kpff Consulting Engineers

March 22, 2013

Mr. J.P. Paull
Atelier Dreiseitl + Place
735 NW 18th Avenue
Portland, OR 97209

RE: Oregon Zoo Condor Habitat
Wall Mesh Revision
Portland, Oregon

Dear J.P.:

Attached please find calculation sheets RD-1 through RD-63, dated March 22, 2013, which verify the structural adequacy of the Oregon Zoo Condor Habitat revised for a decreased wall mesh opening size as shown on drawings S0.1 through S6.2 dated March 22, 2013. The attached calculations supplement previously submitted calculation sheets 1 through 102, dated December 21, 2012 and sheets PR-1 through PR-20, dated January 17, 2013. Design is based on the requirements of the 2010 Oregon Structural Specialty Code (OSSC), based on the 2009 International Building Code.

If you have any questions or need further information, please call me.

Sincerely,

Lindsey Weisgerber

LW:kw
212044.01/calcs 03-22-13.docx

111 SW Fifth Avenue, Suite 2500 Portland, Oregon 97204-3628 (503) 227-3251 Fax (503) 227-7980

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LETTER OF TRANSMITTAL

Date: January 30, 2013 **Job No:** 212044
Attn: J.P. Paul
RE: Oregon Zoo Condor Exhibit

To: Place Architects
735 NW 18th Ave.
Portland, Oregon 97209

WE ARE SENDING YOU VIA: ☒ Messenger ☐ U.S. Mail ☐ Overnight Courier ☐ Hand Deliver

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COPIES	DATE	NO.	DESCRIPTION
2			Condor Structural Plan Review Comment response letter and calculations

THESE ARE TRANSMITTED as checked below:

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☐ For your approval
☐ As requested
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☐ For BIDS DUE _____, 19___

☐ Approved as submitted
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PRINTS RETURNED AFTER LOAN TO US

REMARKS

Copy To:

Signed Lindsey Weisgerber

kpff Consulting Engineers

January 30, 2013

Mr. J.P. Paull
Place Studio, LLC
735 NW 18th Avenue
Portland, OR 97209

RE: Oregon Zoo Condor Habitat – 4001 SW Canyon Rd.
New 425 SF Condor Habitat Enclosure and Associated Site Work
Response to City of Portland Review Comments
Application #: 12-219447, 12-219449, 12-219450-000-00-CO

Dear J.P.:

Below is KPFF's response to the City of Portland's Structural Checksheet Review Comments by Lisa Buellesbach, dated January 17, 2013.

Item #	Location on plans	Code Section	Clarification / Correction Required
3.	S0.1	OSSC 107.2.1	Micropiles and Helical Piles may not be deferred submittals. Please provide design and details for these items. **KPFF Response**: Micropiles and helical piles are proprietary systems that must be deferred submittals and shall be coordinated in construction with the supplier. See geotechnical report for additional information.
4.	L8.10, L8.03	OSSC 1607.7	Please provide calculations showing the adequacy of the guardrails. **KPFF Response**: Please see attached calculation sheets PR-1 through PR-14.
5.	S0.1	OSSC 107.2.1	In the load section of the General Notes, list the roof soil load that the keeper structure is designed to support. (Calcs pg 81) **KPFF Response**: The criterion has been added to S0.1. Please see latest drawings with revision date 02-04-2013.
6.	S2.2, S5.2		You have #4 at 10 inches in the Viewing Shelter roof slab. This is based on the thickness of 12 inches. This slab is much thicker than that in places and the reinforcing shown is less than the .0018 minimum required. Please provide minimum reinforcement in the roof slab. **KPFF Response**: Reinforcing has been revised as requested. Please see latest drawings with revision date 02-04-2013.

