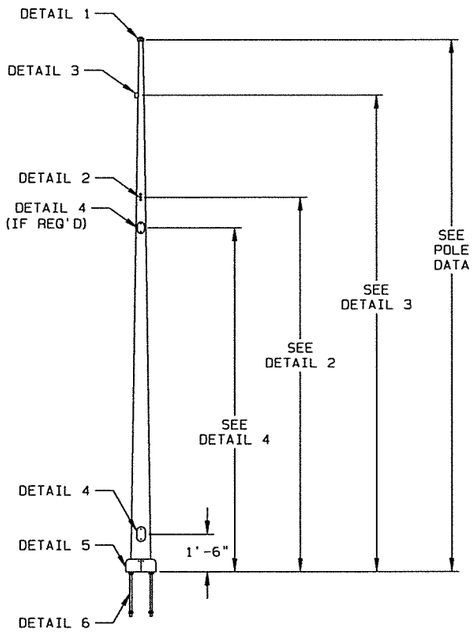
Print Name: Kevin T. Scharenbroch

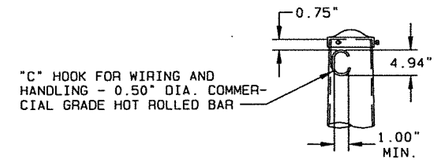
Signature:

Date: 8/29/18 License# 52416

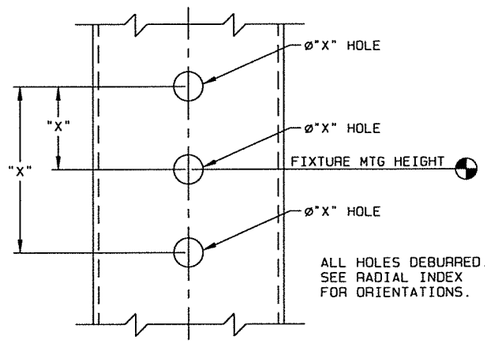
LIMITATIONS AND RESTRICTIONS

1. This report was prepared in accordance with generally accepted structural engineering practices common to the industry and makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of the agreement between Engineer and Client. This report has not been prepared for uses or parties other than those specifically named, or for uses or applications other than those enumerated herein. The report may contain insufficient or inaccurate information for other purposes, applications, and/or other uses.
2. This report is intended for the use of the client and cannot be utilized or relied upon by other parties without the written consent of Edge Consulting Engineers.
3. Edge Consulting Engineers is not responsible for any, and all, modifications completed prior to, or hereafter, which Edge Consulting Engineers was not, or will not, be directly involved.
4. The model, conclusions, and recommendations contained within this report are based upon the supplied and attained information as described within the report. If it is known, or becomes known, that any item(s) are in conflict with what is described within this document, this report should be considered void and Edge Consulting Engineers should be contacted immediately.
5. Edge Consulting Engineers disclaims all liability for any information, conclusion, or recommendation that is not expressly stated or represented within this report.
6. Edge Consulting Engineers shall not be liable for any incidental, consequential, indirect, special or punitive damages arising out of any claim associated with the use of this report.
7. The scope of worked performed for this analysis is limited to the items in which we were furnished complete and accurate information.
8. Accessories and appurtenances such as antenna mounts, feed line ladders, climbing ladders, lighting mounts, etc. were not analyzed as part of this work, and Edge Consulting Engineers, Inc. makes no claim as to their adequacy of their design or their installation.
9. This analysis provided by Edge Consulting Engineers, Inc. addresses the structural adequacy or deficiencies of the primary structural members under wind load only. This analysis assumes that the stresses applied at the base of the vertical shaft controls the design. The evaluation of each bolt, plate connection detail, weld, T-base, H-base, tapered base, breakaway base, etc. is outside the scope of this analysis. Fatigue was also assumed to not control the design.
10. This analysis was performed under the assumption that all structural elements are in like new condition, free from rust and other deterioration. It is also assumed that everything was properly installed per construction documents. Edge Consulting Engineers cannot account for, nor be held responsible, if elements are deteriorated, damaged, and/or missing.
11. This analysis was performed based upon the antenna and equipment loading and placement as described within this report. Any alterations to the described loading or placement will require re-analysis, and the findings contained in this report are not valid.
12. The loading utilized for this analysis is based on information provided by the client, and readily available manufacturer/vendor information (antenna and mount projected areas, weight and shape factors). For all other appurtenances, the EPA's were based off of ground level images. It is the client's responsibility to gage the acceptable level of uncertainty from these ground images and the heights estimated. If more certainty is required, a climb should be completed. Furthermore, if the described loading criteria and design assumptions within this report are not accurate, are altered, or changed in any form, this analysis shall be considered void and an additional analysis must be performed.
13. It is the responsibility of the client and the building owner to thoroughly review the existing and proposed loading, and bring any discrepancy to the attention of Edge Consulting Engineers.
14. Site-specific loading or local building code requirements may be more stringent than the minimum loading requirements specified in the Standard. These and other unique loads or loading combination requirements are to be specified by the owner (in the procurement specifications).
15. Unless stated otherwise, for the purpose of this analysis, no geotechnical report or properties were provided. It has been assumed that the soils at the site have a minimum strength equivalent to a class 4 soil per the IBC. If it is determined that this assumption is not accurate, this analysis is void and an additional analysis should be performed.



