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FABRICATING

November 22, 2024

Archer-United Joint Venture
1021 Briargate Cir
Columbia, SC 29210

Attn: Anderson Bowers

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER
No. 35290
ROBERT R WIGINTON

Project: P039718
County: Lexington & Richland
Walpar Job No: C3546
Subject: OH-20 Footing Review

Nov 22 2024

Anderson,

This letter summarizes the findings from the design review of structure OH-20, specifically addressing the shear condition Vcr < Vca for the approved and installed spread foundations. The review was conducted using data provided by the concrete testing agency, which included the lowest 28-day break compressive strength f ′c (psi) of the concrete used for the foundation installation. The review focused on determining the required f ′c to ensure Vcr > Vca and compared this required value to the actual f ′c values obtained.

28-Day Break Information provided:

- OH-20L = 5850 psi.
- OH-20R = 7520 psi.

OH-20L:

- The required f c for the installed foundation was 3300 psi, giving Vcr = 73 psi > Vca = 72 psi
- Based on the break f ‘c = 5850 psi on the installed concrete gives additional capacity of 43.5% remaining beyond required.

OH-20R:

- The required f c for the installed foundation was 4300 psi, giving Vcr = 83 psi > Vca = 82 psi
- Based on the break f ‘c = 7520 psi on the installed concrete gives additional capacity of 42.8% remaining beyond required.

Based on the findings from this review comparing the actual compressive strength f ′c to the required design strength f ′c, I believe that the structure would be acceptable as installed. I have included updated calculations that reflect the revised required f ′c design values.

Should you have any questions, please don’t hesitate to contact me.

Sincerely,

Robert R Wiginton

Robert R. Wiginton, PE, M.ACSE/SEA

SCDOT
South Carolina Department of Transportation
ACCEPTED
☐ AS NOTED
REVIEWED BY: John Egan 3/6/24
DATE

INFRASTRUCTURE CONSULTING & ENGINEERING
SHOP DRAWING REVIEW
REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS OR DETAILS.

APPROVED	☒
APPROVED AS NOTED	☐
REVISE AND RESUBMIT	☐
REJECTED	☐

BY: PLC DATE: 1/10/25

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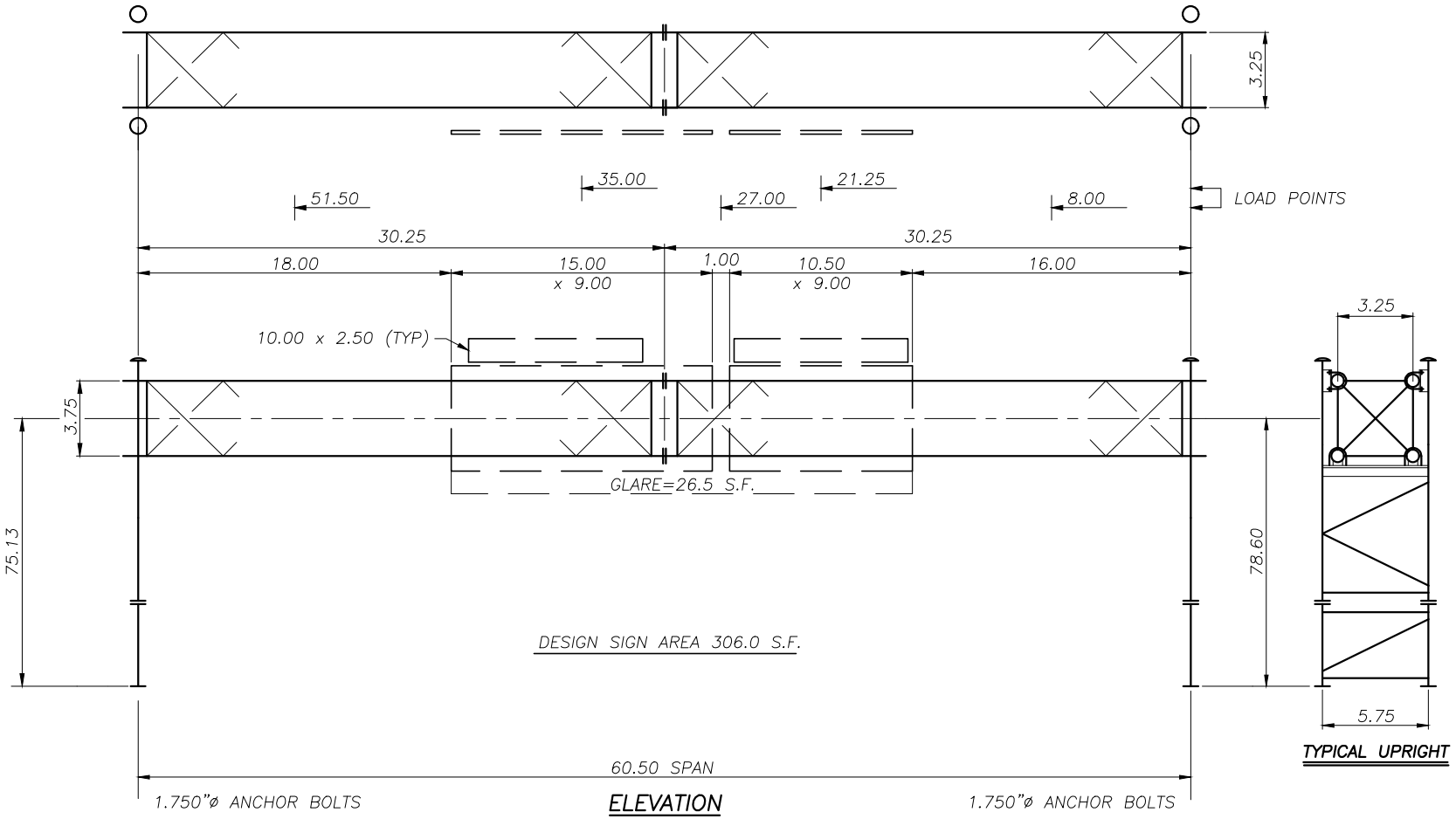