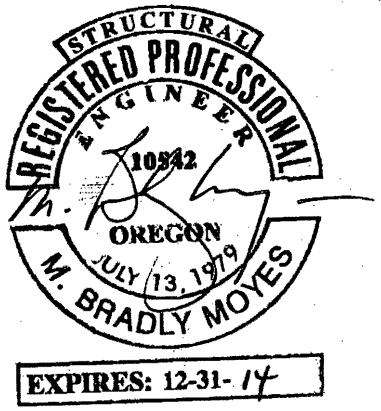
7.	S5.1	OSSC 107.2.1	Detail 7/ S5.1 states to see the plan for the bottom of footing elevation. This information is not on the plan. Please provide. **KPFF Response**: Bottom of footing elevations have been provided on plan sheet S2.1. Bottom of footing elevation call-outs are adjacent to the footing in parentheses, as referenced in plan note 5.
8.	calcs	OSSC 107.2.1	Please provide a legible copies of the computer model showing the nodes, (pg 20), the members, (pg 21), and the reactions, (pg 24). An 11 x 17 sheet may be helpful. **KPFF Response**: Please see attached calculation sheets PR-15, 16 and 17 for 11x17 sheets as requested.
9.	Viewing Shelters	OSSC 1604.4	It appears the viewing shelters are being used to resist horizontal loads from the mesh structure. Please show that the shelters are heavy enough to resist these loads. **KPFF Response**: Please see attached calculation sheet PR-18.
10.	S6.1, S6.2	OSSC 1604.4	Please provide calculations showing that the steel connections shown on sheets S6.1 and S6.2 are adequate. **KPFF Response**: Please see attached calculation sheets PR-19 and PR-20.

If you have any questions, please contact me.

Sincerely,

Lindsey Weisgerber, P.E.

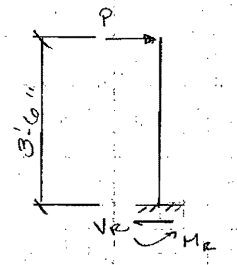
LW:kw
212044/Plan Rev Response Comments.doc



kpff Consulting Engineers Portland, Oregon	Project OR Zoo - Condor	By LLW	Sheet No.
	Location	Date	PR-1
	Client Place	Revised	Job No.
		Date	212044

HANDRAIL DESIGN - TIMBER

STANDARD POST AND RAIL:



$P = MAX \begin{cases} 200\# \\ (50PLF)\,6' = 300\# \end{cases}$ ← CONTROLS

$V_R = P = 300\#$

$M_R = Ph = 300\#(3.5') = 1050\#'$

TRY 4x4 CEDAR POST: WESTERN CEDAR SS — $A = 12.25\,in^2$, $F_b = 1000\,PSI$, $S = 7.146\,in^3$, $F_v = 155\,PSI$, $I = 12.51\,in^4$, $E = 1.1 \cdot 10^6\,PSI$

$C_F = 1.5$ PER TABLE 4A

$C_D = 1.6$ TEN MINUTE DURATION

$F_v' = C_D F_v = 248\,PSI$

$F_b' = C_D C_F F_b = (1.6)(1.5)(1000\,PSI) = 2400\,PSI$

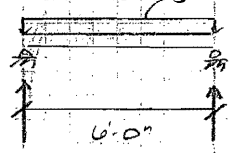
DEMAND:

$f_v = V_R/A = 300\#/12.25\,in^2 = 24.5\,PSI \ll F_v' = 155\,PSI$ OK

$f_b = M_R/S = 1050\#' \cdot 12''/1'/7.146\,in^3 = 1763\,PSI < F_b' = 2400\,PSI$ OK

PROVIDE 4x4 POSTS @ 6'-0" MAX OF WESTER CEDAR SS

RAIL:



$V = wl/2 = (50PLF)(6')/2 = 150\#$

$M = wl^2/8 = (50PLF)(6')^2/8 = 225\#'$

OR $M = (200\#)(6)/2 = 600\#'$

TRY 2x6 CEDAR FLAT: WESTERN CEDAR NO2 — $A = 8.25\,in^2$, $F_b = 700\,PSI$, $S_{xx} = 7.563\,in^3$, $F_v = 155\,PSI$