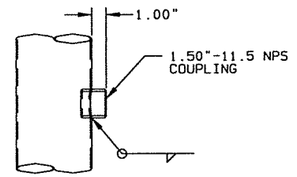


DETAIL 1 | POLE TOP



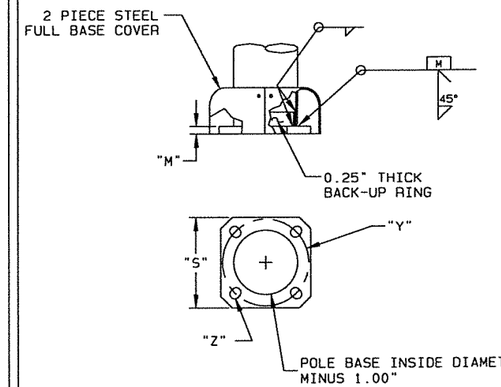
DRILLING	HEIGHT FROM BASE OF POLE	ORIENTATION

DETAIL 2 | FIXTURE DRILL TEMPLATE

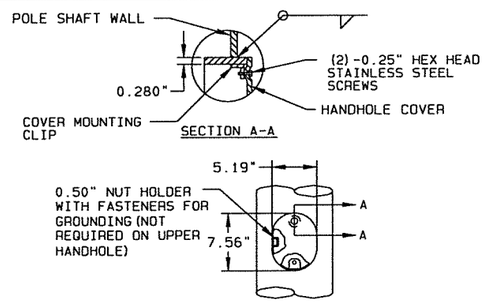


COUPLING	HEIGHT FROM BASE OF POLE	ORIENTATION
W		
X		
Y		
Z		

DETAIL 3 | POLE COUPLING



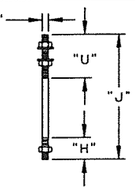
DETAIL 5 | POLE BASE



HANDHOLE	HEIGHT FROM BASE OF POLE	ORIENTATION
A	1.50'	0°
B		
C		
D		

DETAIL 4 | 4" X 6.5" HANDHOLE

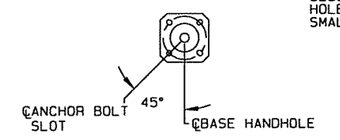
(4) -FULLY GALVANIZED ANCHOR BOLTS WITH (3) HEX NUTS AND (2) WASHERS PER BOLT.



DETAIL 6 | ANCHOR BOLT

SEE NOTE 1

ALL ANGLES MEASURED CLOCKWISE FROM HAND-HOLE AS VIEWED FROM SMALL END OF POLE



RADIAL INDEX

MATERIAL DATA

COMPONENT	ASTM DESIGNATION	MIN YIELD (KSI)
TAPERED SHAFTS	A595 GR.A	55
BASE PLATE	A36	36
ANCHOR BOLTS	F1554 GR 55	55
HARDWARE COATING	HOT DIP ZINC	--

FINISH NOTES

SYSTEM: FINISH PAINT/GALVANIZED (FPGV)
BASE COAT: HOT-DIP GALVANIZED TO ASTM A123
PRIME COAT: NONE
FINISH COAT: TGIC OR URETHANE POLYESTER POWDER
COLOR: ????
SPEC: F-283????

