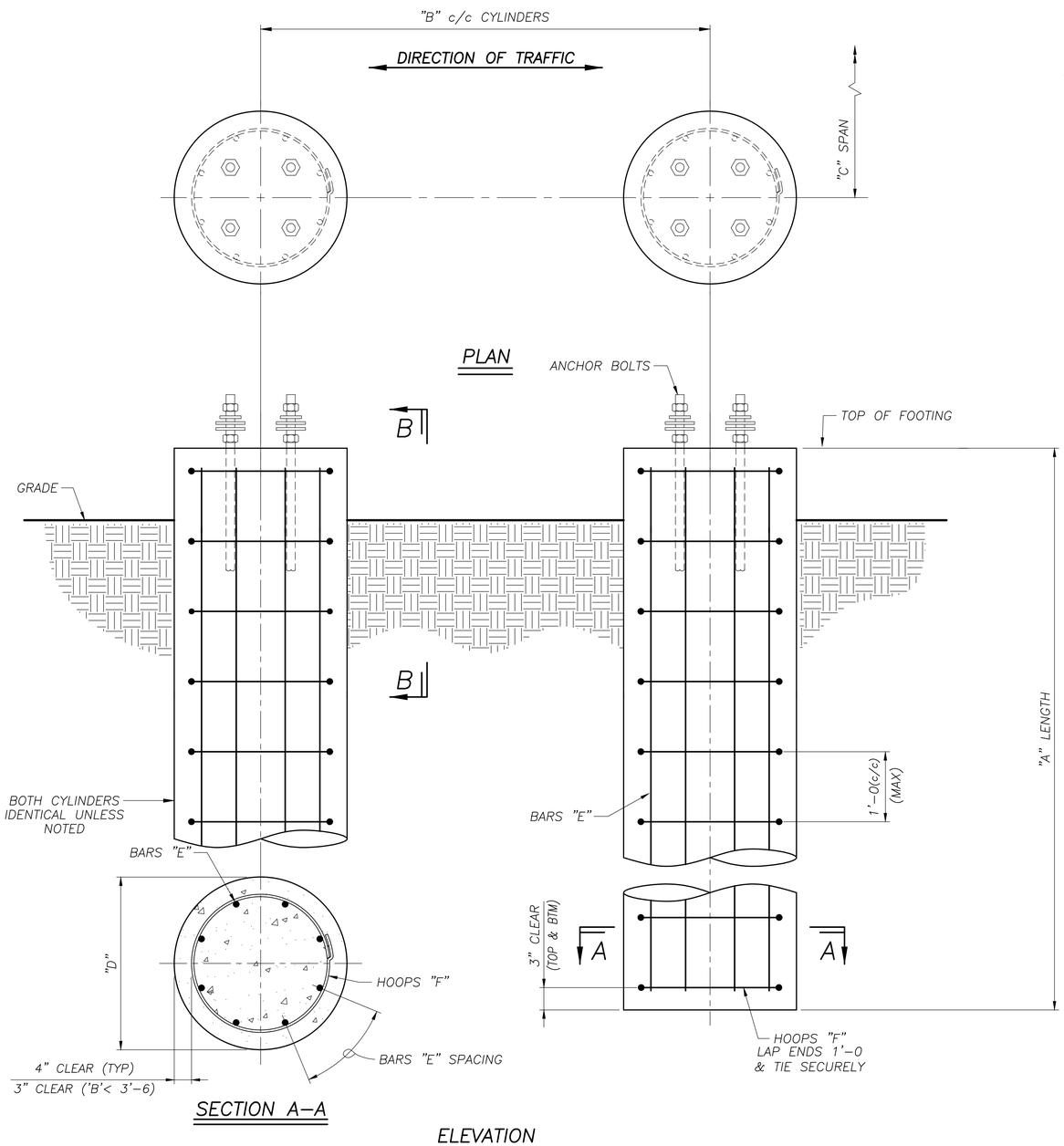
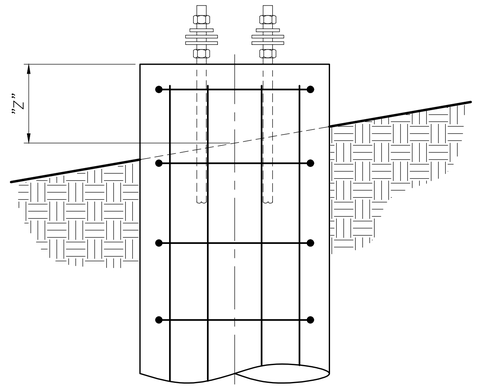
STRUCTURE	STATION	LENGTH "A"	"B"	SPAN "C"	CYL DIA "D"	BARS "E" (±)c/c (per cyl)	HOOPS "F" (±)c/c (per cyl)	TOTAL FOR FOUNDATION REBAR WT	TOTAL FOR FOUNDATION CONCRETE (cu yds)	"Z"
OH–9(L)	7393+20.45 (WB)	22'–0	5'–6	75'–0	4'–0	19 – #9 @ 6¼	23 – #4 @ 1'–0	3122	20.48	1'–6
OH–9(R)	7393+20.45 (WB)	25'–0	5'–6	75'–0	4'–0	16 – #10 @ 7 7/16	26 – #4 @ 1'–0	3763	23.27	1'–9
OH–11(R)	412+69.92 (EB)	17'–0	5'–3	104'–0	3'–0	13 – #8 @ 6¾	18 – #4 @ 1'–0	1352	8.90	1'–6
OH–14(R)	428+79.25 (EB)	24'–0	5'–3	84'–0	3'–6	14 – #9 @ 7⅛	25 – #4 @ 1'–0	2559	17.10	1'–6
OH–23(L)	5424+27.06 (EB)	23'–0	5'–6	70'–0	3'–0	13 – #8 @ 6¾	24 – #4 @ 1'–0	1837	12.04	1'–0
OH–23(R)	5424+27.06 (EB)	18'–0	5'–6	70'–0	4'–0	19 – #9 @ 6¼	19 – #4 @ 1'–0	2546	16.76	9"
2										



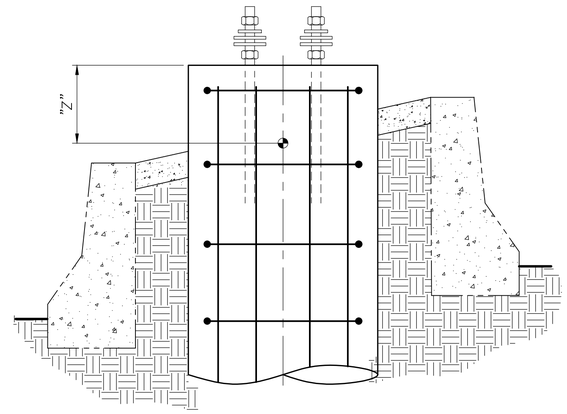
SECTION A–A

ELEVATION

DOUBLE POLE OVERHEAD FOOTING



SECTION B–B



* SECTION B–B

(USE FOR OH–23(L) ONLY)

SCDOT
South Carolina Department of Transportation

ACCEPTED

[X] AS NOTED

REVIEWED BY: John Egan 8/20/24
DATE

Note: OH-16 sign hangers 36S4 & 36S2 should be swapped to fit 16.0' retained sign. See mark-up on previous submittal.

NOTE:

SEE GENERAL NOTES DRAWING FOR MATERIAL SPECIFICATIONS, FOUNDATION AND STANDARD NOTES

GROUP 1

AASHTO 6th Edition Spec's

SEALED BY:

SOUTH CAROLINA PROFESSIONAL ENGINEER
No. 38665
DAVID A LALLONE

Jun 21 2024

walpar
A valmont COMPANY

POST OFFICE BOX 28650
BIRMINGHAM ALABAMA 35228
4200 JEFFERSON AVENUE
BIRMINGHAM ALABAMA 35221
PHONE (205)–925–4990
FAX (205) 925–7273

2

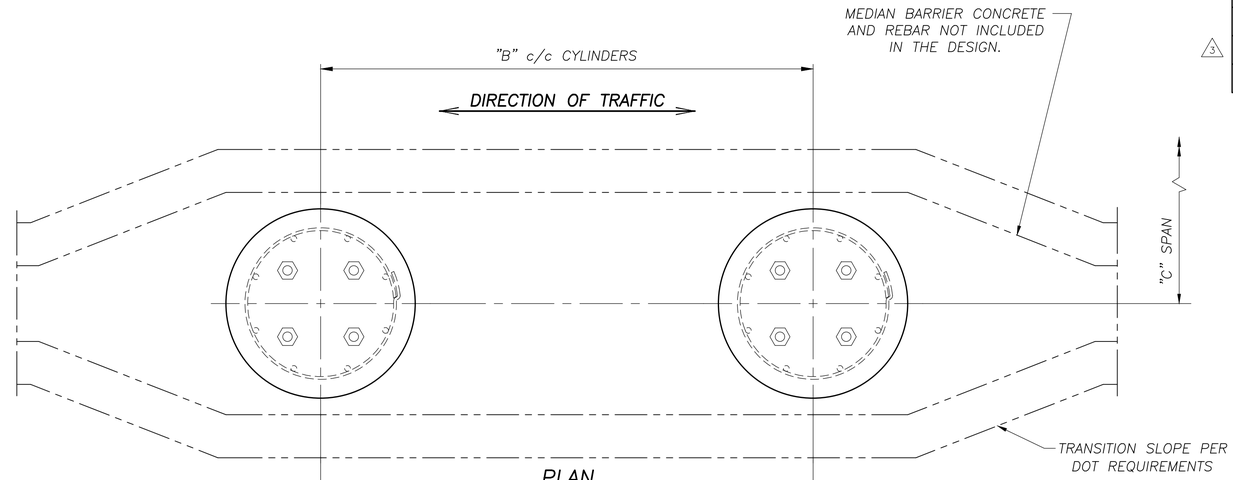
STATE:	South Carolina
FED PROJ:	Carolina Crossroads Phase 1 & 2
ST PROJ:	P039718
COUNTY:	Lexington & Richland
ROUTE:	I–26 & I–126
SUBJECT:	OVERHEAD SIGN SUPPORT
	CYLINDRICAL FOOTING DRAWING
FOR:	Archer–United Joint Venture
DRAWN BY:	IWL DATE: 7/19/23
CHECKED BY:	DAL DATE: 8/18/23
DWG NO:	C3546–D6