$C_F = 1.3$ PER TABLE 4A

$C_D = 1.6$ TEN MINUTE DURATION

$C_L = 1.0$ BRACED BY ADD'L RAIL COMPONENTS

CAPACITY:

$F_v' = F_v C_D = (155)(1.6) = 248\,PSI$

$F_b' = F_b C_D C_F = (700)(1.6)(1.3) = 1456\,PSI$

DEMAND:

$f_v = V/A = 150\#/8.25\,in^2 = 18.2\,PSI \ll F_v' = 248\,PSI$ OK

$f_b = M/S = 600\#' \cdot 12''/1'/7.563\,in^3 = 952\,PSI < F_b' = 1456\,PSI$ OK

PROVIDE 2x6 RAIL OF WESTERN CEDAR NO2

Project: Zoo Condor Exhibit
Project No.: 212044
Client: Place
Subject: Bolted Wood Post Connection

Engineer: LLW
File: HandrailConn.MCD
Date: 1/2013
Rev.:

Steel Plate Properties:

$L_b := 5 \cdot in$ $d := 2.75 \cdot in$ $t := .25 \cdot in$ $F_y := 36 \cdot ksi$ $C_b := 1.0$

$S_x := \frac{t \cdot d^2}{6}$ $S_x = 0.315\,in^3$ $Z_x := \frac{t \cdot d^2}{4}$ $Z_x = 0.473\,in^3$ $I_x := \frac{t \cdot d^3}{12}$ $I_x = 0.433\,in^4$

Flexural Analysis:

$M_p := F_y \cdot Z_x$ $M_p = 1.418\,k \cdot ft$ $lim := \frac{L_b \cdot d}{t^2}$ $lim = 220$

$M_y := F_y \cdot S_x$ $M_y = 0.945\,k \cdot ft$

$F_{cr} := \frac{1.9 \cdot E_s \cdot C_b}{\left(\frac{L_b \cdot d}{t^2}\right)}$ $F_{cr} = 250.455\,ksi$ $\frac{0.08 \cdot E_s}{F_y} = 64.444$ $\frac{1.9 \cdot E_s}{F_y} = 1530.556$

$M_{np} := \min(M_p, 1.6 \cdot M_y)$ $M_{np} = 1.418\,k \cdot ft$

$$M_n := \begin{cases} M_{np} & \text{if } lim \le 0.08 \cdot \frac{E_s}{F_y} \\ \left[C_b \cdot \left[1.52 - 0.274 \cdot (lim) \cdot \frac{F_y}{E_s}\right] \cdot M_y\right] & \text{if } lim \le 1.9 \cdot \frac{E_s}{F_y} \\ (F_{cr} \cdot S_x) & \text{if } lim > 1.9 \cdot \frac{E_s}{F_y} \end{cases}$$ $M_n = 1.366\,k \cdot ft$

$\Omega_b := 1.67$

$\frac{M_n}{\Omega_b} = 818.046\,lb \cdot ft$ > $M := 200 \cdot lb \cdot 3.5 \cdot ft$ $M = 700\,lb\,ft$ OK

Project: Zoo Condor Exhibit
Project No.: 212044
Client: Place
Subject: Bolted Wood Post Connection

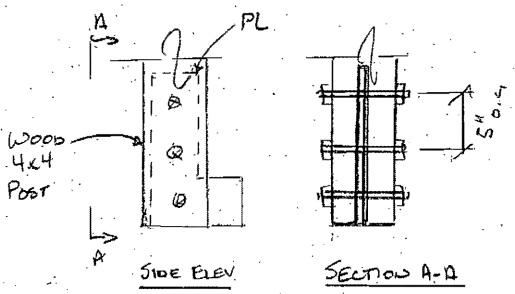
Check Connection of steel plate slotted CL of wood post: per NDS chapter 11