ALTHOUGH RARE, VIBRATIONS SEVERE ENOUGH TO CAUSE DAMAGE CAN OCCASIONALLY OCCUR IN STRUCTURES OF ALL TYPES. BECAUSE THEY ARE INFLUENCED BY MANY INTERACTING VARIABLES, VIBRATIONS ARE GENERALLY UNPREDICTABLE. THE USER'S MAINTENANCE PROGRAM SHOULD INCLUDE OBSERVATION FOR EXCESSIVE VIBRATION AND EXAMINATION FOR ANY STRUCTURAL DAMAGE OR BOLT LOOSENING. THE VALMONT WARRANTY SPECIFICALLY EXCLUDES FATIGUE FAILURE OR SIMILAR PHENOMENA RESULTING FROM INDUCED VIBRATION, HARMONIC OSCILLATION OR RESONANCE ASSOCIATED WITH MOVEMENT OF AIR CURRENTS AROUND THE PRODUCT.

VIBRATION DISCLAIMER

POLE DATA

ITEM	QTY.	POLE TUBE				POLE BASE				ANCHOR BOLT			
		BASE DIA. (IN)	TOP DIA. (IN)	LENGTH (FT)	GAUGE OR THK. (IN)	SQUARE "S" (IN)	BOLT CIRCLE "Y" (IN)	THK. "M" (IN)	SLOT "Z" (IN)	DIA. "K" (IN)	LENGTH "J" (IN)	BOTTOM THREAD LENGTH "H" (IN)	TOP THREAD LENGTH "U" (IN)
1		11.00	5.40	40.00	7	16.00	15.00	1.250	1.63 X 2.13	1.50	54.00	6.00	8.00

CRITERIA:
WIND VELOCITY: 115 MPH
GUST FACTOR: 1.14
RISK CATEGORY: II
EXPOSURE CATEGORY: C

*ICE IS INCLUDED.

DESIGN INFORMATION

NOTES:

1. PLEASE PROVIDE LOCATION AND ORIENTATION FOR FIXTURE DRILLING(S), COUPLING(S), AND ADDITIONAL HANDHOLE(S) PRIOR TO RELEASE FOR PRODUCTION.
2. FINISH MUST BE PROVIDED IN FORM OF VALMONT FINISH SPEC, PAINT CHIP, FEDERAL#, AND/OR RAL# PRIOR TO RELEASE FOR PRODUCTION.
3. HANDHOLE SIZE AND/OR SHAPE MAY VARY BASED ON POLE DIAMETER AT HANDHOLE HEIGHT.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.
Print Name: MITCHELL SPINLER
Signature:
Date 9/06/2017 License # 43840

REV	DRAWN BY-DATE	CHECK BY-DATE	DESCRIPTION
—	KJW5 01/05/17	KJW5 01/05/17	— — — — — — — — — — — — — — — — — —

SOLD TO: EDGE CONSULTING ENGINEERS
SHIP TO:
P.O. #:
AGENT: LARRY GRIMES

JOB: DS210-ROUND TAPERED POLE DESIGN EDGE - VERIZON
TITLE: LIGHTING STRUCTURES

valmont
Valley, NE 68064
(402) 359-2201

ORDER NUMBER: 353359-P1
PAGE NUMBER: 1 OF 1
DRAWING NUMBER: MN353359P1
REV

Antenna Wind Load Calculations

Project Name - Freddies (MS90XSU69)
Maple Grove, Minnesota
Edge #17270

Edge Consulting Engineers, Inc.