NO:	REVISIONS	DATE	MADE	CHECKED
2	MOVED OH–16(R) TO DRAWING D22	6/21/24	IWL	DAL

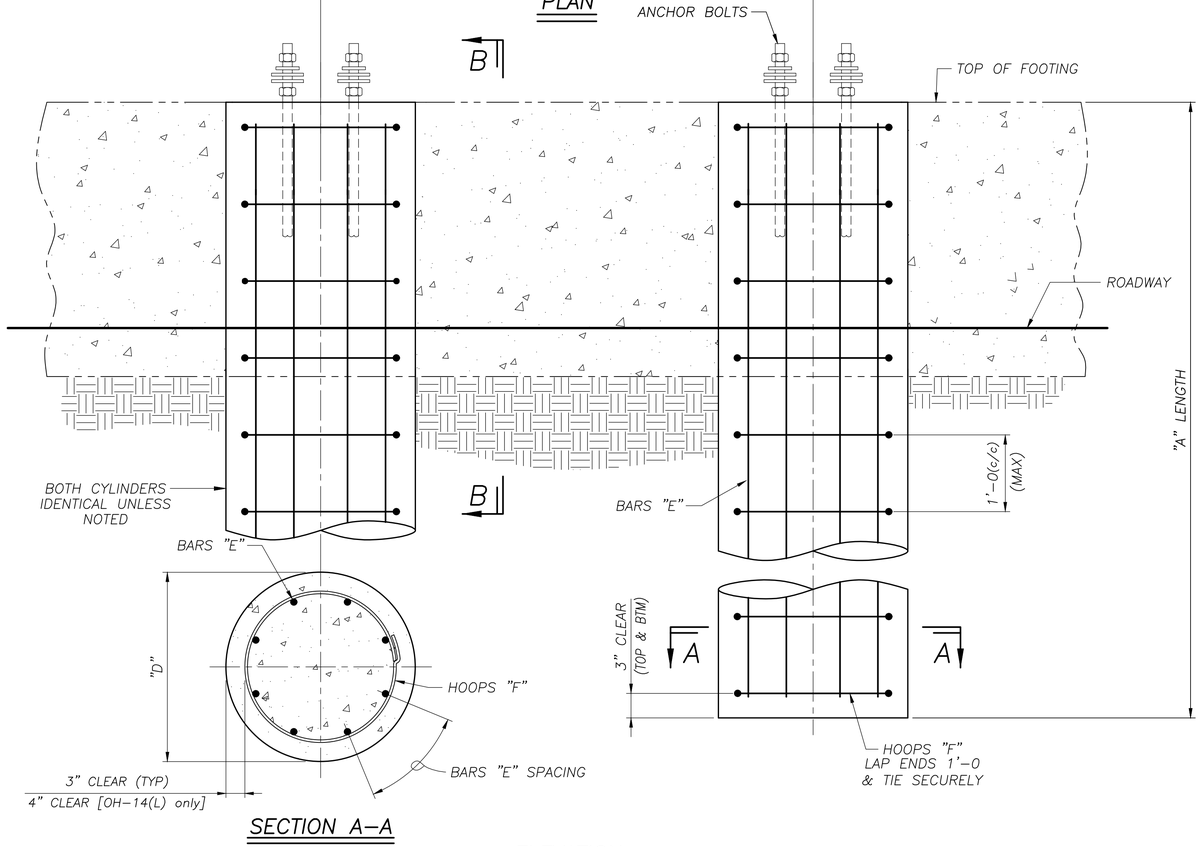
DP–CF–D

STRUCTURE	STATION	LENGTH "A"	"B"	SPAN "C"	CYL DIA "D"	BARS "E" (±)c/c (per cyl)	HOOPS "F" (±)c/c (per cyl)	TOTAL FOR FOUNDATION REBAR WT	TOTAL FOR FOUNDATION CONCRETE (cu yds)	"Z"	"ZZ"
OH–11(L)	412+69.92 (EB)	23'–0	5'–3	104'–0	3'–0	12 – #9 @ 7 5/16	24 – #4 @ 1'–0	2111	12.04	3'–10	3'–10
OH–14(L)	428+79.25 (EB)	23'–0	5'–3	84'–0	3'–6	16 – #9 @ 6 1/4	24 – #4 @ 1'–0	2757	16.39	5'–0	4'–6
OH–16(L)	440+94.34 (WB)	20'–0	7'–0	95'–0	3'–0	13 – #8 @ 6 3/4	21 – #4 @ 1'–0	1595	10.47	4'–5 3/4	4'–6 3/4
OH–26(L)	37+34.06 (WB)	21'–0	4'–9	96'–0	2'–6	9 – #8 @ 7 11/16	22 – #4 @ 1'–0	1192	7.64	4'–6 1/2	4'–6 1/2

3



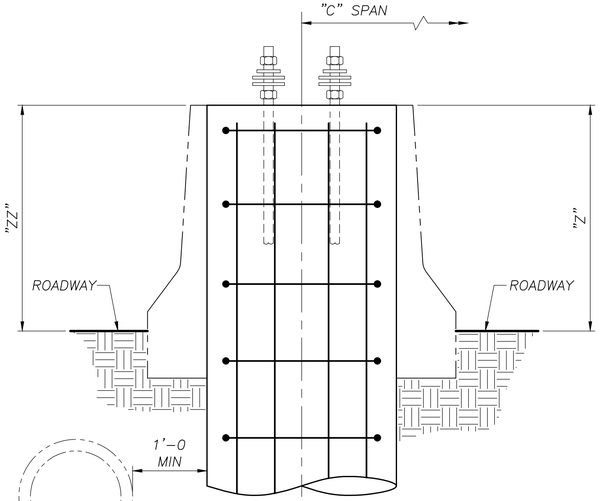
PLAN



SECTION A–A

ELEVATION

DOUBLE POLE OVERHEAD FOOTING



SECTION B–B

ANY ENCOUNTERS WITH RCP DRAINAGE PIPES DURING THE INSTALLATION OF A FOUNDATION SHOULD BE ROUTED AROUND AFTER THE FOUNDATION IS COMPLETED WITH 1'–0 CLEAR

NOTE:
SEE GENERAL NOTES DRAWING FOR MATERIAL SPECIFICATIONS, FOUNDATION AND STANDARD NOTES

GROUP 1

AASHTO 6th Edition Spec's

SEALED BY:

SOUTH CAROLINA PROFESSIONAL ENGINEER
No. 38665
DAVID A LALLONE

Jun 21 2024

NO:	REVISIONS	DATE	MADE	CHECKED
3	CORRECTED QUANTITY	6/21/24	IWL	DAL

walpar
A valmont COMPANY
POST OFFICE BOX 28650
BIRMINGHAM ALABAMA 35228
4200 JEFFERSON AVENUE
BIRMINGHAM ALABAMA 35221
PHONE (205)–925–4990
FAX (205) 925–7273

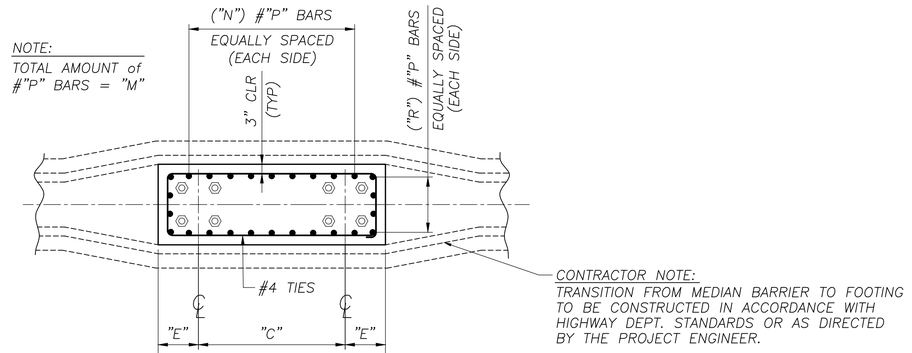
3

STATE:	South Carolina
FED PROJ:	Carolina Crossroads Phase 1 & 2
ST PROJ:	P039718
COUNTY:	Lexington & Richland
ROUTE:	I–26 & I–126
SUBJECT:	OVERHEAD SIGN SUPPORT CYLINDRICAL FOOTING DRAWING
FOR:	Archer–United Joint Venture
DRAWN BY:	IWL DATE: 7/19/23
CHECKED BY:	DAL DATE: 8/18/23
DWG NO:	C3546–D7

DP–CF–D

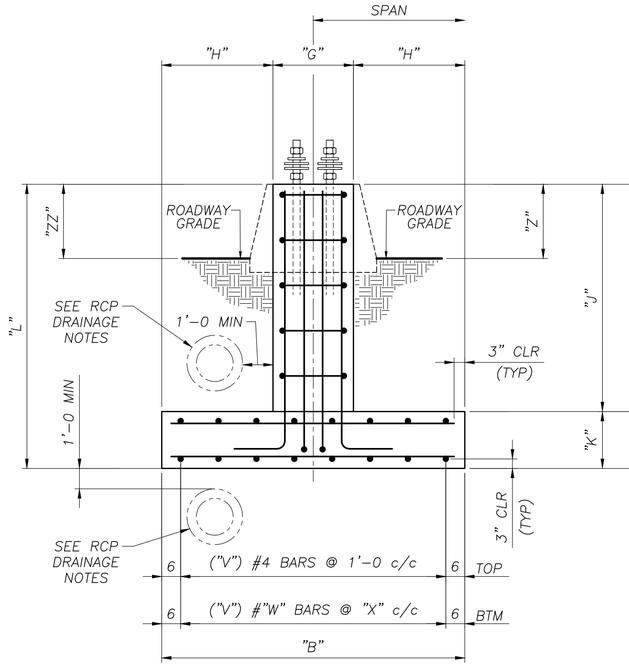
STRUCTURE	STATION	CONC/FTG (yds[3])	REINF/FTG (lbs)	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"	"M"	"N"	"P"	"R"	"S"	"T"	"U"	"V"	"W"	"X"	"Z"	"ZZ"
OH–11(L)	412+69.92 (EB)	14.79	1637	21'–0	10'–0	5'–3	7'–6	1'–1½	6'–9	2'–3	3'–10½	5'–0	1'–6	6'–6	32	12	8	4	6	21	4	10	8	1'–0	3'–10	3'–10
OH–14(L)	428+79.25 (EB)	17.51	2184	22'–0	11'–0	5'–3	7'–6	1'–1½	7'–3	2'–3	4'–4½	6'–6	1'–6	8'–0	32	12	8	4	7	22	5	11	9	1'–0	5'–0	4'–6
OH–16(L)	440+94.34 (WB)	14.13	1721	19'–0	9'–0	7'–0	9'–3	1'–1½	4'–10½	2'–3	3'–4½	6'–0	1'–6	7'–6	40	16	8	4	7	19	5	9	7	1'–0	4'–5¾	4'–6¾
OH–26(L)	37+34.06 (WB)	10.11	1130	16'–0	8'–0	4'–9	6'–9	1'–0	4'–7½	2'–0	3'–0	6'–0	1'–6	7'–6	28	10	8	4	7	16	4	8	6	1'–0	4'–6½	4'–6½

2



NOTE:
TOTAL AMOUNT of #"P" BARS = "M"

CONTRACTOR NOTE:
TRANSITION FROM MEDIAN BARRIER TO FOOTING TO BE CONSTRUCTED IN ACCORDANCE WITH HIGHWAY DEPT. STANDARDS OR AS DIRECTED BY THE PROJECT ENGINEER.



END VIEW
(LOOKING IN DIRECTION OF TRAFFIC)

SIDE VIEW
(PARALLEL TO ROADWAY)

RCP DRAINAGE NOTE:

ANY ENCOUNTERS WITH RCP DRAINAGE PIPES DURING THE INSTALLATION OF A FOUNDATION SHOULD BE ROUTED AROUND THE PEDESTAL AS SHOWN IN END VIEW IF LOCATED ABOVE PAD OF FOOTING. IF THE RCP PIPE IS LOCATED BELOW PAD OF THE FOUNDATION, RCP PIPE MUST HAVE A MINIMUM OF 1'–0 PACKED COVER.