$D := 0.375 \cdot in$ $F_{yb} := 45 \cdot ksi$ 3/8" dia. A307 thru bolt

$l_m := 0.25 \cdot in$ $F_{em} := 87 \cdot ksi$ 1/4" steel plate main member

$l_s := 1.625 \cdot in$ $F_{es} := 3550 \cdot psi$ remaining 4x4 wood post section each side of plate

$R_e := \frac{F_{em}}{F_{es}}$ $R_e = 24.507$



Double Shear Yield Modes:

$K_\theta := 1 + .25 \cdot \frac{90}{90}$ $K_\theta = 1.25$

$R_{d\_Im} := 4 \cdot K_\theta$ $R_{d\_Im} = 5$

$Z_{Im} := \frac{D \cdot l_m \cdot F_{em}}{R_{d\_Im}}$ $\boxed{Z_{Im} = 1631.25\ lb}$

$R_{d\_Is} := 4 \cdot K_\theta$ $R_{d\_Is} = 5$

$Z_{Is} := \frac{2 \cdot D \cdot l_s \cdot F_{es}}{R_{d\_Is}}$ $\boxed{Z_{Is} = 865.313\ lb}$

$R_{d\_III} := 3.2 \cdot K_\theta$ $R_{d\_III} = 4$

$k_3 := -1 + \sqrt{\frac{2 \cdot (1 + R_e)}{R_e} + \frac{2 \cdot F_{yb} \cdot (2 + R_e) \cdot D^2}{3 \cdot F_{em} \cdot l_s^2}}$ $k_3 = 0.603$

$Z_{III} := \frac{2 \cdot k_3 \cdot D \cdot l_s \cdot F_{em}}{(2 + R_e) \cdot R_{d\_III}}$ $\boxed{Z_{III} = 602.632\ lb}$

$R_{d\_IV} := 3.2 \cdot K_\theta$ $R_{d\_IV} = 4$

$Z_{IV} := \frac{2 \cdot D^2}{R_{d\_IV}} \cdot \sqrt{\frac{2 \cdot F_{em} \cdot F_{yb}}{3 \cdot (1 + R_e)}}$ $\boxed{Z_{IV} = 711.251\ lb}$

Yield Mode III controls: $Z := Z_{III}$ $\boxed{Z = 602.632\ lb}$

Project: Zoo Condor Exhibit
Project No.: 212044
Client: Place
Subject: Bolted Wood Post Connection

Page -3-
Engineer: LLW
File: HandrailConn.MCD
Date: 1/2013
Rev.:

$Z = 603\,lb$

ASD adjustment factors: $C_d := 1.6$ short term load

All other adjustment factors negligable by inspection

$Z_p := Z \cdot C_d$ $Z_p = 964\,lb$

Try (3) botl connection spacing $s := 5 \cdot in$ assuming center bolt takes shear force, T&B bolts take moment couple

Moment from post analysis: $M = 700\,lb\,ft$

Moment arm: $d := 2 \cdot s$ $d = 10\,in$

T/C from moment: $T := \frac{M}{d}$ $T = 840\,lb$

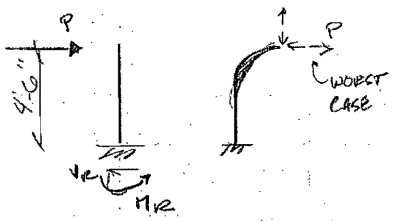
$T = 840\,lb$ < $Z_p = 964\,lb$ OK

Provide (3) 3/8" dia. A307 thru bolts @ 5" o.c. in 1/4" plate slotted in 4x4 wood post

kpff Consulting Engineers
Portland, Oregon

Project CONDORS	By LLW	Sheet No. PR-5
Location	Date	
Client PLACE	Revised	Job No. 212044
	Date	