Completed By: TAC
Checked By: KTS

Referenced Shape Factor Standard: ASCE 7-10

Pole Base Wind Pressure Calculation:

Exposure Category =	C	
Importance Category =	II	
Topographic Category =	Flat/Rolling Terrain	
Crest Height (H) =	0	ft
K_z =	1.04	
K_e =	1.00	
K_h =	NA	
K_t =	NA	
K_{zt} =	1.00	
K_d =	0.90	
V =	115	mph
Vnom =	89.08	mph

$$q_z = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot I$$

q_z = 31.80 psf

$$F = q_z \cdot G \cdot C_f \cdot A$$

G = 1.10

Wind Force/Weight Calculation:

#	Appurtenance	Type	Normal Orientation	Owner	Elevation ft	K_d	q_z psf	Weight lbs	Bracket lbs	Height (H) in	Width (W) in	Depth (D) in	Front AR	Side AR	Front (C_a)	Side (C_a)	EPA_{norm} ft^2	EPA_{tan} ft^2	Total lbs
1	Alpha AW3613-S1-G	Omni	Worst	Zayo	32	0.95	32.02	16.50	N/A	28.30	8.60	8.60	3.3	3.3	0.54	0.54	0.91	0.91	16.50
1	Small Cell Omni Mount	Omni Mount	Worst	Zayo	30	0.9	29.93	2.00	N/A	11.00	4.00	4.00	2.8	2.8	1.33	1.33	0.41	0.41	2.00
1	Mast Pipe - 3 ft 2" Std	Mount Pipe	Worst	Zayo	28.5	0.95	31.25	10.98	N/A	36.00	2.38	2.38	15.2	15.2	0.98	0.98	0.58	0.58	10.98
2	Pipe to Pipe Clamp (Big)	Mount	Worst	Zayo	27	0.9	29.27	27.50	N/A	2.00	16.00	12.00	8.0	6.0	1.43	1.38	0.32	0.23	27.50
1	Airspan iR460-SPB-ST-1-P-0 w/ Side Arm	UE Relay	Worst	Zayo	25	0.95	30.40	14.70	N/A	15.00	8.52	8.52	1.8	1.8	0.51	0.51	0.46	0.46	14.70
1	Airspan AirHarmony 4400 w/ Mount & Sunshield	Radio Unit	Worst	Zayo	22	0.9	28.04	65.00	N/A	29.00	11.50	13.90	2.5	2.1	1.33	1.32	3.69	3.07	65.00
1	Tallysman GPS-ANT-3	GPS	Worst	Zayo	22	0.9	28.04	0.30	N/A	2.00	2.60	2.60	1.3	1.3	1.31	1.31	0.05	0.05	0.30
1	Transector 1101-1207-1012	AC Distribution	Worst	Zayo	19	0.9	27.19	17.00	N/A	12.00	12.00	4.00	1.0	3.0	1.30	1.33	1.30	0.44	17.00
1	Schneider DU221RB	Disconnect	Worst	Zayo	17	0.9	26.56	4.82	N/A	9.63	7.25	3.75	1.3	2.6	1.31	1.33	0.63	0.33	4.82
1	Milbank U4801-XL-5TP	Electric Meter	Worst	Zayo	5	0.9	25.90	21.00	N/A	19.00	13.00	4.84	1.5	3.9	1.31	1.35	2.24	0.86	21.00
1	LED Light	Light	Worst	Other	38.5	0.9	31.54	36.00	N/A	7.13	17.50	17.50	2.5	2.5	1.32	1.32	1.15	1.15	36.00

Load Summary

#	Appurtenance	Total Weight lbs	Norm. lbs	Tan. Force lbs
1	Alpha AW3613-S1-G	16.50	32.04	32.04
1	Small Cell Omni Mount	2.00	13.37	13.37
1	Mast Pipe - 3 ft 2" Std	10.98	20.03	20.03
2	Pipe to Pipe Clamp (Big)	27.50	10.26	10.26
1	Airspan iR460-SPB-ST-1-P-0 w/ Side Arm	14.70	15.22	15.22
1	Airspan AirHarmony 4400 w/ Mount & Sunshield	65.00	113.80	113.80
1	Tallysman GPS-ANT-3	0.30	1.45	1.45
1	Transector 1101-1207-1012	17.00	38.88	38.88
1	Schneider DU221RB	4.82	18.49	18.49
1	Milbank U4801-XL-5TP	21.00	63.90	63.90
1	LED Light	36.00	39.79	39.79