NOTE:

SEE GENERAL NOTES DRAWING FOR MATERIAL SPECIFICATIONS, FOUNDATION AND STANDARD NOTES

GROUP 1

AASHTO 6th Edition Spec's

SEALED BY:

SOUTH CAROLINA PROFESSIONAL ENGINEER
DAVID A LALLONE
No. 38665

Jun 21 2024

NO:	REVISIONS	DATE	MADE	CHECKED
2	CORRECTED QUANTITY	6/21/24	IWL	DAL

walpar
A valmont COMPANY
POST OFFICE BOX 28650
BIRMINGHAM ALABAMA 35228
4200 JEFFERSON AVENUE
BIRMINGHAM ALABAMA 35221
PHONE (205)–925–4990
FAX (205) 925–7273

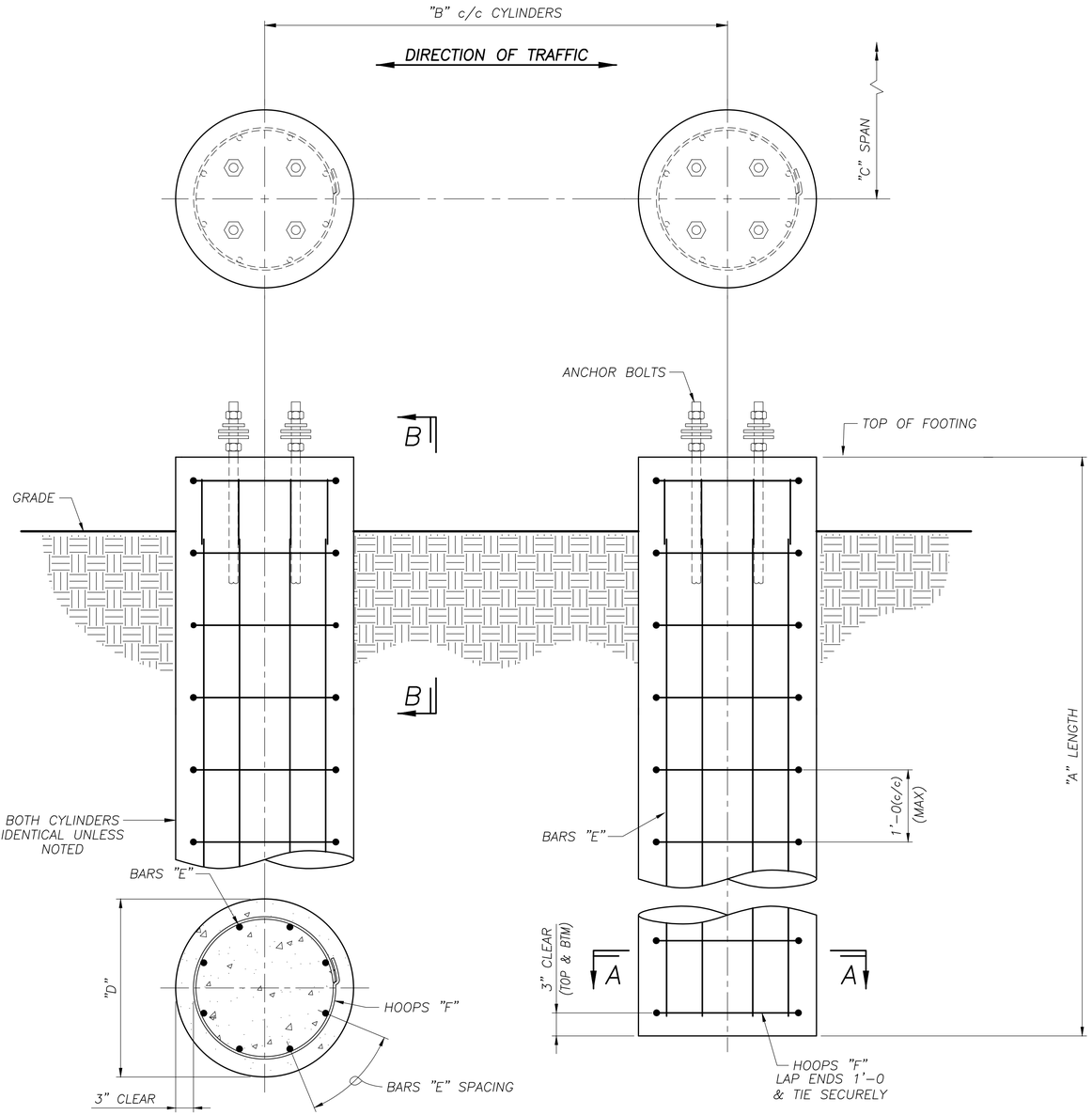
2

STATE:	South Carolina
FED PROJ:	Carolina Crossroads Phase 1 & 2
ST PROJ:	P039718
COUNTY:	Lexington & Richland
ROUTE:	I–26 & I–126
SUBJECT:	OVERHEAD SIGN SUPPORT
	MEDIAN SPREAD FOOTING DRAWING
FOR:	Archer–United Joint Venture
DRAWN BY:	IWL DATE: 7/19/23
CHECKED BY:	DAL DATE: 8/21/23
DWG NO:	C3546–D9

DP–SF–D

STRUCTURE	STATION	LENGTH "A"	"B"	SPAN "C"	CYL DIA "D"	BARS "E" (±)c/c (per cyl)	HOOPS "F" (±)c/c (per cyl)	TOTAL FOR FOUNDATION REBAR WT	TOTAL FOR FOUNDATION CONCRETE (cu yds)	"Z"
OH–16(R)	440+94.34 (WB)	26'–0	7'–0	95'–0	3'–0	12 – #9 @ 7 5/16	27 – #4 @ 1'–0	2391	13.61	1'–0

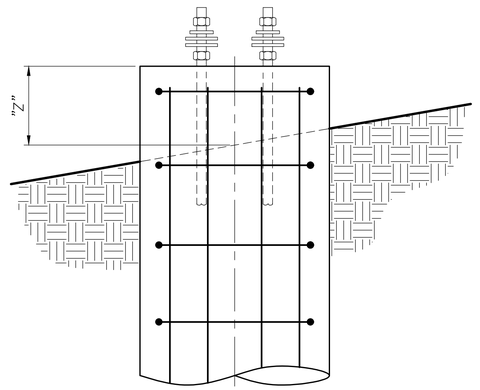
NOTE:
ROCK SOCKET DESIGN ASSUMES ROCK QUALITY DESIGNATION (RQD) OF 75% OR MORE, AS DETERMINED BY A GEOTECHNICAL ENGINEER. IF ROCK ENCOUNTERED DOES NOT MEET THIS CRITERIA, WALPAR MUST BE NOTIFIED.



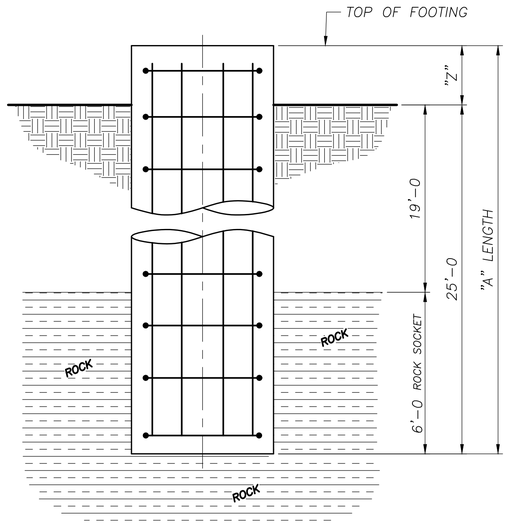
SECTION A–A

ELEVATION

DOUBLE POLE OVERHEAD FOOTING



SECTION B–B



SECTION @ OH–16(R)

NOTE:
SEE GENERAL NOTES DRAWING FOR MATERIAL SPECIFICATIONS, FOUNDATION AND STANDARD NOTES

GROUP 1

AASHTO 6th Edition Spec's

SEALED BY:

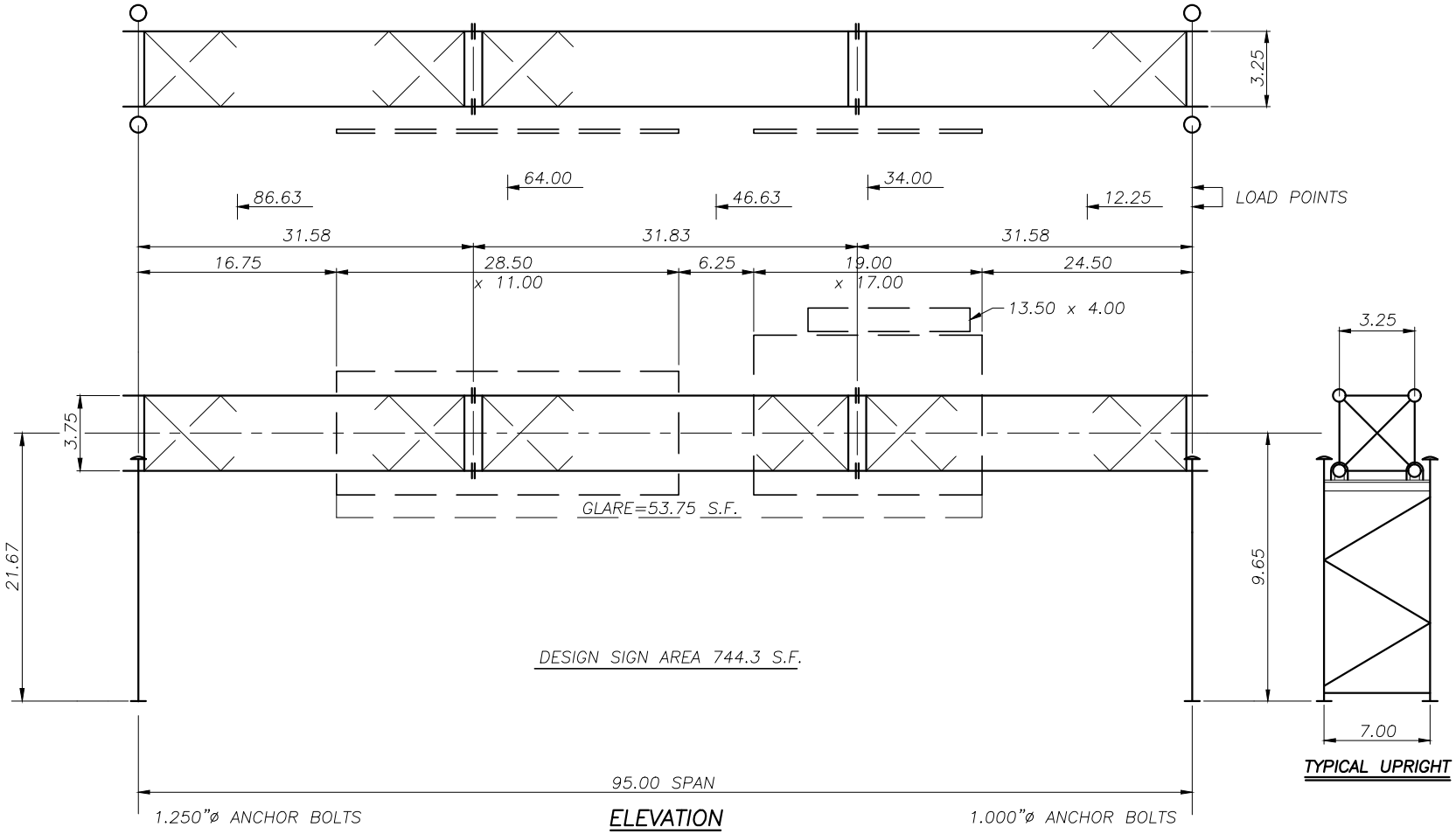
SOUTH CAROLINA PROFESSIONAL ENGINEER
DAVID A LALLONE
No. 38665
Jun 21 2024

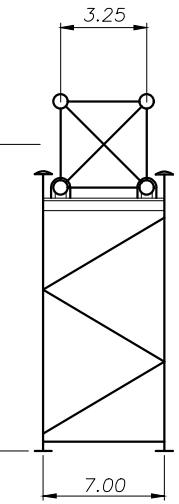
walpar
A valmont COMPANY
POST OFFICE BOX 28650
BIRMINGHAM ALABAMA 35228
4200 JEFFERSON AVENUE
BIRMINGHAM ALABAMA 35221
PHONE (205)–925–4990
FAX (205) 925–7273