STEEL HANDRAIL DESIGN



$P_{max} = 300^{\#}$ PER W2000 POST CALC

$V_R = P_{max} = 300^{\#}$

$M_R = Ph = (300^{\#})(4.5') = 1350^{\#'}$

PER AISI PIPE HANDRAIL DESIGN, LOADS DISTRIBUTE AMONG POSTS IN A LINE. A WORST CASE 3 POST, END POST REDUCTION FACTOR = 0.95

REF. ANSI/NAAMM AMP 521

EFFECTIVE $P_{max} = 0.95 \times 300^{\#} = 285^{\#}$

" $M_R = 0.95 \times 1350^{\#'} = 1283^{\#'}$

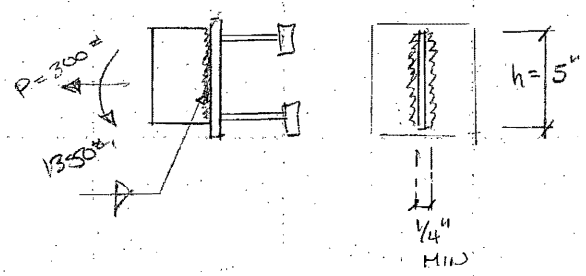
TRY 2"ϕ STD PIPE: $F_y = 35$ KSI $\quad Z = 0.761\ in^3$

$M_n/\Omega_b = F_y Z / 1.67$

$= (35\text{KSI})(0.761\ in^3)/1.67/12 = 1.33$ K FT > 1.283 K FT $= M_{R\ EFF.}$ OK

SHEAR OK BY INSPECTION

BASE CONNECTION:



$A_w = 2h = 2(5") = 10"$

$S_w = h^2/3 = (5")^2/3 = 8.33\ in^2$

$f_v = P/A_w = 300^{\#}/10" = 30$ LB/IN

$f_b = M/S_w = 1350^{\#'} \cdot 12/8.33\ in^2 = 1944$ LB/IN

$f_b + f_v = 0.030$ K/IN $+ 1.944$ K/IN $= 1.974$ K/IN

$f_r = 0.6 F_{exx} \frac{\sqrt{2}}{2} / 1.67 = 17.78$ KSI

Ω_2

$t_{req} = f_{tot}/f_r = 1.974$ K/IN $/ 17.78$ KSI $= 0.111" <$ 1/8" MIN REQ'D

DESIGN ANCHORS — SEE ATTACHED HILTI PROFIS ANCHOR CALC

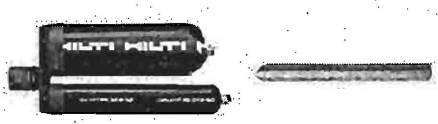
3/16" PROVIDED OK

PR-6

Company:		Page:	1
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	1/30/2013
E-Mail:			