Antenna Wind Load Calculations

Project Name - Freddies (MS90XSU69)
Maple Grove, Minnesota
Edge #17270

Completed By: TAC
Checked By: KTS

Summary of Loading Relative to Grade

Component of the Tower	CENTROID X (ft)	CENTROID Y (ft)	CENTROID Z (ft)	F_{dead} (lb)	F_{side} (lb)	F_{front} (lb)
(1) Alpha AW3613-S1-G	-1.0	32.0	0.0	16.5	32.0	32.0
(1) Small Cell Omni Mount	-1.0	30.0	0.0	2.0	13.4	13.4
(1) Mast Pipe - 3 ft 2" Std	-1.0	28.5	0.0	11.0	20.0	20.0
(2) Pipe to Pipe Clamp (Big)	-1.0	27.0	0.0	55.0	20.5	20.5
(1) Airspan iR460-SPB-ST-1-P-0 w/ Side Arm	-1.5	25.0	0.0	14.7	15.2	15.2
(1) Airspan AirHarmony 4400 w/ Mount & Sunshield	0.0	22.0	0.0	65.0	113.8	113.8
(1) Tallysman GPS-ANT-3	0.0	22.0	0.0	0.3	1.5	1.5
(1) Transector 1101-1207-1012	0.0	19.0	0.0	17.0	38.9	38.9
(1) Schneider DU221RB	0.0	17.0	0.0	4.8	18.5	18.5
(1) Milbank U4801-XL-5TP	0.0	5.0	0.0	21.0	63.9	63.9
(1) LED Light	1.0	38.5	0.0	36.0	39.8	39.8
Base Plate	0.0	0.1	0.0	60.4	6.7	6.7
Base Pole Section 1	0.0	2.5	0.0	100.3	60.1	60.1
Base Pole Section 2	0.0	7.5	0.0	93.6	60.2	60.2
Base Pole Section 3	0.0	13.0	0.0	103.5	75.0	75.0
Base Pole Section 4	0.0	27.1	0.0	317.4	491.0	491.0

Resulting Forces at Base of Pole

F-X lb	F-Y lb	F-Z lb	M-X_{dead} ft-lb	M-Z_{dead} ft-lb	M-X_{side} ft-lb	M-Y_{side} ft-lb	M-Y_{front} ft-lb	M-Z_{front} ft-lb	Force - X lb	Force -Y lb	Force - Z lb	M-X_{force} ft-lb	M-Y_{Force} ft-lb	M-Z_{force} ft-lb
1070.5	-918.6	1070.5	0.0	5.9	1935.3	5.7	0.0	-1935.3	0.0	0.0	0.0	0.0	0.0	0.0

Controlling ASD Base Reactions

F-X lb	F-Y lb	F-Z lb	M-X ft-lb	M-Y ft-lb	M-Z ft-lb
-481.71	918.62	482	10451	31	10521

Possible Additional Loading for Coax/Cable 150 lb dead load

*Assuming Bolts are Ungrouted and have the orientation of MAXIMUMS

Number of Anchor Bolts = 4
Bolt Circle Diameter = 15 in

Max Tension in Bolt = 11710 lb
Max Compression in Bolt = 12131 lb
Max Shear in Bolt = 183 lb

Resulting Forces at Critical Elevation of 0 ft above concrete

F-X lb	F-Y lb	F-Z lb	M-X_{dead} ft-lb	M-Z_{dead} ft-lb	M-X_{side} ft-lb	M-Y_{side} ft-lb	M-Y_{front} ft-lb	M-Z_{front} ft-lb	Force - X lb	Force -Y lb	Force - Z lb	M-X_{force} ft-lb	M-Y_{Force} ft-lb	M-Z_{force} ft-lb
1070.5	-918.6	1070.5	0.0	5.9	1935.3	5.7	0.0	-1935.3	0.0	0.0	0.0	0.0	0.0	0.0

Controlling LRFD Forces

F-X lb	F-Y lb	F-Z lb	M-X ft-lb	M-Y ft-lb	M-Z ft-lb
-802.8	1102.3	802.8	17417.6	51.7	17502.3