STATE:	South Carolina
FED PROJ:	Carolina Crossroads Phase 1 & 2
ST PROJ:	P039718
COUNTY:	Lexington & Richland
ROUTE:	I–26 & I–126
SUBJECT:	OVERHEAD SIGN SUPPORT CYLINDRICAL FOOTING DRAWING
FOR:	Archer–United Joint Venture
DRAWN BY:	DAL DATE: 6/21/24
CHECKED BY:	DAL DATE: 6/21/24
DWG NO:	C3546–D22

NO:	REVISIONS	DATE	MADE	CHECKED
0	CHECK COMPLETE	6/21/24	---	DAL

DP–CF–D





TYPICAL UPRIGHT

ELEVATION

STR NO: OH-16
STA NO: 440+94.34 (WB)

TRUSS:	CHORDS	6.625 x 0.188
	VERT DIAGONALS	1.900 x 0.200
	HORIZ DIAGONALS	1.900 x 0.200
	STRUTS	1.660 x 0.140
	INT DIAGONALS	1.660 x 0.140

UPRIGHTS:	LEFT POSTS	10.750 x 0.250
	STRUTS & DIAGONALS	2.875 x 0.203
	RIGHT POSTS	8.625 x 0.188
	STRUTS & DIAGONALS	2.875 x 0.203

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 38665
DAVID A LALLONE

Jun 21 2024

Subject Box Truss Design Information Sheet BT4
Job No C3546 By IWL Date 2/19/24
GROUP 1 Chk'd By DAL Date 6/21/24

2

Box Truss Double Pole Structure Design

Reference Walpar Job Number C3546
Reference Design Information Sheet Number BT4 Structure : OH-16 Station : 440+94.34 (WB)
State SC
AASHTO Specification 6th Edition Fatigue Category : II
Design Wind Velocity (V) 100 mph

Structure Dimensions

Span (S)	95.00 ft	Truss Hgt (U)	3.75 ft	Truss Depth (Y)	3.25 ft
End Section Length	32.08 ft	Middle Section Length	31.83 ft	Coeff of Hgt (Kz)	0.94
Left Upright Hgt (H)	21.67 ft	Right Upright Hgt (H)	9.65 ft	Center to center of upright posts (Yu)	7.00 ft

Sign Information **Design Sign Area: 744.25 sq ft**

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	19.00	18.00	34.00	7.00		1.13	F	6.50	396.0	X
2	4	28.50	12.00	64.00	7.00		1.19	F	6.50	348.3	X

Walkway Information

	Lgth	Location	Width	Unit wgt	Y Ecc
WW1	61.75	47.88	2.54	60	5.65

Load Summary Estimate for Field Use Only

(Distance from right end of assembled truss)

Weight of truss only	7543 lbs
Weight of erected signs & WW	7083 lbs
Center of erected sign & WW+truss load	48.80 ft
Front to Back Overturning on Truss	28160 ft-lbs
Max upright weight	1920 lbs
Max truss section weight	2585 lbs



Jun 21 2024

2

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Loads

Unit wind load on sign(s)/C_d: 27.43 psf Unit wind load on exposed truss: 32.92 psf Unit wgt of truss: 74.08 plf Unit ice wgt on truss: 30.57 plf

Truss Area for Wind Load (A_t): 1.60 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: (BT4)	1	1815	1289	749
	2	4180	12287	1769
	3	463	329	191
	4	4549	11375	1916
	5	1241	882	512
WW Loads	WW1	3705	1240	1648
Left Reaction (R_L)		8020	13817	3412
Right Reaction (R_R)		7932	13585	3373
Maximum Moments (M)		228007	427074	97350
Point of "0" shear (A_m)		46.09	42.71	46.09

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

Serviceability Requirements

Truss DL + IL Deflection	2.52 in
Limit for Deflection	7.60 in
Camber Used (Cu)	3.25 in
Permanent Camber (Cp)	1.47 in

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 38665 DAVID A LALLONE

Jun 21 2024

Post Loads

	Dead	Wind	Ice	Group II t_c	Group III t_c	Lateral Stiffness Ratio
Left Upright	1920	668	467	147	220	0.13
Right Upright	954	199	196	62	94	0.87

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Load Combinations for Design Sign Area

Truss Member Loads	DL	DL +WL	DL+1/2 WL+IL
Truss Chords (Pc)	38355	104059	87687
Vertical Diagonals (Pv)	9395	15107	15928
Horizontal Diagonals (Ph)	3457	19359	12612
Vertical Struts (Psv)	6606	8027	9197
Horizontal Struts (Psh)	2250	12598	8208
Truss Moments			
Truss Chords (XMc)	1378	4244	3006

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)	306942	61034	14485	2887	9940	24885	17597
Group III Comb. 1 (DL+1/2WL+IL)	153471	30517	7243	1443	13819	12443	8798
Group II Comb. 2 (DL+WL)	184165	91551	8691	4330	9940	15902	11244
Group III Comb. 2 (DL+1/2WL+IL)	92083	45775	4346	2165	13819	7951	5622
Right Upright							
Group II Comb. 1 (DL+WL)	133152	26764	13783	2803	8886	29599	20930
Group III Comb. 1 (DL+1/2WL+IL)	66576	13382	6892	1401	12455	14799	10465
Group II Comb. 2 (DL+WL)	79891	40145	8270	4204	8886	18559	13123
Group III Comb. 2 (DL+1/2WL+IL)	39946	20073	4135	2102	12455	9279	6562

Material Information

	Pipe Size (Min Yield)	Unbraced Length	CSR Group II	CSR Group III
Truss Chords	6.625 x 0.188 (52 ksi)	7.58 ft	0.96	0.78
Vertical Diagonals	1.900 x 0.200 (52 ksi)	5.33 ft	0.80	0.84
Vertical Struts	1.660 x 0.140 (52 ksi)	3.75 ft	0.48	0.55
Horizontal Diagonals	1.900 x 0.200 (52 ksi)	4.99 ft	0.90	0.59
Horizontal Struts	1.660 x 0.140 (52 ksi)	3.25 ft	0.67	0.44

	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	10.750 x 0.250 (52 ksi)	19.52 ft	0.56	0.30	0.69	0.37
Left Upright Diagonals	2.875 x 0.203 (52 ksi)	8.01 ft	0.76	0.38	0.49	0.24
Left Upright Strut	2.875 x 0.203 (52 ksi)	6.10 ft	0.39	0.19	0.25	0.12
Right Upright Posts	8.625 x 0.188 (52 ksi)	7.49 ft	0.54	0.29	0.64	0.35
Right Upright Diagonals	2.875 x 0.203 (52 ksi)	8.16 ft	0.94	0.47	0.59	0.29
Right Upright Strut	2.875 x 0.203 (52 ksi)	6.28 ft	0.47	0.24	0.30	0.15



Jun 21 2024

2

BT4 - 3 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Structure Detail Information

Truss Chord Splices

Maximum Design Load at Splice	117184 lbs
Splice Moment (per inch of circum)	3519 in-lbs
Splice Bolt Circle	9.5 in.
Splice Bolt Qty & Size	6 - 7/8" ø A325
Splice Plate Thickness	1.0 in.
Splice Plate Weld	¼ fillet

Upright Detail

	Left	Right
Maximuim Anchor Bolt Pullout	31555 lbs	16567 lbs.
Anchor Bolt Spacing	12 in.	10.5 in.
Anchor Bolt Yield	55 ksi	55 ksi
Anchor Bolt Qty & Size (ea pole)	4 - 1.25" ø	4 - 1" ø
Anchor Bolt Length (Embed)	4.50 ft (3.5 ft)	4.50 ft (3.5 ft)
Anchor Bolt CSR	0.80	0.57
Base Plate Thickness	1.5 in.	1 in.
Base Plate Weld	5/16 fillet	5/16 fillet
Truss Seat	W8x24	W8x24
Truss Connection U-Bolts	½" ø	½" ø

Structure Input (For Foundation Designs)

	Left	Right
Truss DL React (Rd)	10.62 k	10.48 k
Upr DL React (Rv)	1.92 k	0.95 k
Truss WL React (Rh)	14.32 k	16.29 k
Upr WL React (Wv)	0.67 k	0.20 k
Distance To Rh (H1)	21.67 ft	9.65 ft
Distance To Wv (H2)	11.77 ft	5.76 ft
Min Ped Lgth (PL)	9.25 ft	9.00 ft
Min Ped Wth (PW)	2.25 ft	2.00 ft

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	6.98 ft	7.75 ft	2 - ½" ø	L5x3x5/16	W6x9
2	4.40 ft	9.00 ft	2 - ½" ø	L5x3x5/16	W6x9



Jun 21 2024

2

BT4 - 4 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

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	15.59 psf
Natural Wind Gust Load on Truss	5.30 psf	Extent of Truck Induced Gust	12.00 ft
		Truss Area for Truck Induced Gust	1.56 sq ft / ft
		Location of Center of Truck Induced Gust	47.50 ft

Truck Induced Gust Loading

ID	P_{TG} (Uplift)	P_{TG} Torque	Location
Truss Chords	293		47.50
SIGN 1 (PARTIAL)			42.50
Walkway	1265	1906	47.50
Left Reaction	779		
Right Reaction	779		
Maximum Moments	34662		

Truss Load Summary for Natural Wind

LOADS (i)	$P_{NWG(i)}$
1	208
2	1980
3	53
4	1833
5	142
Left Reaction	2226 lbs
Right Reaction	2189 lbs
Maximum Moments	68810 ft-lbs

Load Combinations for Vibration and Fatigue

Truss Members	P_{NWG}	P_{TG}
Truss Chords	10586	4622
Vertical Diagonals		554
Horizontal Diagonals	855	
Vertical Struts		389
Horizontal Struts	557	
Upright Members		
Left Post	6891	389
Right Post	3016	389

Vibration and Fatigue Stresses

	NWG (ksi)	TIG (ksi)	Allowable (ksi)	
Truss Vertical Diagonals		0.52	1.20	
Truss Horizontal Diagonals	0.80		1.20	
Truss Vertical Struts		0.58	1.20	
Truss Horizontal Struts	0.83		1.20	
Truss chord at web members	0.76	1.22	4.50	
Upright Base Connection LT	0.84	0.05	2.60	Socket Connection Base Detail
Upright Base Connection RT	0.61	0.08	2.60	Socket Connection Base Detail
Anchor bolts - LT	1.78		7.00	
Anchor bolts - RT	1.24		7.00	



Jun 21 2024

2

BT4 - 5 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Left Foundation Design

Boring Type SPT Boring Designation G-137
Major Soil Type Cohesionless Depth to Water NA Surcharge (Frost) Depth 2 ft
Ground Slope 0:1 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	12	106	34			1.05	369	24	07
2 - 3	50	125	39			1.20	7417	100	07
3 - 40	50	125	36			1.09		44	07

* 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 9.00 ft
Footing length, L 19.00 ft
Eccentricity, e_L 3.40 ft
Eccentricity, e_B 0.69 ft
Effective ftg width, B' 7.61 ft
Effective ftg width, L' 12.20 ft

Total wgt of load, foundation and soil, Pt 93.49 k
Normal moment, ML 318.05 ft-k
Transverse moment, Mw 64.93 ft-k
Distance from ground to bottom of footing, d_{min} 2.94 ft
Distance from ground to bottom of footing, D_f 2.94 ft
Distance to ground water from bottom of ftg, z_w N.A.
Overburden pressure at base of footing, q 0.37 ksf
Weighted average soil unit weight below pad, γ 125 pcf

Ultimate bearing capacity, q_{ult} 56.90 ksf
Allowable Bearing Capacity 19.75 ksf
Bearing Capacity used *** 3.00 ksf

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



Jun 21 2024

2

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Right Foundation Design

Boring Type SPT Boring Designation G-136
Major Soil Type Cohesionless Depth to Water NA Surcharge (Frost) Depth 0 ft
Ground Slope 0:1 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 - 6.5	12	113	40			1.01	222	24	01
6.5 - 35	40	150	40	4000	0.55		1598	40	13
							2461		

* Soil Type 13 indicates rock layer with N>60 for cohesionless soil or N>40 for cohesive soils
**Top 0.0 ft of soil will not contribute to load resistance.