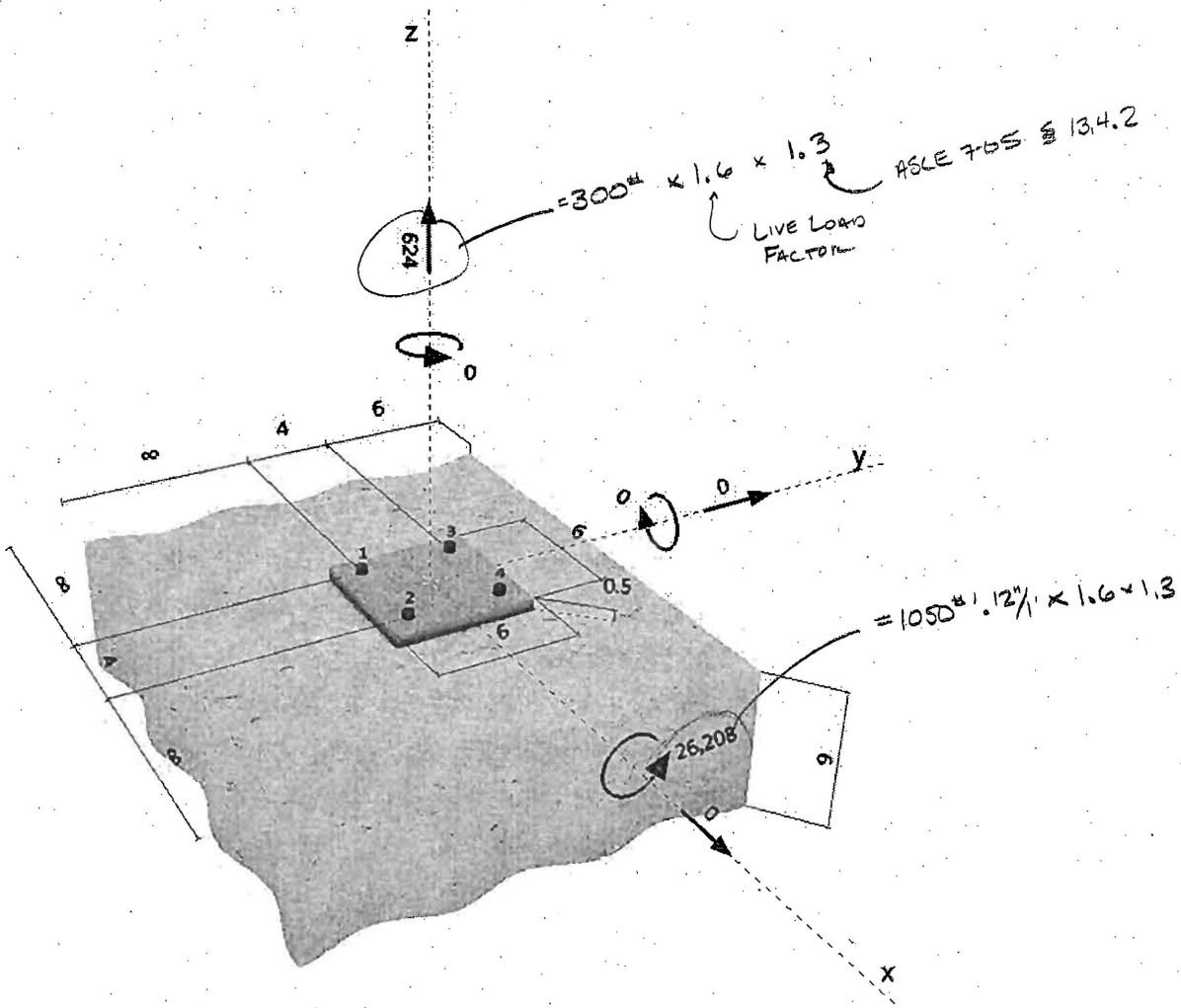
Specifier's comments:

1 Input data



Anchor type and diameter:	**HIT-RE 500-SD + HAS 1/2**
Effective embedment depth:	$h_{ef,opti}$ = 4.252 in. ($h_{ef,limit}$ = 4.750 in.)
Material:	ASTM F 568M Class 5.8
Evaluation Service Report::	ESR 2322
Issued I Valid:	4/1/2010 | 4/1/2012
Proof:	design method ACI 318 / AC308
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3000 psi; h = 6.000 in., Temp. short/long: 32/32 °F
Installation:	hammer drilled hole, installation condition: dry
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

Geometry [in.] & Loading [lb, in.lb]