Possible Additional Loading for Coax/Cable 150 lb dead load

LRFD Pole Capacities

P_T = 544.41 lb
D_P = 737.93 lb
P_r = 1408.78 lb
B = 1.059

φPn = 10889 lb
φMn = 78350 ft-lb
φVn = 90467 lb
φTn = 86109 ft-lb
P_e = 25117 lb

Axial Ratio = 0.118
Moment Ratio = 0.334
Shear Ratio = 0.013
Combined Ratio = 0.393

Controlling Combined Capacity

$$P_r = \sqrt[3]{\frac{I_B}{I_T}} \cdot P_T + 0.38 \cdot D_P$$

$$B = \frac{1}{1 - P_r/P_e}$$

$$If \left(\frac{V_r}{V_n} + \frac{T_r}{T_c}\right) > 0.2 \qquad \frac{P_r}{P_c} + \frac{BM_r}{M_c} + \left(\frac{V_r}{V_n} + \frac{T_r}{T_c}\right)^2 \leq 1.0$$

$$Else\ If \frac{P_r}{P_c} \geq 0.2 \qquad \frac{P_r}{P_c} + \frac{8}{9} \cdot \frac{BM_r}{M_c} \leq 1.0$$

$$Else \qquad \frac{P_r}{2 \cdot P_c} + \frac{BM_r}{M_c} \leq 1.0$$

Ratio = 0.393 **OK**

Drilled Pier Foundation Calculations

Project Name - Freddies (MS90XSU69)
Maple Grove, Minnesota
Edge #17270

Completed By: TAC
Checked By: KTS

Applied Loads:

Design Axial w/o Ice (P) =	0.919	kip	
Design Shear (V) =	681.2	lb	(Reactions w/o ice)
Design Moment (M) =	14829.3	ft-lb	

Foundation Dimensions & Soil Properties:

Pier Diameter (D_{pier}) =	2.50	ft	
Pier Total Height (H_{pier}) =	10.00	ft	
Pier Height Above Ground Surface (H_p) =	0.00	ft	
Pier MOI (I) =	39760.78	in^4	
Pier Area (A) =	706.86	in^2	
Water Table Depth (d_{wt}) =	99	ft	*Based on IBC Table 1806.2, Assumed Class 4 Soil
γ_{soil} =	100	lb/ft^3	
$\gamma_{soil(sub)}$ =	60	lb/ft^3	
φ_{soil} =	30	°	
Kp*γ =	300.00	psf/ft	
q_a =	2000	lb/ft^2	**Net**
γ_c =	150	lb/ft^3	
$\gamma_{c(sub)}$ =	87.6	lb/ft^3	*Concrete below the water table
$H_{pier(sub)}$ =	0.0	ft	

$$H_{ug} = H_{pier} - H_p$$

Underground Pier Length (H_{ug}) = 10.00 ft

Bearing Check

Distance on top of Ignored Skin Friction (d_{sf}) =	0.0	ft	
Allowable Skin Friction (F_a) =	0.0	psf	*All Friction is Ignored

$$W_{concrete} = \left(\left(\frac{D_{pier}}{2}\right)^2 \cdot \pi \cdot H_{ug}\right) \cdot \frac{\gamma_c - \gamma_{soil}}{1000} + \left(\left(\frac{D_{pier}}{2}\right)^2 \cdot \pi \cdot H_p\right) \cdot \frac{\gamma_c}{1000}$$

Weight of Concrete ($W_{concrete}$) = 2.5 kip

*γ_{soil} = 0 if q_a is not net

$$R_f = \pi \cdot D_{pier} \cdot \left(H_{ug} - d_{sf}\right) \cdot F_a$$

Applied Skin Friction (R_f) = 0.0 kip **Soil is beared**

$$q_{max} = \left(\frac{P + W_{concrete} - R_f}{\pi \cdot \left(\frac{D_{pier}}{2}\right)^2}\right) \cdot 1000$$

q_{max} = 687 psf **qmax < qa OK**

IBC Flagpole Nonconstrained Foundation Check

Isolated Pole Increase =	1.0		Per IBC 1806.3.4, Isolated poles not adversely affected by
Factor Of Safety =	2.0		1/2" motion at ground are allowed to be 2x Tabular Values
Allowable Lateral Soil-Bearing Pressure (S_1) =	500	psf	
Effective Height (h_{ef}) =	21.77	ft	

$$A = \frac{2.34 \cdot V}{S_1 \cdot D_{pier}}$$

A = 1.28 ft

$$H_{req} = 0.5 \cdot A \cdot \left(1 + \left(1 + \frac{4.36 \cdot h_{ef}}{A}\right)^{0.5}\right)$$