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 38665 DAVID A LALLONE

Jun 21 2024

2

BT4 - 7 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Left Upright Spread Footing Design

Material/Soil Specifications and Safety Factors

Concrete f'_c :	3000 psi	Concrete wgt :	150 pcf
Rebar yield f_y :	60000 psi	Rebar F_s :	24000 psi
Soil Bearing Capacity :	3000 psf	Soil unit wgt :	110 pcf

Load Safety Factor[1] : 1.15

Loads and Locations From Structure

Truss DL React (Rd)	10.62 k	Base to Truss Load Dim (H1)	21.67 ft
Upright DL React (Rv)	1.92 k	Base to Upright Load Dim (H2)	11.77 ft
Truss WL React (Rh)	14.32 k	Total DL React (DL)	12.54 k
Upright WL React (Wv)	0.67 k	Transverse Wind Component (tc)	3.00 k

Loads at Top of Pedestal from Structure

Axial load (P)	12.54 k		
Moment (ML)	318.05 ft-k	Moment (MW)	64.93 ft-k
Shear (VL)	14.98 k	Shear (VW)	3.00 k

Final Spread Footing Design Sizes

Pad Length (L)	19.00 ft	Pedestal Width (PW)	2.25 ft
Pad Width (W)	9.00 ft	Pedestal Length (PL)	9.25 ft
Pad Thickness (T)	1.50 ft	Pedestal Projection at Ctr (PE)	4.56 ft
		Ground line to top of pad (PT)	1.44 ft

Reinforcement

Pad	Pedestal
Top each way - #4 Bars @ 12" o.c.	4 ea. - #8 Vert. Bars @ 6.33" o.c. @ Ends
X Direction - 9 - #7 Bars @ 12.00" o.c.	16 ea. - #8 Vert. Bars @ 6.06" o.c. @ Sides
Y Direction - 19 - #5 Bars @ 12" o.c.	7 - #4 Ties @ 12" max. o.c.

Serviceability	Quantities
17.33% of footing in uplift	1721 lbs of reinforcement
Safety factor against overturning = 25.64	14.13 cyd of concrete

Uncracked Section Calculations

Wgt of soil above pad (Ps)	23.75 k		
Wgt of concrete (Pc)	57.21 k	Total Area (A)	171.00 ft²
Total Load (Pt)	93.49 k		
X	9.50 ft	Y	4.50 ft
Ix	1154.25 ft⁴	Iy	5144.25 ft⁴
Mx	100.52 k-ft	My	495.00 k-ft

Corner Stresses [Factored[1] (unfactored) loads]	
F1	1.85 ksf (1.68 ksf)
F2	1.07 ksf (1.00 ksf)
F3	-0.76 ksf (-0.59 ksf)
F4	0.02 ksf (0.09 ksf)

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

A1	60.18 ft² (89.70 ft²)	L1	6.69 ft (9.97 ft)	W1	9.00 ft (9.00 ft)
A2	27.53 ft² (22.04 ft²)	L2	12.31 ft (9.03 ft)	W2	2.24 ft (2.44 ft)
A3	41.64 ft² (29.63 ft²)	L3	12.31 ft (9.03 ft)	W3	6.76 ft (6.56 ft)
A'	129.36 ft² (141.37 ft²)				
Xc	1.74 ft (1.36 ft)	X1	6.16 ft (4.52 ft)	Y1	0.00 ft (0.00 ft)
Yc	0.72 ft (0.48 ft)	X2	-3.34 ft (-4.98 ft)	Y2	3.38 ft (3.28 ft)
		X3	-1.29 ft (-3.48 ft)	Y3	0.01 ft (-0.13 ft)
Ixc	448.17 ft⁴ (663.34 ft⁴)	X'	11.24 ft (10.86 ft)		
Iyc	3513.54 ft⁴ (3729.06 ft⁴)	Y'	5.22 ft (4.98 ft)		
Ixcyc	-570.57 ft⁴ (-489.21 ft⁴)				
Mxc	32.95 ft-k (42.08 ft-k)				
Myc	332.61 ft-k (303.28 ft-k)				

Corner Stresses [Factored[1] (unfactored) loads]	
F1	3.10 ksf (2.22 ksf)
F2	0.90 ksf (0.99 ksf)
F3	-1.65 ksf (-0.90 ksf)
F4	0.55 ksf (0.33 ksf)



Jun 21 2024

2

BT4 - 8 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Left Upright Spread Footing Design (cont.)

Moment and Shear Calculation Results

LL	4.88 ft	WW	3.38 ft	S_{y0}	2.00 ksf	S_{x0}	1.82 ksf
L_{x1}	8.00 ft	W_{x1}	0.00 ft	S_{y1}	1.80 ksf	S_{x1}	1.82 ksf
L_{x2}	5.79 ft	W_{x2}	2.21 ft	S_{y2}	1.50 ksf	S_{x2}	1.28 ksf
L_{y1}	1.50 ft	W_{y1}	4.50 ft	S_{y3}	1.34 ksf	S_{x3}	1.00 ksf
L_{y2}	2.21 ft	W_{y2}	2.29 ft	Pcs	0.38 ksf		
				DTS_y	8.61 k/ft	DTS_x	3.08 k/ft
				M_{YY}	16.61 ft-k	M_{XX}	6.64 ft-k

Reinforcement Calculations

f_{cr} : 1596 psi v_{cr} : 69 psi n : 9.29

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

About Y Axis		About X Axis	
p :	0.0030	p :	0.0018
k :	0.2109	k :	0.1669
j :	0.9297	j :	0.9444
f_{ca} :	864 psi	f_{ca} :	430 psi
v_{ca} :	55 psi	v_{ca} :	19 psi
Mt :	363980 in-k	Mt :	145404 in-k
ld_r :	21.14 in	ld_r :	23.63 in
ld_a :	55.50 in	ld_a :	37.50 in
ld_{min} :	47.93 in	ld_{min} :	34.23 in
A_{sr} :	0.48 in²	A_{sr} :	0.19 in²
A_s Used :	0.60 in²	A_s Used :	0.31 in²

Tie Size : #4

Pedestal Calculations

V_1 : 15281 lbs V_2 : 0 lbs V_t : 15281 lbs

About Y Axis		About X Axis	
C_x :	55.50 in	C_y :	13.50 in
G_x :	103.00 in	G_y :	19.00 in
f_a :	4.18 psi	f_v :	483.59 psi
F_a :	1596 psi	F_v :	26334 psi
f_{bx} :	13.42 psi	f_{by} :	304.02 psi
F_{bx} :	1596 psi	F_{by} :	1596 psi
M_x :	82915 ft-lb	M_y :	407960 ft-lb
M_{ox} :	439193 ft-lb	M_{oy} :	2380886 ft-lb
I_x :	4115183 in⁴	I_y :	217389 in⁴
A_g :	2997 in²	A_{sm} :	29.97 in²
A_{st} :	31.60 in²	A_s :	8.69 in²
QTY :	40	A_b :	0.79 in²
X Sp'g :	6.06 in	Y Sp'g :	6.33 in
C_{sx} :	29.69 in	C_{sy} :	8.80 in
N qty :	16	R qty :	4
CSR :	0.20	CSM :	0.36



Jun 21 2024

Sliding friction μ : 0.40

Factor of safety against sliding : 2.00

2

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

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. :	3 in	Min factor of safety for lateral load :	2.86

Loads and Locations From Structure

Truss DL React (Rd)	10.62 k	Base to Truss Load Dim (H1)	21.67 ft
Upright DL React (Rv)	1.92 k	Base to Upright Load Dim (H2)	11.77 ft
Truss WL React (Rh)	14.32 k	Footing Projection at Ctr (H3)	4.56 ft
Upright WL React (Wv)	0.67 k	C/C of Cylinders (C)	7.00 ft

Normal Overturning Moment (M_{WL})	386.42 ft-k	Effective Hgt (H_{eff})	25.79 ft
Transverse Moment (M_{TL})	77.28 ft-k	Lateral Load (P_{eff})	5.87 k
Resultant Moment (M_R)	394.07 ft-k	Axial Force	9.40 k
Effective Overturning Moment	201.76 ft-k		

Final Cylindrical Footing Design Sizes

Req'd area of steel (A_s)	10.15 in²	Rebar Cage Dia (D1)	28.00 in
1% Cyl Area Min (A_m)	10.18 in²	Vertical bar spacing	6.77 in
Actual Reinf Area (A_p)	10.27 in²		

USE 36 in DIA x 20'- 0 CYLINDER
w/ 13- # 8 VERT. BARS & 21 - #4 HOOPS

Serviceability	Quantities
Calculated lateral safety factor = 6.7	1595 lbs of reinforcement
Calculated uplift safety factor = 5.0	10.47 cyd of concrete

Side Shear Results
(from Beta Method)

Cylinder Embedment	15.44 ft
Axial load	6.27 k
Uplift load	28.82 k
Weight of shaft	21.21 k
Side Resistance Capacity	145.50 k

Lateral Load Calculation Results
(from Brom's Method)

Soil friction angle Φ	36.4°
Soil unit weight γ	119 pcf
Average $(N_1)_{60}$ over eff depth (BPF)	75
Effective lateral load on cylinder	5.87 k
Effective moment on cylinder	151.32 ft-k
Axial thrust from moment and vertical loads	38.22 k
Rankine Passive Pressure Coeff. K_P	3.54
Ultimate soil resistance P_{ult}	115.99 k
Allowable soil resistance P_{max}	53.94 k
Ultimate soil moment capacity M_{ult}	1530 ft-k
Allowable soil moment capacity M_{max}	712 ft-k
Ground line moment	178 ft-k
Dist. from GL to 0 shear point in cyl.	3.76 ft
Maximum moment in shaft	227 ft-k

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 38665
DAVID A LALLONE

Jun 21 2024

2

BT4 - 10 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

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. :	3 in	Min factor of safety for lateral load :	2.86