ELEVATION

STR NO: OH-20
STA NO: 5418+54.43(EB)

TRUSS:	CHORDS	4.500 x 0.188
	VERT DIAGONALS	1.660 x 0.140
	HORIZ DIAGONALS	1.660 x 0.140
	STRUTS	1.315 x 0.133
	INT DIAGONALS	1.315 x 0.133

UPRIGHTS:	LEFT POSTS	18.000 x 0.250
	STRUTS & DIAGONALS	4.500 x 0.188
	RIGHT POSTS	20.000 x 0.250
	STRUTS & DIAGONALS	5.563 x 0.188

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Robert R Wiginton

Nov 22 2024

Subject: Box Truss Design Information
Job No: C3546
By: RRW
Date: 11/22/24
Sheet: BT8
GROUP 2
Chk'd By: ---
Date: ---

Box Truss Double Pole Structure Design

Reference Walpar Job Number C3546
Reference Design Information Sheet Number BT8 Structure : OH-20 Station : 5418+54.43(EB)
State SC
AASHTO Specification 6th Edition Fatigue Category : II
Design Wind Velocity (V) 100 mph

Structure Dimensions

Span (S)	60.50 ft	Truss Hgt (U)	3.75 ft	Truss Depth (Y)	3.25 ft
Truss Section Length	31.25 ft			Coeff of Hgt (Kz)	1.21
Left Upright Hgt (H)	75.13 ft	Right Upright Hgt (H)	78.60 ft	Center to center of upright posts (Yu)	5.75 ft
Left Upright Splice Dist:	36.5208 ft	Right Upright Splice Dist:	41.1042 ft		

Sign Information **Design Sign Area: 306.00 sq ft** Z Ecc to bottom of Glare Screen

Sign	Load (i)	Lgth (B_i)	Hgt (D_i)	Location (a_i)	Unit Wgt	Depth	C_d	Front/Back	Z Ecc	Area	Exit Panel
1	2	10.50	9.00	21.25	7.00		1.13	F	5.50	130.5	X
2	4	15.00	9.00	35.00	7.00		1.14	F	5.50	175.5	X

Walkway Information

	Lgth	Location	Width	Unit wgt	Y Ecc
WW1	31.50	26.75	2.54	60	5.52

Load Summary Estimate for Field Use Only
(Distance from right end of assembled truss)

Weight of truss only	3148 lbs
Weight of erected signs & WW	3144 lbs
Center of erected sign & WW+truss load	30.69 ft
Front to Back Overturning on Truss	13024 ft-lbs
Max upright weight	10991 lbs
Max truss section weight	1589 lbs



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Loads

Unit wind load on sign(s)/C_d: 35.31 psf Unit wind load on exposed truss: 42.38 psf Unit wgt of truss: 49.82 plf Unit ice wgt on truss: 22.90 plf

Truss Area for Wind Load (A_t): 1.19 sq ft / ft ***All loads in charts in lbs, ft or ft-lbs unless noted**

Truss Load Summary For Actual Sign & WW Condition

	Load (i)	Dead	Wind (W_p & W_h)	Ice
Sign and Truss Loads Ref: (BT8)	1	797	806	366
	2	1437	5192	632
	3	50	50	23
	4	1976	7073	870
	5	897	907	412
WW Loads	WW1	1890	814	841
Left Reaction (R_L)		3374	7176	1507
Right Reaction (R_R)		3672	7666	1638
Maximum Moments (M)		68674	160531	30479
Point of "0" shear (A_m)		29.58	29.89	29.58

** WW/EQ Loads are incorporated into Sign and Truss Loads to determine Reactions and Moments

Serviceability Requirements

Truss DL + IL Deflection	0.44 in
Limit for Deflection	4.84 in
Camber Used (Cu)	1.56 in
Permanent Camber (Cp)	1.25 in

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Post Loads

	Dead	Wind	Ice	Group II t_c	Group III t_c	Lateral Stiffness Ratio
Left Upright	9504	4958	2651	1608	2413	0.45
Right Upright	10991	5731	3124	1198	1797	0.55

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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Load Combinations for Design Sign Area

Truss Member Loads	DL	DL +WL	DL+1/2 WL+IL
Truss Chords (Pc)	12398	37095	30243
Vertical Diagonals (Pv)	4348	5010	6519
Horizontal Diagonals (Ph)	1675	8035	5510
Vertical Struts (Psv)	3126	2312	3067
Horizontal Struts (Psh)	1118	5364	3678
Truss Moments			
Truss Chords (XMc)	706	4266	2523