Required Embedment Depth (H_{req}) = 6.18 ft **OK**

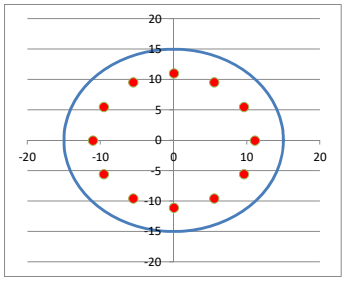
Concrete Column Strength Check

Project Name - Freddies (MS90XSU69)
Maple Grove, Minnesota
Edge #17270

Edge Consulting Engineers, Inc.

Completed By: TAC
Checked By: KTS

Concrete Column Parameters:

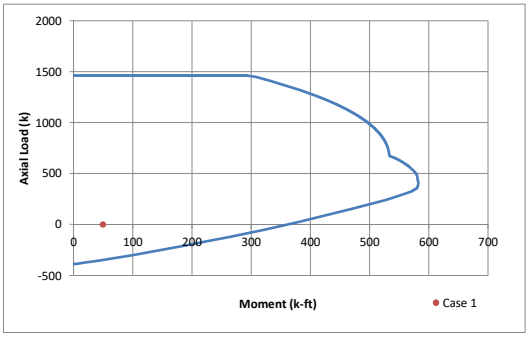


Strength Parameters

Concrete Design Stress (f'c) =	4.0	ksi
Steel Yield Stress (fy) =	60	ksi
Esteel =	29000	ksi

Geometry Parameters

Column Shape =	Circle	
Overall Width (b_w)=	2.50	ft
Overall Height (h)=	2.50	ft
Inner Opening Width =	0.00	ft
Inner Opening Height =	0.00	ft
Rebar Layout	Circle	
# of Vertical Rebar	12	
Size of Vertical Rebar	#7	
Clear Cover	3	in
Tie Size	#4	
Tie Spacing	12	in
Number of Shear Ties Within Spacing	2	



Resulting Foundation Parameters

Gross Area Concrete (A_{cg}) =	706.9	in^2
Provided Area of Vertical Steel (A_{spro}) =	7.20	in^2
Minimum Temperature and Shrinkage Steel =	1.27	in2

$$\rho_{stpro} = \frac{A_{spro}}{A_{cg}}$$

Provided Reinforcement Ratio (ρ_{stpro}) = 1.02%

Meets Min Requirements

Design Loads

Case 1

Applied Axial (Pu) =	1.35	kip
Applied Shear (Vu) =	21.39	kip
Applied Moment (Mu) =	49.21	kip-ft

Shear Capacity:

Additional Shear Strength Parameters

Lightweight Concrete Modification Factor (λ) =	1.0
Shear Strength Reduction Factor (ϕ) =	0.75

Steel

$$V_s = \frac{A_v f_y d}{s}$$

Concrete

$$X = \begin{cases} 500, & P_u < 0 \\ 2000, & P_u \geq 0 \end{cases}$$

$$V_c = 2\left(1 + \frac{P_u}{X \cdot A_g}\right)\lambda\sqrt{f_c'} \cdot b_w d$$

Capacity

$$\phi V_n = \phi(V_s + V_c)$$

Resulting Shear Capacities

Area of Steel provided (Av) =	0.40	in^2
Minimum Area of Steel (Av min) =	0.30	in^2
Steel Shear Capacity (Vs) =	48.00	kip

Case 1

Concrete Shear Capacity (Vc) =	91.07	kip
Nominal Shear Capacity (φVn) =	104.31	kip
DCR =	0.21	

OK