Loads and Locations From Structure

Truss DL React (Rd)	10.48 k	Base to Truss Load Dim (H1)	9.65 ft
Upright DL React (Rv)	0.95 k	Base to Upright Load Dim (H2)	5.76 ft
Truss WL React (Rh)	16.29 k	Footing Projection at Ctr (H3)	13.50 ft
Upright WL React (Wv)	0.20 k	C/C of Cylinders (C)	7.00 ft

Normal Overturning Moment (M_{WL})	380.90 ft-k	Effective Hgt (H_{eff})	23.10 ft
Transverse Moment (M_{TL})	76.18 ft-k	Lateral Load (P_{eff})	5.05 k
Resultant Moment (M_R)	388.45 ft-k	Axial Force	8.58 k
Effective Overturning Moment	155.45 ft-k		

Final Cylindrical Footing Design Sizes

Req'd area of steel (A_s)	11.68 in²	Rebar Cage Dia (D1)	27.88 in
1% Cyl Area Min (A_m)	10.18 in²	Vertical bar spacing	7.30 in
Actual Reinf Area (A_p)	12.00 in²		

USE 36 in DIA x 26'- 0 CYLINDER
w/ 12- # 9 VERT. BARS & 27 - #4 HOOPS

Serviceability	Quantities
Calculated lateral safety factor = SEE NOTE	2391 lbs of reinforcement
Calculated uplift safety factor = 19.9	13.61 cyd of concrete

Cylinder is socketed into rock

Side Shear Results
(from Beta Method)

Cylinder Embedment	12.50 ft
Axial load	5.72 k
Uplift load	22.21 k
Weight of shaft	27.57 k
Side Resistance Capacity	442.05 k

Lateral Load Calculation Results
(from Brom's Method)

Soil friction angle Φ	40.1°
Soil unit weight γ	132 pcf
Average $(N_1)_{60}$ over eff. depth (BPF)	51
Effective lateral load on cylinder	5.05 k
Effective moment on cylinder	116.59 ft-k
Axial thrust from moment and vertical loads	30.78 k
Rankine Passive Pressure Coeff. K_P	4.56
Ultimate soil resistance P_{ult}	67.54 k
Allowable soil resistance P_{max}	31.41 k
Ultimate soil moment capacity M_{ult}	1756 ft-k
Allowable soil moment capacity M_{max}	817 ft-k
Ground line moment	185 ft-k
Dist. from GL to 0 shear point in cyl.	1.37 ft
Maximum moment in shaft	260 ft-k



Jun 21 2024

2

BT4 - 11 of 12

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-16 Station : 440+94.34 (WB)

Load Summary for Foundation Design

	Left Upright	Right Upright
Truss Dead Load	3519 lb	3519 lb
Sign Dead Load	4501 lb	4413 lb
Dead Load of Upright (Rv)	1920 lb	954 lb
Wind Load on Truss and Signs (Rh)	13817 lb	13585 lb
Distance from top of foundation to loads Rh and tc	21.85 ft	9.83 ft
Transverse Wind Load on Truss and Signs (Load Case 1) (tc)	2763 lb	2717 lb
Transverse Wind Load on Truss and Signs (Load Case 2) (tc)	4145 lb	4075 lb
Wind Load on Upright (Normal) (Wv)	668 lb	199 lb
Transverse Wind Load on Upright (Load Case 1) (tcu)	147 lb	62 lb
Transverse Wind Load on Upright (Load Case 2) (tcu)	220 lb	94 lb
Distance from top of foundation to loads Wv and tcu	11.96 ft	5.93 ft
Ice Load on Truss	1452 lb	1452 lb
Ice Load on Signs	1960 lb	1921 lb
Ice Load on Upright	467 lb	196 lb

Loads at Left Upright

	Total-M_X	DL&IL-M_X	M_Y	V_X	V_Y	Axial	
GROUP II COMB 1	306942	16874	61034	2887	14485	9940	DL+WL
GROUP III COMB 1	153471	23587	30517	1443	7243	13819	DL+WL/2+IL
GROUP II COMB 2	184165	16874	91551	4330	8691	9940	DL+WL
GROUP III COMB 2	92083	23587	45775	2165	4346	13819	DL+WL/2+IL
GROUP I		16874				9940	DL

Loads at Right Upright

	Total-M_X	DL&IL-M_X	M_Y	V_X	V_Y	Axial	
GROUP II COMB 1	133152	16568	26764	2803	13783	8886	DL+WL
GROUP III COMB 1	66576	22597	13382	1401	6892	12455	DL+WL/2+IL
GROUP II COMB 2	79891	16568	40145	4204	8270	8886	DL+WL
GROUP III COMB 2	39946	22597	20073	2102	4135	12455	DL+WL/2+IL
GROUP I		16568				8886	

Units are in feet, pounds and ft-pounds

M_X is normal moment, M_Y is transverse moment

V_Y is normal direction, V_X is transverse direction

DL&IL -M_X are due to sign eccentricity and are included in Total-M_X

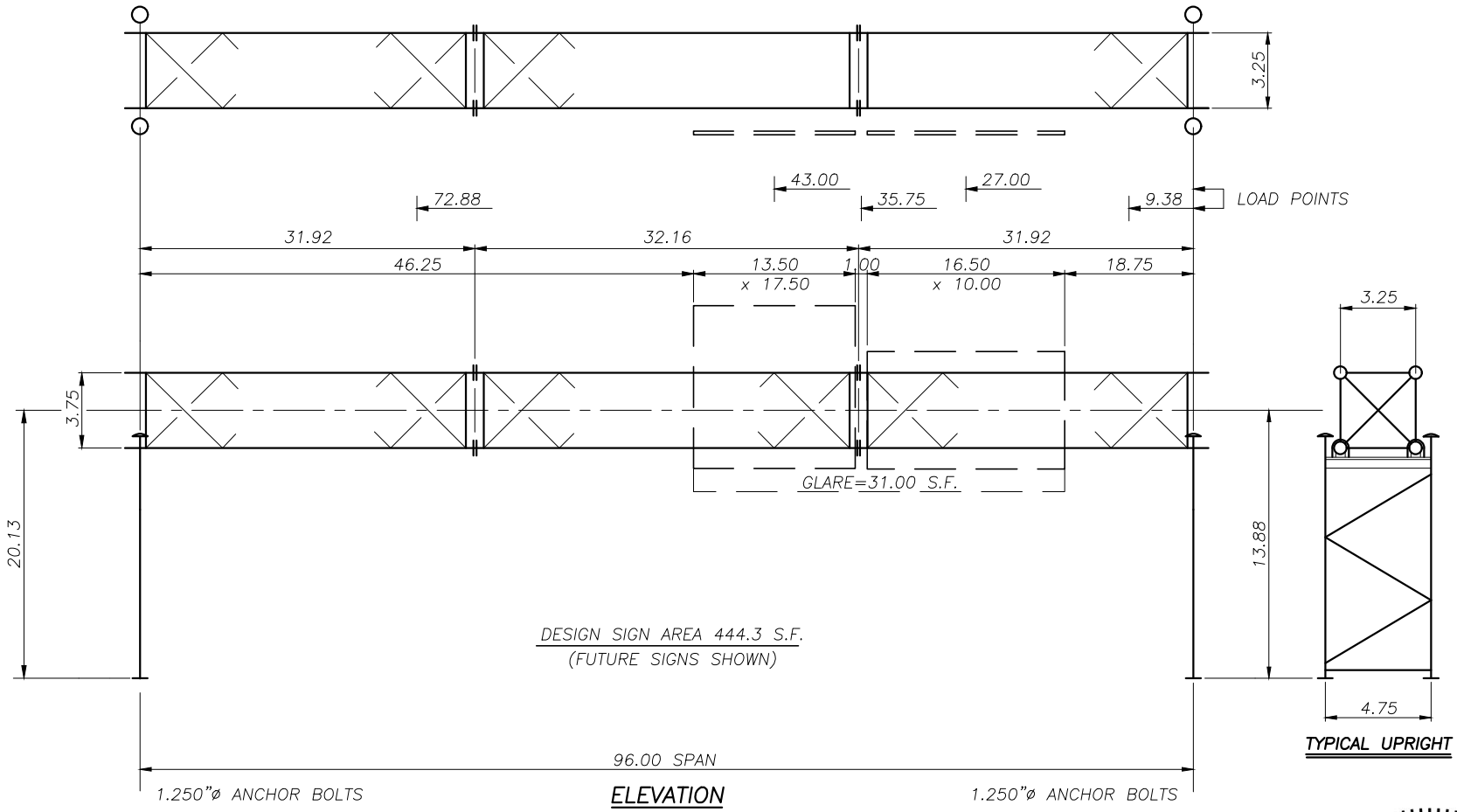


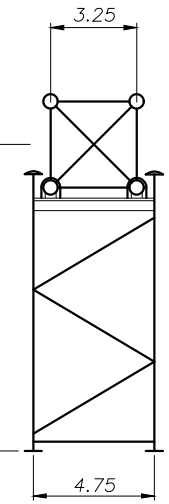
Jun 21 2024

2

BT4 - 12 of 12

Walpar © 2014





TYPICAL UPRIGHT

ELEVATION

STR NO: OH-26
STA NO: 37+34.06 (WB)

TRUSS:	CHORDS	4.500 x 0.337
	VERT DIAGONALS	1.900 x 0.145
	HORIZ DIAGONALS	1.900 x 0.145
	STRUTS	1.315 x 0.133
	INT DIAGONALS	1.315 x 0.133

UPRIGHTS:	LEFT POSTS	8.625 x 0.188
	STRUTS & DIAGONALS	2.375 x 0.154
	RIGHT POSTS	8.625 x 0.188
	STRUTS & DIAGONALS	2.375 x 0.154

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 38665
DAVID A LALLONE

Jun 21 2024

Subject Box Truss Design Information Sheet BT6
Job No C3546 By IWL Date 2/19/24
GROUP 1 Chk'd By DAL Date 6/21/24

2

Box Truss Double Pole Structure Design

Reference Walpar Job Number C3546
Reference Design Information Sheet Number BT6 Structure : OH-26 Station : 37+34.06 (WB)
State SC
AASHTO Specification 6th Edition Fatigue Category : II
Design Wind Velocity (V) 100 mph

Structure Dimensions

Span (S)	96.00 ft	Truss Hgt (U)	3.75 ft	Truss Depth (Y)	3.25 ft
End Section Length	32.42 ft	Middle Section Length	32.17 ft	Coeff of Hgt (Kz)	0.94
Left Upright Hgt (H)	20.13 ft	Right Upright Hgt (H)	13.88 ft	Center to center of upright posts (Yu)	4.75 ft

Sign Information **Design Sign Area: 444.25 sq ft**

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	16.50	11.00	27.00	7.00		1.15	F	6.00	188.0	X
2	4	13.50	18.50	43.00	7.00		1.15	F	6.00	256.3	X

Walkway Information

	Lgth	Location	Width	Unit wgt	Y Ecc
WW1	45.75	38.88	2.54	60	5.73

Load Summary Estimate for Field Use Only

(Distance from right end of assembled truss)

Weight of truss only	7783 lbs
Weight of erected signs & WW	5000 lbs
Center of erected sign & WW+truss load	44.59 ft
Front to Back Overturning on Truss	19895 ft-lbs
Max upright weight	1216 lbs
Max truss section weight	2649 lbs

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER
David A Lallone
No. 38665
DAVID A LALLONE