Upright Member Loads	Upright Loads					Web Member Loads	
Left Upright	M_N	M_{tc}	V_N	V_{tc}	Axial	Diagonals	Struts
Group II Comb. 1 (DL+WL)	732489	174234	12134	3093	12878	18215	12880
Group III Comb. 1 (DL+1/2WL+IL)	366244	87117	6067	1546	17036	9108	6440
Group II Comb. 2 (DL+WL)	439493	261351	7281	4639	12878	11800	8344
Group III Comb. 2 (DL+1/2WL+IL)	219747	130675	3640	2320	17036	5900	4172
Right Upright							
Group II Comb. 1 (DL+WL)	1069534	165465	13397	2682	14663	20327	14373
Group III Comb. 1 (DL+1/2WL+IL)	534767	82732	6698	1341	19424	10163	7187
Group II Comb. 2 (DL+WL)	641721	248197	8038	4023	14663	12851	9087
Group III Comb. 2 (DL+1/2WL+IL)	320860	124099	4019	2012	19424	6425	4544

Material Information

	Pipe Size (Min Yield)	Unbraced Length	CSR Group II	CSR Group III
Truss Chords	4.500 x 0.188 (52 ksi)	7.25 ft	0.88	0.62
Vertical Diagonals	1.660 x 0.140 (52 ksi)	5.22 ft	0.51	0.66
Vertical Struts	1.315 x 0.133 (52 ksi)	3.75 ft	0.27	0.36
Horizontal Diagonals	1.660 x 0.140 (52 ksi)	4.87 ft	0.71	0.49
Horizontal Struts	1.315 x 0.133 (52 ksi)	3.25 ft	0.49	0.34

	Pipe Size (Min Yield)	Unbraced Length	CSR (Comb. 1) Group II	CSR (Comb. 1) Group III	CSR (Comb. 2) Group II	CSR (Comb. 2) Group III
Left Upright Posts	18.000 x 0.250 (52 ksi)	73.06 ft	0.62	0.32	0.72	0.37
Left Upright Diagonals	4.500 x 0.188 (52 ksi)	6.04 ft	0.21	0.11	0.14	0.07
Left Upright Strut	4.500 x 0.188 (52 ksi)	4.25 ft	0.14	0.07	0.09	0.04
Right Upright Posts	20.000 x 0.250 (52 ksi)	76.54 ft	0.55	0.29	0.61	0.31
Right Upright Diagonals	5.563 x 0.188 (52 ksi)	5.70 ft	0.18	0.09	0.11	0.06
Right Upright Strut	5.563 x 0.188 (52 ksi)	4.08 ft	0.12	0.06	0.08	0.04



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Structure Detail Information

Truss Chord Splices

Maximum Design Load at Splice	65503 lbs
Splice Moment (per inch of circum)	2896 in-lbs
Splice Bolt Circle	7.5 in.
Splice Bolt Qty & Size	4 - ¾" ø A325
Splice Plate Thickness	0.75 in.
Splice Plate Weld	¼ fillet

Upright Detail

	Left	Right
Maximuim Anchor Bolt Pullout	64634 lbs	63502 lbs.
Anchor Bolt Spacing	18 in.	20 in.
Anchor Bolt Yield	55 ksi	55 ksi
Anchor Bolt Qty & Size (ea pole)	4 - 1.75" ø	4 - 1.75" ø
Anchor Bolt Length (Embed)	4.50 ft (3.5 ft)	4.50 ft (3.5 ft)
Anchor Bolt CSR	0.87	0.84
Base Plate Thickness	2 in.	2 in.
Base Plate Weld	5/16 fillet	5/16 fillet
Truss Seat	W8x24	W8x24
Truss Connection U-Bolts	½" ø	½" ø
Splice Moment (per inch of circum)	4803 in. lbs	4809 in. lbs
Splice Bolt Circle	21 in.	23 in.
Splice Bolt Qty & Size	16 - 1" ø A325	16 - 1" ø A325
Splice Plate Thickness	1.25 in.	1.25 in.
Splice Plate Weld	5/16 fillet	5/16 fillet

Sign Hanger Detail

Design hanger spacing 9.00 ft

Sign Hanger U-Bolt type ASTM-A307

SIGN	Max UBL at End	Max Spacing	Hanger U-Bolt	Sign Hanger	Hanger Support
1	3.15 ft	9.00 ft	2 - ½" ø	L5x3x5/16	W6x9
2	3.15 ft	9.00 ft	2 - ½" ø	L5x3x5/16	W6x9

Structure Input (For Foundation Designs)

	Left	Right
Truss DL React (Rd)	4.45 k	4.96 k
Upr DL React (Rv)	9.50 k	10.99 k
Truss WL React (Rh)	7.20 k	7.71 k
Upr WL React (Wv)	4.96 k	5.73 k
Distance To Rh (H1)	75.13 ft	78.60 ft
Distance To Wv (H2)	38.50 ft	40.24 ft
Min Ped Lgth (PL)	8.50 ft	8.75 ft
Min Ped Wth (PW)	2.75 ft	3.00 ft



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Vibration and Fatigue (Per AASHTO 6th Edition)

Natural Wind Gust Load on Sign(s)/C_d	4.42 psf	Truck Induced Gust Load on Truss	17.02 psf
Natural Wind Gust Load on Truss	5.30 psf	Extent of Truck Induced Gust	12.00 ft
		Truss Area for Truck Induced Gust	1.16 sq ft / ft
		Location of Center of Truck Induced Gust	30.25 ft

Truck Induced Gust Loading

ID	P_{TG} (Uplift)	P_{TG} Torque	Location
Truss Chords	236		30.25
SIGN 1 (PARTIAL)			25.38
Walkway	1265	1862	30.25
Left Reaction	751		
Right Reaction	751		
Maximum Moments	20458		

Truss Load Summary for Natural Wind

LOADS (i)	$P_{NWG(i)}$
1	101
2	595
3	6
4	807
5	113
Left Reaction	834 lbs
Right Reaction	891 lbs
Maximum Moments	18534 ft-lbs

Load Combinations for Vibration and Fatigue

Truss Members	P_{NWG}	P_{TG}
Truss Chords	2851	2728
Vertical Diagonals		522
Horizontal Diagonals	334	
Vertical Struts		375
Horizontal Struts	223	
Upright Members		
Left Post	10894	375
Right Post	12181	375

Vibration and Fatigue Stresses

	NWG (ksi)	TIG (ksi)	Allowable (ksi)	
Truss Vertical Diagonals		0.78	1.20	
Truss Horizontal Diagonals	0.50		1.20	
Truss Vertical Struts		0.76	1.20	
Truss Horizontal Struts	0.45		1.20	
Truss chord at web members	0.34	1.07	4.50	
Upright Base Connection LT	0.78	0.03	2.60	Socket Connection Base Detail
Upright Base Connection RT	0.79	0.02	2.60	Socket Connection Base Detail
Anchor bolts - LT	1.43		7.00	
Anchor bolts - RT	1.60		7.00	



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Left Foundation Design

Boring Type SPT Boring Designation IB31-1
Major Soil Type Cohesionless Depth to Water 16.6 ft Surcharge (Frost) Depth 2 ft
Ground Slope 10:1 Consider slope stability? N

SOIL TYPES	
01-GP	07-SM
02-GW	08-ML
03-GM	09-MH
04-GC	10-SC
05-SP	11-CL
06-SW	12-CH

Soil Properties

Depth	N Value	γ' (pcf)	Φ (deg)	S_u (lbf/ft^2)	α	β	f_{SN} (lbf/ft^2)	$(N_1)_{60}$	Soil Type
**0 - 2	9	110	34	1125			259	18	10
2 - 6	13	107	34			1.07	618	26	07
6 - 11	30	121	40			1.11	7417	43	01
11 - 16.6	35	150	40	4000	0.55		1429	35	13
16.6 - 21	35	90	40	4000	0.55		7417	35	13
21 - 36	40	90	40	4000			7417	40	13
36 - 46	45	90	40	4000				45	13

* Soil Type 13 indicates rock layer with N>60 for cohesionless soil or N>40 for cohesive soils
**Top 2.0 ft of soil will not contribute to load resistance.

Soil Bearing Capacity for Left Spread Footing Design

Footing width, B 12.00 ft
Footing length, L 23.00 ft
Eccentricity, e_L 4.06 ft
Eccentricity, e_B 1.01 ft
Effective ftg width, B' 9.97 ft
Effective ftg width, L' 14.88 ft

Total wgt of load, foundation and soil, Pt 180.39 k
Normal moment, ML 732.04 ft-k
Transverse moment, Mw 182.72 ft-k
Distance from ground to bottom of footing, d_{min} 4.15 ft
Distance from ground to bottom of footing, D_f 4.75 ft
Distance to ground water from bottom of ftg, z_w 12.45 ft
Overburden pressure at base of footing, q 0.52 ksf
Weighted average soil unit weight below pad, γ 133 pcf

Ultimate bearing capacity, q_{ult} 60.00 ksf
Allowable Bearing Capacity 20.75 ksf
Bearing Capacity used *** 2.00 ksf

***Note: Bearing capacities greater than 4.0 ksf will rarely effect spread footing pad size



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Right Foundation Design

Boring Type SPT Boring Designation IB31-3
Major Soil Type Cohesionless Depth to Water 10 ft Surcharge (Frost) Depth 2 ft
Ground Slope 10:1 Consider slope stability? N

SOIL TYPES	
01-GP	07-SM
02-GW	08-ML
03-GM	09-MH
04-GC	10-SC
05-SP	11-CL
06-SW	12-CH

Soil Properties

Depth	N Value	γ' (pcf)	Φ (deg)	S_u (lbf/ft^2)	α	β	f_{SN} (lbf/ft^2)	$(N_1)_{60}$	Soil Type
**0 - 2	15	108	35			1.20	173	30	07
2 - 7.2	30	115	37			1.20	523	60	07
7.2 - 10	30	150	40	3750	0.55		1100	30	13
10 - 15.6	30	61	40			1.02	7417	35	01
15.6 - 30.6	40	90	40	4000	0.55		7417	40	13
30.6 - 45.6	45	90	40	4000			7417	45	13
							7417		

* Soil Type 13 indicates rock layer with N>60 for cohesionless soil or N>40 for cohesive soils
**Top 2.0 ft of soil will not contribute to load resistance.