Jun 21 2024

2

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

Loads

Unit wind load on sign(s)/C_d: 27.43 psf Unit wind load on exposed truss: 32.92 psf Unit wgt of truss: 76.55 plf Unit ice wgt on truss: 23.43 plf

Truss Area for Wind Load (A_t): 1.23 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: (BT6)	1	1435	760	439
	2	2579	5912	951
	3	77	41	23
	4	2827	8092	1085
	5	3540	1875	1084
WW Loads	WW1	2745	919	1221
Left Reaction (R_L)		5960	7172	2122
Right Reaction (R_R)		7244	10426	2681
Maximum Moments (M)		194796	307525	73575
Point of "0" shear (A_m)		43.44	41.59	43.04

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

Serviceability Requirements

Truss DL + IL Deflection	1.72 in
Limit for Deflection	7.68 in
Camber Used (Cu)	3.31 in
Permanent Camber (Cp)	2.06 in

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 38665 DAVID A LALLONE

Jun 21 2024

Post Loads

	Dead	Wind	Ice	Group II t_c	Group III t_c	Lateral Stiffness Ratio
Left Upright	1216	500	342	116	174	0.22
Right Upright	972	299	241	80	120	0.78

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

Load Combinations for Design Sign Area

Truss Member Loads	DL	DL +WL	DL+1/2 WL+IL
Truss Chords (Pc)	31700	79011	67690
Vertical Diagonals (Pv)	8224	10771	12607
Horizontal Diagonals (Ph)	2853	13301	9195
Vertical Struts (Psv)	5751	5403	6506
Horizontal Struts (Psh)	1845	8602	5946
Truss Moments			
Truss Chords (XMc)	1257	5262	3321

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)	149613	36642	7672	1876	7175	14953	10573
Group III Comb. 1 (DL+1/2WL+IL)	74807	18321	3836	938	9639	7476	5287
Group II Comb. 2 (DL+WL)	89768	54963	4603	2814	7175	9643	6818
Group III Comb. 2 (DL+1/2WL+IL)	44884	27481	2302	1407	9639	4821	3409
Right Upright							
Group II Comb. 1 (DL+WL)	149106	25013	10725	1840	8216	19698	13929
Group III Comb. 1 (DL+1/2WL+IL)	74553	12507	5362	920	11137	9849	6964
Group II Comb. 2 (DL+WL)	89463	37520	6435	2760	8216	12326	8716
Group III Comb. 2 (DL+1/2WL+IL)	44732	18760	3217	1380	11137	6163	4358

Material Information

	Pipe Size (Min Yield)	Unbraced Length	CSR Group II	CSR Group III
Truss Chords	4.500 x 0.337 (52 ksi)	7.67 ft	0.91	0.71
Vertical Diagonals	1.900 x 0.145 (52 ksi)	5.36 ft	0.73	0.85
Vertical Struts	1.315 x 0.133 (52 ksi)	3.75 ft	0.63	0.76
Horizontal Diagonals	1.900 x 0.145 (52 ksi)	5.03 ft	0.80	0.55
Horizontal Struts	1.315 x 0.133 (52 ksi)	3.25 ft	0.79	0.55

	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	8.625 x 0.188 (52 ksi)	18.06 ft	0.69	0.36	0.85	0.45
Left Upright Diagonals	2.375 x 0.154 (52 ksi)	5.34 ft	0.55	0.27	0.35	0.18
Left Upright Strut	2.375 x 0.154 (52 ksi)	4.03 ft	0.32	0.16	0.21	0.10
Right Upright Posts	8.625 x 0.188 (52 ksi)	11.81 ft	0.54	0.30	0.62	0.34
Right Upright Diagonals	2.375 x 0.154 (52 ksi)	5.93 ft	0.81	0.40	0.50	0.25
Right Upright Strut	2.375 x 0.154 (52 ksi)	4.03 ft	0.42	0.21	0.26	0.13



Jun 21 2024

2

BT6 - 3 of 9

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

Structure Detail Information

Truss Chord Splices

Maximum Design Load at Splice	115034 lbs
Splice Moment (per inch of circum)	5086 in-lbs
Splice Bolt Circle	7.5 in.
Splice Bolt Qty & Size	6 - 7/8" ø A325
Splice Plate Thickness	1.0 in.
Splice Plate Weld	¼ fillet

Upright Detail

	Left	Right
Maximuim Anchor Bolt Pullout	22143 lbs	17488 lbs.
Anchor Bolt Spacing	10.5 in.	10.5 in.
Anchor Bolt Yield	55 ksi	55 ksi
Anchor Bolt Qty & Size (ea pole)	4 - 1.25" ø	4 - 1.25" ø
Anchor Bolt Length (Embed)	4.50 ft (3.5 ft)	4.50 ft (3.5 ft)
Anchor Bolt CSR	0.39	0.25
Base Plate Thickness	1.25 in.	1.25 in.
Base Plate Weld	5/16 fillet	5/16 fillet
Truss Seat	WT6x13	WT6x13
Truss Connection U-Bolts	½" ø	½" ø

Structure Input (For Foundation Designs)

	Left	Right
Truss DL React (Rd)	7.36 k	9.37 k
Upr DL React (Rv)	1.22 k	0.97 k
Truss WL React (Rh)	7.68 k	11.26 k
Upr WL React (Wv)	0.50 k	0.30 k
Distance To Rh (H1)	20.13 ft	13.88 ft
Distance To Wv (H2)	11.00 ft	7.88 ft
Min Ped Lgth (PL)	6.75 ft	6.75 ft
Min Ped Wth (PW)	2.00 ft	2.00 ft

Sign Hanger Detail

Design hanger spacing 8.00 ft

Sign Hanger U-Bolt type ASTM-A307

SIGN	Max UBL at End	Max Spacing	Hanger U-Bolt	Sign Hanger	Hanger Support
1	3.65 ft	8.00 ft	2 - ½" ø	L5x3x5/16	W6x9
2	7.48 ft	6.00 ft	2 - ½" ø	L5x3x5/16	W6x9



Jun 21 2024

2

BT6 - 4 of 9

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

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	16.24 psf
Natural Wind Gust Load on Truss	5.30 psf	Extent of Truck Induced Gust	12.00 ft
		Truss Area for Truck Induced Gust	1.20 sq ft / ft
		Location of Center of Truck Induced Gust	48.00 ft

Truck Induced Gust Loading

ID	P_{TG} (Uplift)	P_{TG} Torque	Location
Truss Chords	234		48.00
SIGN 2 (PARTIAL)			45.88
Walkway	1265	1933	48.00
Left Reaction	749		
Right Reaction	749		
Maximum Moments	33722		

Truss Load Summary for Natural Wind

LOADS (i)	$P_{NWG(i)}$
1	122
2	952
3	7
4	1304
5	302
Left Reaction	1156 lbs
Right Reaction	1680 lbs
Maximum Moments	49548 ft-lbs

Load Combinations for Vibration and Fatigue

Truss Members	P_{NWG}	P_{TG}
Truss Chords	7623	4496
Vertical Diagonals		536
Horizontal Diagonals	649	
Vertical Struts		375
Horizontal Struts	420	
Upright Members		
Left Post	4896	375
Right Post	4907	375

Vibration and Fatigue Stresses

	NWG (ksi)	TIG (ksi)	Allowable (ksi)	
Truss Vertical Diagonals		0.67	1.20	
Truss Horizontal Diagonals	0.81		1.20	
Truss Vertical Struts		0.76	1.20	
Truss Horizontal Struts	0.85		1.20	
Truss chord at web members	0.32	1.02	4.50	
Upright Base Connection LT	0.98	0.08	4.50	Socket Connection Base Detail
Upright Base Connection RT	0.99	0.08	4.50	Socket Connection Base Detail
Anchor bolts - LT	1.26		7.00	
Anchor bolts - RT	1.27		7.00	



Jun 21 2024

2

BT6 - 5 of 9

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

Left Foundation Design

Boring Type SPT Boring Designation G-028A
Major Soil Type Cohesionless Depth to Water 15 ft Surcharge (Frost) Depth 2 ft
Ground Slope 0:1 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 - 6	13	118	29	1625	0.55		259	26	12
6 - 8	4	109	24	500	0.55		391	8	12
8 - 12	11	106	32			0.79	607	16	07
12 - 15	12	111	34	1500	0.55		866	17	10
15 - 18.5	12	51	33	1500	0.55		1994	14	10
18.5 - 23.5	13	52	32	1625			1237	12	10
23.5 - 28.5	25	59	34	3125				17	10
28.5 - 35	50	65	35			1.20		36	07

* 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 8.00 ft
Footing length, L 16.00 ft
Eccentricity, e_L 2.36 ft
Eccentricity, e_B 0.49 ft
Effective ftg width, B' 7.03 ft
Effective ftg width, L' 11.28 ft

Total wgt of load, foundation and soil, Pt 67.89 k
Normal moment, ML 160.12 ft-k
Transverse moment, MW 32.94 ft-k
Distance from ground to bottom of footing, d_{min} 2.96 ft
Distance from ground to bottom of footing, D_f 2.96 ft
Distance to ground water from bottom of ftg, z_w 12.04 ft
Overburden pressure at base of footing, q 0.33 ksf
Weighted average soil unit weight below pad, γ 111 pcf

Ultimate bearing capacity, q_{ult} 49.25 ksf
Allowable Bearing Capacity 17.00 ksf
Bearing Capacity used *** 3.00 ksf

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



Jun 21 2024

2

BT6 - 6 of 9

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

Left Upright Spread Footing Design

Material/Soil Specifications and Safety Factors

Concrete f'_c :	3000 psi	Concrete wgt :	150 pcf
Rebar yield f_y :	60000 psi	Rebar F_s :	24000 psi
Soil Bearing Capacity :	3000 psf	Soil unit wgt :	110 pcf

Load Safety Factor[1] : 1.35

Loads and Locations From Structure

Truss DL React (Rd)	7.36 k	Base to Truss Load Dim (H1)	20.13 ft
Upright DL React (Rv)	1.22 k	Base to Upright Load Dim (H2)	11.00 ft
Truss WL React (Rh)	7.68 k	Total DL React (DL)	8.57 k
Upright WL React (Wv)	0.50 k	Transverse Wind Component (tc)	1.64 k

Loads at Top of Pedestal from Structure

Axial load (P)	8.57 k		
Moment (ML)	160.12 ft-k	Moment (MW)	32.94 ft-k
Shear (VL)	8.18 k	Shear (VW)	1.64 k

Final Spread Footing Design Sizes

Pad Length (L)	16.00 ft	Pedestal Width (PW)	2.00 ft
Pad Width (W)	8.00 ft	Pedestal Length (PL)	6.75 ft
Pad Thickness (T)	1.50 ft	Pedestal Projection at Ctr (PE)	4.54 ft
		Ground line to top of pad (PT)	1.46 ft

Reinforcement

Pad	Pedestal
Top each way - #4 Bars @ 12" o.c.	4 ea. - #8 Vert. Bars @ 5.33" o.c. @ Ends
X Direction - 8 - #6 Bars @ 12.00" o.c.	10 ea. - #8 Vert. Bars @ 6.64" o.c. @ Sides
Y Direction - 16 - #4 Bars @ 12" o.c.	7 - #4 Ties @ 12" max. o.c.