Soil Bearing Capacity for Right Spread Footing Design

Footing width, B 12.00 ft
Footing length, L 24.00 ft
Eccentricity, e_L 4.40 ft
Eccentricity, e_B 1.11 ft
Effective ftg width, B' 9.78 ft
Effective ftg width, L' 15.20 ft

Total wgt of load, foundation and soil, Pt 190.08 k
Normal moment, ML 836.28 ft-k
Transverse moment, Mw 211.23 ft-k
Distance from ground to bottom of footing, d_{min} 4.15 ft
Distance from ground to bottom of footing, D_f 4.75 ft
Distance to ground water from bottom of ftg, z_w 5.25 ft
Overburden pressure at base of footing, q 0.46 ksf
Weighted average soil unit weight below pad, γ 96 pcf

Ultimate bearing capacity, q_{ult} 60.00 ksf
Allowable Bearing Capacity 20.00 ksf
Bearing Capacity used *** 2.00 ksf

***Note: Bearing capacities greater than 4.0 ksf will rarely effect spread footing pad size

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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Left Upright Spread Footing Design

Material/Soil Specifications and Safety Factors

Concrete f'_c :	3300 psi	Concrete wgt :	150 pcf
Rebar yield f_y :	60000 psi	Rebar F_s :	24000 psi
Soil Bearing Capacity :	2000 psf	Soil unit wgt :	110 pcf

Load Safety Factor[1] : 1.15

Loads and Locations From Structure

Truss DL React (Rd)	4.45 k	Base to Truss Load Dim (H1)	75.13 ft
Upright DL React (Rv)	9.50 k	Base to Upright Load Dim (H2)	38.50 ft
Truss WL React (Rh)	7.20 k	Total DL React (DL)	13.95 k
Upright WL React (Wv)	4.96 k	Transverse Wind Component (tc)	2.43 k

Loads at Top of Pedestal from Structure

Axial load (P)	13.95 k		
Moment (ML)	732.04 ft-k	Moment (Mw)	182.72 ft-k
Shear (VL)	12.16 k	Shear (Vw)	2.43 k

Final Spread Footing Design Sizes

Pad Length (L)	23.00 ft	Pedestal Width (PW)	2.75 ft
Pad Width (W)	12.00 ft	Pedestal Length (PL)	8.50 ft
Pad Thickness (T)	1.50 ft	Pedestal Projection at Ctr (PE)	0.75 ft
		Ground line to top of pad (PT)	3.25 ft

Reinforcement

Pad	Pedestal
Top each way - #4 Bars @ 12" o.c.	6 ea. - #8 Vert. Bars @ 5.00" o.c. @ Ends
X Direction - 12 - #8 Bars @ 12.00" o.c.	16 ea. - #8 Vert. Bars @ 5.53" o.c. @ Sides
Y Direction - 23 - #5 Bars @ 12" o.c.	5 - #4 Ties @ 12" max. o.c.

Serviceability

9.49% of footing in uplift

Safety factor against overturning = 30.67

Quantities

2170 lbs of reinforcement

18.80 cyd of concrete

Uncracked Section Calculations

Wgt of soil above pad (Ps)	90.31 k		
Wgt of concrete (Pc)	76.13 k	Total Area (A)	276.00 ft²
Total Load (Pt)	180.39 k		
X	11.50 ft	Y	6.00 ft
Ix	3312.00 ft⁴	Iy	12167.00 ft⁴
Mx	225.52 k-ft	My	918.76 k-ft

Corner Stresses [Factored[1] (unfactored) loads]

F1	1.93 ksf (1.76 ksf)
F2	1.11 ksf (1.05 ksf)
F3	-0.62 ksf (-0.46 ksf)
F4	0.19 ksf (0.25 ksf)

Cracked Section Calculations [Factored loads[1] (unfactored loads)]

A1	161.95 ft² (188.10 ft²)	L1	13.50 ft (15.68 ft)	W1	12.00 ft (12.00 ft)
A2	35.81 ft² (35.54 ft²)	L2	9.50 ft (7.32 ft)	W2	3.77 ft (4.85 ft)
A3	39.12 ft² (26.18 ft²)	L3	9.50 ft (7.32 ft)	W3	8.23 ft (7.15 ft)
A'	236.88 ft² (249.82 ft²)				
Xc	1.38 ft (0.95 ft)	X1	4.75 ft (3.66 ft)	Y1	0.00 ft (0.00 ft)
Yc	0.54 ft (0.38 ft)	X2	-6.75 ft (-7.84 ft)	Y2	4.12 ft (3.57 ft)
		X3	-5.16 ft (-6.62 ft)	Y3	-0.51 ft (-1.23 ft)
Ixc	2301.50 ft⁴ (2670.02 ft⁴)	X'	12.88 ft (12.45 ft)		
Iyc	9186.44 ft⁴ (9904.87 ft⁴)	Y'	6.54 ft (6.38 ft)		
Ixcyc	-1151.51 ft⁴ (-909.63 ft⁴)				
Mxc	128.52 ft-k (127.72 ft-k)				
Myc	670.55 ft-k (627.68 ft-k)				

Corner Stresses [Factored[1] (unfactored) loads]

F1	2.33 ksf (1.96 ksf)
F2	1.15 ksf (1.10 ksf)
F3	-0.81 ksf (-0.51 ksf)
F4	0.37 ksf (0.35 ksf)

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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Left Upright Spread Footing Design (cont.)

Moment and Shear Calculation Results

LL	7.25 ft	WW	4.63 ft	S_{y0}	1.74 ksf	S_{x0}	1.35 ksf
L_{x1}	8.88 ft	W_{x1}	0.00 ft	S_{y1}	1.52 ksf	S_{x1}	1.35 ksf
L_{x2}	5.42 ft	W_{x2}	3.46 ft	S_{y2}	1.22 ksf	S_{x2}	1.01 ksf
L_{y1}	2.63 ft	W_{y1}	6.00 ft	S_{y3}	1.12 ksf	S_{x3}	0.90 ksf
L_{y2}	3.46 ft	W_{y2}	2.54 ft	Pcs	0.58 ksf		
				DTS_y	11.08 k/ft	DTS_x	2.74 k/ft
				M_{YY}	25.08 ft-k	M_{XX}	6.61 ft-k

Reinforcement Calculations

f_{cr} : 1755.6 psi v_{cr} : 73 psi n : 8.86

b : 12.00 in d : 14.00 in x : 5.25 in

About Y Axis		About X Axis	
p :	0.0046	p :	0.0018
k :	0.2472	k :	0.1633
j :	0.9176	j :	0.9456
f_{ca} :	1128 psi	f_{ca} :	437 psi
v_{ca} :	72 psi	v_{ca} :	17 psi
Mt :	549529 in-k	Mt :	144918 in-k
ld_r :	24.80 in	ld_r :	26.47 in
ld_a :	84.00 in	ld_a :	52.50 in
ld_{min} :	52.22 in	ld_{min} :	32.64 in
A_{sr} :	0.73 in²	A_{sr} :	0.19 in²
A_s Used :	0.79 in²	A_s Used :	0.31 in²

Tie Size : #4

Pedestal Calculations

V_1 : 12402 lbs V_2 : 0 lbs V_t : 12402 lbs

About Y Axis		About X Axis	
C_x :	51.00 in	C_y :	16.50 in
G_x :	94.00 in	G_y :	25.00 in
f_a :	4.15 psi	f_v :	356.79 psi
F_a :	1756 psi	F_v :	26334 psi
f_{bx} :	30.79 psi	f_{by} :	418.22 psi
F_{bx} :	1756 psi	F_{by} :	1756 psi
M_x :	192453 ft-lb	M_y :	780684 ft-lb
M_{ox} :	577885 ft-lb	M_{oy} :	2172848 ft-lb
I_x :	3825057 in⁴	I_y :	369601 in⁴
A_g :	3366 in²	A_{sm} :	33.66 in²
A_{st} :	34.76 in²	A_s :	8.69 in²
QTY :	44	A_b :	0.79 in²
X Sp'g :	5.53 in	Y Sp'g :	5.00 in
C_{sx} :	28.90 in	C_{sy} :	11.00 in
N qty :	16	R qty :	6
CSR :	0.26	CSM :	0.69



Sliding friction μ : 0.40

Factor of safety against sliding : 4.75

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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Right Upright Spread Footing Design

Material/Soil Specifications and Safety Factors

Concrete f'_c :	4300 psi	Concrete wgt :	150 pcf
Rebar yield f_y :	60000 psi	Rebar F_s :	24000 psi
Soil Bearing Capacity :	2000 psf	Soil unit wgt :	110 pcf

Load Safety Factor[1] : 1.15

Loads and Locations From Structure

Truss DL React (Rd)	4.96 k	Base to Truss Load Dim (H1)	78.60 ft
Upright DL React (Rv)	10.99 k	Base to Upright Load Dim (H2)	40.24 ft
Truss WL React (Rh)	7.71 k	Total DL React (DL)	15.95 k
Upright WL React (Wv)	5.73 k	Transverse Wind Component (tc)	2.69 k

Loads at Top of Pedestal from Structure

Axial load (P)	15.95 k		
Moment (ML)	836.28 ft-k	Moment (Mw)	211.23 ft-k
Shear (VL)	13.44 k	Shear (Vw)	2.69 k

Final Spread Footing Design Sizes

Pad Length (L)	24.00 ft	Pedestal Width (PW)	3.00 ft
Pad Width (W)	12.00 ft	Pedestal Length (PL)	8.75 ft
Pad Thickness (T)	1.50 ft	Pedestal Projection at Ctr (PE)	0.75 ft
		Ground line to top of pad (PT)	3.25 ft

Reinforcement

Pad	Pedestal
Top each way - #4 Bars @ 12" o.c.	6 ea. - #8 Vert. Bars @ 5.60" o.c. @ Ends
X Direction - 12 - #9 Bars @ 12.00" o.c.	18 ea. - #8 Vert. Bars @ 5.11" o.c. @ Sides
Y Direction - 24 - #5 Bars @ 12" o.c.	5 - #4 Ties @ 12" max. o.c.