Serviceability	Quantities
10.33% of footing in uplift	1130 lbs of reinforcement
Safety factor against overturning = 30.36	10.11 cyd of concrete

Uncracked Section Calculations

Wgt of soil above pad (Ps)	18.37 k		
Wgt of concrete (Pc)	40.95 k	Total Area (A)	128.00 ft²
Total Load (Pt)	67.89 k		
X	8.00 ft	Y	4.00 ft
Ix	682.67 ft⁴	Iy	2730.67 ft⁴
Mx	61.04 k-ft	My	299.02 k-ft

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

F1	1.76 ksf (1.44 ksf)
F2	1.05 ksf (0.91 ksf)
F3	-0.70 ksf (-0.38 ksf)
F4	0.01 ksf (0.15 ksf)

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

A1	55.14 ft² (87.50 ft²)	L1	6.89 ft (10.94 ft)	W1	8.00 ft (8.00 ft)
A2	16.44 ft² (14.06 ft²)	L2	9.11 ft (5.06 ft)	W2	1.81 ft (2.78 ft)
A3	28.21 ft² (13.22 ft²)	L3	9.11 ft (5.06 ft)	W3	6.19 ft (5.22 ft)
A'	99.79 ft² (114.78 ft²)				
Xc	1.40 ft (0.73 ft)	X1	4.55 ft (2.53 ft)	Y1	0.00 ft (0.00 ft)
Yc	0.55 ft (0.26 ft)	X2	-3.45 ft (-5.47 ft)	Y2	3.10 ft (2.61 ft)
		X3	-1.93 ft (-4.63 ft)	Y3	0.13 ft (-0.52 ft)
Ixc	320.41 ft⁴ (534.50 ft⁴)	X'	9.40 ft (8.73 ft)		
Iyc	1875.70 ft⁴ (2177.29 ft⁴)	Y'	4.55 ft (4.26 ft)		
Ixcyc	-303.37 ft⁴ (-200.52 ft⁴)				
Mxc	23.90 ft-k (27.55 ft-k)				
Myc	203.76 ft-k (172.14 ft-k)				

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

F1	2.66 ksf (1.62 ksf)
F2	0.98 ksf (0.95 ksf)
F3	-1.30 ksf (-0.44 ksf)
F4	0.38 ksf (0.23 ksf)



Jun 21 2024

2

BT6 - 7 of 9

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

Left Upright Spread Footing Design (cont.)

Moment and Shear Calculation Results

LL	4.63 ft	WW	3.00 ft	S_{y0}	1.82 ksf	S_{x0}	1.52 ksf
L_{x1}	6.38 ft	W_{x1}	0.00 ft	S_{y1}	1.59 ksf	S_{x1}	1.52 ksf
L_{x2}	4.54 ft	W_{x2}	1.83 ft	S_{y2}	1.33 ksf	S_{x2}	1.13 ksf
L_{y1}	1.63 ft	W_{y1}	4.00 ft	S_{y3}	1.16 ksf	S_{x3}	0.89 ksf
L_{y2}	1.83 ft	W_{y2}	2.17 ft	Pcs	0.39 ksf		
				DTS_y	6.76 k/ft	DTS_x	2.07 k/ft
				M_{YY}	13.00 ft-k	M_{XX}	4.16 ft-k

Reinforcement Calculations

f_{cr} : 1596 psi v_{cr} : 69 psi n : 9.29

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

About Y Axis		About X Axis	
p :	0.0024	p :	0.0018
k :	0.1891	k :	0.1669
j :	0.9370	j :	0.9444
f_{ca} :	748 psi	f_{ca} :	269 psi
v_{ca} :	43 psi	v_{ca} :	13 psi
Mt :	284818 in-k	Mt :	91058 in-k
ld_r :	21.08 in	ld_r :	21.96 in
ld_a :	52.50 in	ld_a :	33.00 in
ld_{min} :	41.08 in	ld_{min} :	27.39 in
A_{sr} :	0.37 in²	A_{sr} :	0.12 in²
A_s Used :	0.44 in²	A_s Used :	0.20 in²

Tie Size : #4

Pedestal Calculations

V_1 : 8345 lbs V_2 : 0 lbs V_t : 8345 lbs

About Y Axis		About X Axis	
C_x :	40.50 in	C_y :	12.00 in
G_x :	73.00 in	G_y :	16.00 in
f_a :	4.41 psi	f_v :	377.26 psi
F_a :	1596 psi	F_v :	26334 psi
f_{bx} :	14.55 psi	f_{by} :	271.80 psi
F_{bx} :	1596 psi	F_{by} :	1596 psi
M_x :	42756 ft-lb	M_y :	209221 ft-lb
M_{ox} :	268979 ft-lb	M_{oy} :	1227218 ft-lb
I_x :	1427865 in⁴	I_y :	110845 in⁴
A_g :	1944 in²	A_{sm} :	19.44 in²
A_{st} :	22.12 in²	A_s :	6.32 in²
QTY :	28	A_b :	0.79 in²
X Sp'g :	6.64 in	Y Sp'g :	5.33 in
C_{sx} :	22.28 in	C_{sy} :	7.11 in
N qty :	10	R qty :	4
CSR :	0.18	CSM :	0.33



Jun 21 2024

Sliding friction μ : 0.40

Factor of safety against sliding : 2.65

2

Walpar © 2014

Box Truss Double Pole Structure Design

Job No : C3546 Structure No : OH-26 Station : 37+34.06 (WB)

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. :	3 in	Min factor of safety for lateral load :	2.86

Loads and Locations From Structure

Truss DL React (Rd)	7.36 k	Base to Truss Load Dim (H1)	20.13 ft
Upright DL React (Rv)	1.22 k	Base to Upright Load Dim (H2)	11.00 ft
Truss WL React (Rh)	7.68 k	Footing Projection at Ctr (H3)	4.54 ft
Upright WL React (Wv)	0.50 k	C/C of Cylinders (C)	4.75 ft

Normal Overturning Moment (M_{WL})	197.29 ft-k	Effective Hgt (H_{eff})	24.11 ft
Transverse Moment (M_{TL})	39.46 ft-k	Lateral Load (P_{eff})	3.34 k
Resultant Moment (M_R)	201.19 ft-k	Axial Force	6.43 k
Effective Overturning Moment	107.39 ft-k		

Final Cylindrical Footing Design Sizes

Req'd area of steel (A_s)	6.94 in²	Rebar Cage Dia (D1)	22.00 in
1% Cyl Area Min (A_m)	7.07 in²	Vertical bar spacing	7.68 in
Actual Reinf Area (A_p)	7.11 in²		

USE 30 in DIA x 21'- 0 CYLINDER
w/ 9- # 8 VERT. BARS & 22 - #4 HOOPS

Serviceability	Quantities
Calculated lateral safety factor = 16.8	1192 lbs of reinforcement
Calculated uplift safety factor = 4.0	7.64 cyd of concrete

Side Shear Results
(from Beta Method)

Cylinder Embedment	16.46 ft
Axial load	4.29 k
Uplift load	22.61 k
Weight of shaft	15.46 k
Side Resistance Capacity	89.42 k

Lateral Load Calculation Results
(from Brom's Method)

Soil friction angle Φ	30.2°
Soil unit weight γ	99 pcf
Average $(N_1)_{60}$ over eff depth (BPF)	15
Effective lateral load on cylinder	3.34 k
Effective moment on cylinder	80.54 ft-k
Axial thrust from moment and vertical loads	29.04 k
Rankine Passive Pressure Coeff. K_P	5.49
Ultimate soil resistance P_{ult}	144.14 k
Allowable soil resistance P_{max}	67.03 k
Ultimate soil moment capacity M_{ult}	2052 ft-k
Allowable soil moment capacity M_{max}	954 ft-k
Ground line moment	96 ft-k
Dist. from GL to 0 shear point in cyl.	3.28 ft
Maximum moment in shaft	122 ft-k



Jun 21 2024

2

BT6 - 9 of 9

Walpar © 2014

DOUBLE POLE CYLINDRICAL T-FOOTING DESIGN (CTF)

JOB NO :	C3546	SPECIFICATION :	2013
STRUCTURE NO :	OH-26	STATION NO :	37+34.06(WB)
CONC f 'c (PSI) :	3000	CONC WT (PCF) :	150
REBAR (PSI) :	60000	MEDIAN FOOTING (Y/N) :	N
SOIL BP (PSF) :	350	AB EMBED (FT) :	3.5

SPAN (FT) :	96.00	PEDESTAL & T-BEAM		
"C" (FT) :	4.75	SF :	1.15	
RD (KIPS) :	9.37	PL (FT) :	6.75	("D" DIM)
RV (KIPS) :	0.97	TW (FT) :	4.00	(T Beam Width)
RH (KIPS) :	11.26	"T" (FT) :	4.50	(T Beam Depth)
WV (KIPS) :	0.30	PW (FT) :	2.00	
"B" DIA (FT) :	4.00	PE (FT) :	1.00	
CLEAR (IN) :	4.00			
H1 (FT) :	13.88			
H2 (FT) :	7.88			
H3 (FT) :	1.00	(MAX "Z")		

PEDESTAL CALCULATIONS

DESIGN

SHEAR (KIPS) :	11.79	Asm (IN^2) :	19.44	QTY :	26.00
		Ast (IN^2) :	20.54	Ag (IN^2) :	1944.00
Cx (IN) :	40.50	Cy (IN) :	12.00	Ix (IN^4) :	1401794
Gx (IN) ;	73.00	Gy (IN) :	16.00	Iy (IN^4) :	762777
ML (FT-KIPS) ;	158.60	MW (FT-KIPS) ;	32.08	MLa (FT-KIPS) :	5.17
Mx (FT-KIPS) :	34.39	My (FT-KIPS) :	164.98	MLr (FT-KIPS) :	153.42
Mox (FT-KIPS) :	252.17	Moy (FT-KIPS) :	1150.52	MLt (FT-KIPS) :	12.11
CSM (UNIT) :	0.2798				

fa (PSI) :	5	fv (PSI) :	574
Fa (PSI) :	1596	Fv (PSI) :	26334
fbx (PSI) :	12	fby (PSI) :	31
Fbx (PSI) :	1596	Fby (PSI) :	1596
CSR (UNIT) :	0.0308		



Jun 21 2024

CYLINDER CALCULATIONS

O.T MOM (FT-KIPS) :	168.53	T-BEAM DEPTH CHECK :	OK
EFF H (FT) :	13.27		
EFF PTL (KIPS) :	2.59		
PRL (KIPS) :	11.85		
DEPTH D (FT) :	35.00		
CYL DEPTH (FT) :	30.50		
"A" DIM (FT) :	35.00		

1

Ref Sheet No : BT6-T(R)

DOUBLE POLE CYLINDRICAL T-FOOTING DESIGN (CTF)

JOB NO : C3546 STR NO : OH-26 STATION NO : 37+34.06(WB)

REINFORCING CALCULATIONS

REBAR NO# :	9	WGT/BAR (LBS/FT) :	3.40
MR (FT-KIPS) :	221.84		
D1 (IN) :	37.88		
As (IN^2) :	7.34		
1% CYL AREA (IN^2) :	18.10		
Ab (IN^2) :	1.00		
BARS "F" SPACING (IN) :	6.26		
BARS "F" QTY :	19		
HOOPS "G" QTY :	36		
TOP REINF REQ'D (IN^2) :	0.04		
QTY of #8 BARS "H" in TOP :	3		

FOOTING QUANTITIES

REINF (LBS) :	2645
CONC (CU YD) :	18.70



Jun 21 2024

3/7/2024