Serviceability

11.10% of footing in uplift

Safety factor against overturning = 28.48

Quantities

2506 lbs of reinforcement

19.89 cyd of concrete

Uncracked Section Calculations

Wgt of soil above pad (Ps)	80.55 k		
Wgt of concrete (Pc)	93.58 k	Total Area (A)	288.00 ft²
Total Load (Pt)	190.08 k		
X	12.00 ft	Y	6.00 ft
Ix	3456.00 ft⁴	Iy	13824.00 ft⁴
Mx	259.91 k-ft	My	1046.71 k-ft

Corner Stresses [Factored[1] (unfactored) loads]

F1	2.02 ksf (1.84 ksf)
F2	1.12 ksf (1.06 ksf)
F3	-0.70 ksf (-0.52 ksf)
F4	0.20 ksf (0.26 ksf)

Cracked Section Calculations [Factored loads[1] (unfactored loads)]

A1	152.57 ft² (183.81 ft²)	L1	12.71 ft (15.32 ft)	W1	12.00 ft (12.00 ft)
A2	41.75 ft² (40.08 ft²)	L2	11.29 ft (8.68 ft)	W2	3.70 ft (4.62 ft)
A3	46.84 ft² (32.06 ft²)	L3	11.29 ft (8.68 ft)	W3	8.30 ft (7.38 ft)
A'	241.16 ft² (255.94 ft²)				
Xc	1.60 ft (1.14 ft)	X1	5.64 ft (4.34 ft)	Y1	0.00 ft (0.00 ft)
Yc	0.63 ft (0.44 ft)	X2	-6.36 ft (-7.66 ft)	Y2	4.15 ft (3.69 ft)
		X3	-4.48 ft (-6.21 ft)	Y3	-0.47 ft (-1.08 ft)
Ixc	2169.68 ft⁴ (2624.56 ft⁴)	X'	13.60 ft (13.14 ft)		
Iyc	10218.67 ft⁴ (10981.42 ft⁴)	Y'	6.63 ft (6.44 ft)		
Ixcyc	-1367.99 ft⁴ (-1105.22 ft⁴)				
Mxc	140.55 ft-k (141.76 ft-k)				
Myc	742.58 ft-k (693.40 ft-k)				

Corner Stresses [Factored[1] (unfactored) loads]

F1	2.58 ksf (2.11 ksf)
F2	1.13 ksf (1.10 ksf)
F3	-1.00 ksf (-0.62 ksf)
F4	0.45 ksf (0.39 ksf)



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Right Upright Spread Footing Design (cont.)

Moment and Shear Calculation Results

LL	7.63 ft	WW	4.50 ft	S_{y0}	1.85 ksf	S_{x0}	1.51 ksf
L_{x1}	8.88 ft	W_{x1}	0.00 ft	S_{y1}	1.58 ksf	S_{x1}	1.51 ksf
L_{x2}	5.54 ft	W_{x2}	3.33 ft	S_{y2}	1.28 ksf	S_{x2}	1.11 ksf
L_{y1}	3.13 ft	W_{y1}	6.00 ft	S_{y3}	1.18 ksf	S_{x3}	0.97 ksf
L_{y2}	3.33 ft	W_{y2}	2.67 ft	Pcs	0.58 ksf		
			0.00 ft	DTS_y	12.55 k/ft	DTS_x	3.16 k/ft
			0.00 ft	M_{YY}	30.41 ft-k	M_{XX}	7.59 ft-k

Reinforcement Calculations

f_{cr} : 2287.6 psi v_{cr} : 83 psi n : 7.76

b : 12.00 in d : 14.00 in x : 5.25 in

About Y Axis		About X Axis	
p :	0.0056	p :	0.0018
k :	0.2536	k :	0.1537
j :	0.9155	j :	0.9488
f_{ca} :	1336 psi	f_{ca} :	531 psi
v_{ca} :	82 psi	v_{ca} :	20 psi
Mt :	666260 in-k	Mt :	166227 in-k
ld_r :	26.55 in	ld_r :	26.29 in
ld_a :	88.50 in	ld_a :	51.00 in
ld_{min} :	51.47 in	ld_{min} :	28.59 in
A_{sr} :	0.89 in²	A_{sr} :	0.21 in²
A_s Used :	1.00 in²	A_s Used :	0.31 in²

Tie Size : #4

Pedestal Calculations

V_1 : 13702 lbs V_2 : 0 lbs V_t : 13702 lbs

About Y Axis		About X Axis	
C_x :	52.50 in	C_y :	18.00 in
G_x :	97.00 in	G_y :	28.00 in
f_a :	4.22 psi	f_v :	361.35 psi
F_a :	2288 psi	F_v :	26334 psi
f_{bx} :	31.82 psi	f_{by} :	396.28 psi
F_{bx} :	2288 psi	F_{by} :	2288 psi
M_x :	221979 ft-lb	M_y :	890030 ft-lb
M_{ox} :	706070 ft-lb	M_{oy} :	2446030 ft-lb
I_x :	4395615 in⁴	I_y :	485127 in⁴
A_g :	3780 in²	A_{sm} :	37.80 in²
A_{st} :	37.92 in²	A_s :	9.48 in²
QTY :	48	A_b :	0.79 in²
X Sp'g :	5.11 in	Y Sp'g :	5.60 in
C_{sx} :	29.36 in	C_{sy} :	12.47 in
N qty :	18	R qty :	6
CSR :	0.19	CSM :	0.68



Sliding friction μ : 0.40

Factor of safety against sliding : 4.53

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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Left Upright Cylindrical Footing Design

Concrete f'_c :	3000 psi	Concrete wgt :	150 pcf
Rebar yield f_y :	60000 psi	Min factor of safety for uplift :	1.00
Reinforcement Clear. :	4 in	Min factor of safety for lateral load :	2.86

Loads and Locations From Structure

Truss DL React (Rd)	4.45 k	Base to Truss Load Dim (H1)	75.13 ft
Upright DL React (Rv)	9.50 k	Base to Upright Load Dim (H2)	38.50 ft
Truss WL React (Rh)	7.20 k	Footing Projection at Ctr (H3)	0.75 ft
Upright WL React (Wv)	4.96 k	C/C of Cylinders (C)	5.75 ft

Normal Overturning Moment (M_{WL})	741.16 ft-k	Effective Hgt (H_{eff})	60.94 ft
Transverse Moment (M_{TL})	148.23 ft-k	Lateral Load (P_{eff})	6.27 k
Resultant Moment (M_R)	755.84 ft-k	Axial Force	10.47 k
Effective Overturning Moment	509.79 ft-k		

Final Cylindrical Footing Design Sizes

Req'd area of steel (A_s)	13.64 in²	Rebar Cage Dia (D1)	37.88 in
1% Cyl Area Min (A_m)	18.10 in²	Vertical bar spacing	6.26 in
Actual Reinf Area (A_p)	19.00 in²		

USE 48 in DIA x 19'- 0 CYLINDER
w/ 19- # 9 VERT. BARS & 20 - #4 HOOPS

Serviceability	Quantities
Calculated lateral safety factor = 13.2	2690 lbs of reinforcement
Calculated uplift safety factor = 8.6	17.69 cyd of concrete

Side Shear Results
(from Beta Method)

Cylinder Embedment	18.25 ft
Axial load	6.98 k
Uplift load	88.66 k
Weight of shaft	35.81 k
Side Resistance Capacity	765.09 k

Lateral Load Calculation Results
(from Brom's Method)

Soil friction angle Φ	37.6°
Soil unit weight γ	116 pcf
Average $(N_1)_{60}$ over eff depth (BPF)	32
Effective lateral load on cylinder	6.27 k
Effective moment on cylinder	382.34 ft-k
Axial thrust from moment and vertical loads	99.12 k
Rankine Passive Pressure Coeff. K_P	5.50
Ultimate soil resistance P_{ult}	406.88 k
Allowable soil resistance P_{max}	189.21 k
Ultimate soil moment capacity M_{ult}	5457 ft-k
Allowable soil moment capacity M_{max}	2538 ft-k
Ground line moment	387 ft-k
Dist. from GL to 0 shear point in cyl.	3.28 ft
Maximum moment in shaft	412 ft-k



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Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-20 Station : 5418+54.43(EB)

Right Upright Cylindrical Footing Design

Concrete f'_c :	3000 psi	Concrete wgt :	150 pcf
Rebar yield f_y :	60000 psi	Min factor of safety for uplift :	1.00
Reinforcement Clear. :	4 in	Min factor of safety for lateral load :	2.86

Loads and Locations From Structure

Truss DL React (Rd)	4.96 k	Base to Truss Load Dim (H1)	78.60 ft
Upright DL React (Rv)	10.99 k	Base to Upright Load Dim (H2)	40.24 ft
Truss WL React (Rh)	7.71 k	Footing Projection at Ctr (H3)	0.75 ft
Upright WL React (Wv)	5.73 k	C/C of Cylinders (C)	5.75 ft

Normal Overturning Moment (M_{WL})	846.36 ft-k	Effective Hgt (H_{eff})	62.99 ft
Transverse Moment (M_{TL})	169.27 ft-k	Lateral Load (P_{eff})	7.28 k
Resultant Moment (M_R)	863.12 ft-k	Axial Force	11.97 k
Effective Overturning Moment	611.33 ft-k		

Final Cylindrical Footing Design Sizes

Req'd area of steel (A_s)	16.38 in²	Rebar Cage Dia (D1)	37.88 in
1% Cyl Area Min (A_m)	18.10 in²	Vertical bar spacing	6.26 in
Actual Reinf Area (A_p)	19.00 in²		

USE 48 in DIA x 19'- 0 CYLINDER
w/ 19- # 9 VERT. BARS & 20 - #4 HOOPS

Serviceability	Quantities
Calculated lateral safety factor = 8.8	2690 lbs of reinforcement
Calculated uplift safety factor = 6.1	17.69 cyd of concrete

Side Shear Results
(from Beta Method)

Cylinder Embedment	18.25 ft
Axial load	7.98 k
Uplift load	106.32 k
Weight of shaft	35.81 k
Side Resistance Capacity	648.91 k

Lateral Load Calculation Results
(from Brom's Method)

Soil friction angle Φ	38.4°
Soil unit weight γ	105 pcf
Average $(N_1)_{60}$ over eff. depth (BPF)	46
Effective lateral load on cylinder	7.28 k
Effective moment on cylinder	458.49 ft-k
Axial thrust from moment and vertical loads	118.28 k
Rankine Passive Pressure Coeff. K_P	4.85
Ultimate soil resistance P_{ult}	325.53 k
Allowable soil resistance P_{max}	151.38 k
Ultimate soil moment capacity M_{ult}	4366 ft-k
Allowable soil moment capacity M_{max}	2030 ft-k
Ground line moment	464 ft-k
Dist. from GL to 0 shear point in cyl.	3.54 ft
Maximum moment in shaft	495 ft-k



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