=300# x 1.6 x 1.3 ASCE 7-05 § 13.4.2

LIVE LOAD FACTOR

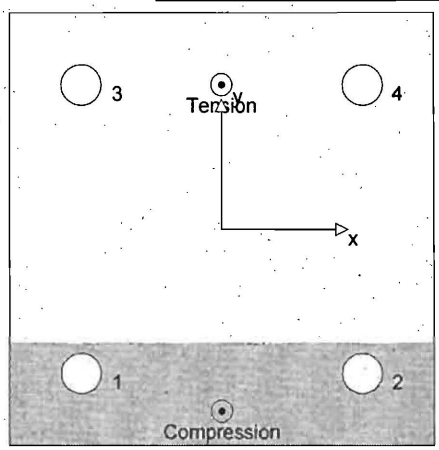
=1050# 1.12"/1" x 1.6 x 1.3

Company:
Specifier:
Address:
Phone I Fax:
E-Mail:

Page: 2
Project:
Sub-Project I Pos. No.:
Date: 1/30/2013

2 Load case/Resulting anchor forces

Load case: Design loads



Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	0	0	0
2	0	0	0	0
3	3070	0	0	0
4	3070	0	0	0

max. concrete compressive strain: 0.30 [‰]
max. concrete compressive stress: 1291 [psi]
resulting tension force in (x/y)=(0.000/2.000): 6139 [lb]
resulting compression force in (x/y)=(0.000/-2.525): 5515 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3070	6688	46	OK
Bond Strength**	6139	6185	100	OK
Concrete Breakout Strength**	6139	6639	93	OK

* anchor having the highest loading **anchor group (anchors in tension)

3.1 Steel Strength

N_{sa} [lb]	ϕ	ϕN_{sa} [lb]	N_{ua} [lb]
10290	0.650	6688	3070

3.2 Bond Strength

A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$s_{cr,Na}$ [in.]	$c_{cr,Na}$ [in.]	c [in.]	c_{ac} [in.]	
200.39	154.14	12.415	6.208	6.000	9.929	

$k_{c,cr}$	$\tau_{k,uncr,2500}$ [psi]	κ_{dry}	$\tau_{k,cr}$ [psi]	$\tau_{k,max,cr}$ [psi]	$\psi_{g,Na0}$	$\psi_{g,Na}$
17	2235	1.00	1075	1221	1.072	1.031

$e_{c1,N}$ [in.]	$\psi_{ec1,Na}$	$e_{c2,N}$ [in.]	$\psi_{ec2,Na}$	$\psi_{p,Na}$	$\psi_{ed,Na}$
0.000	1.000	0.000	1.000	1.000	0.990

N_{a0} [lb]	ϕ	ϕN_{ag} [lb]	N_{ua} [lb]
7170	0.650	6185	6139

3.3 Concrete Breakout Strength

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$c_{a,min}$ [in.]	c_{ac} [in.]	$\psi_{c,N}$		
207.04	162.26	6.000	9.929	1.000		

$e_{c1,N}$ [in.]	$\psi_{ec1,N}$	$e_{c2,N}$ [in.]	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	k_{cr}
0.000	1.000	0.000	1.000	0.983	1.000	17

N_b [lb]	ϕ	ϕN_{cbg} [lb]	N_{ua} [lb]
8147	0.650	6639	6139

Company:
Specifier:
Address:
Phone I Fax:
E-Mail:

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (relevant anchors)

5 Warnings

- To avoid failure of the anchor plate the required thickness can be calculated in PROFIS Anchor. Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions
- The present version of the software does not account for adhesive anchor special design provisions corresponding to overhead applications. Refer to the ICC-ES Evaluation Service Report (e.g. section 4.1.1 of the ICC-ESR 2322) for details.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI318 or the relevant standard!

Fastening meets the design criteria!

Cable Rail Design per "Designing Prestressed Barrier Cables" by Hoshang Presswalla

Project: Condors
Location: Site Handrail

l =	6.00	ft	(max indiv. Span)
L =	72.00	ft	(overall cable length)
E =	28000	ksi	(Type 316 stainless)
A =	0.0166	in^2	(3/16" cable)
a' =	0.77	in	(deflection limit)

Method 1: Standard Building Code Method

P = 12.5 pounds (ASCE 7-05 4.4.1; 50 lbs / 3"o.c.)

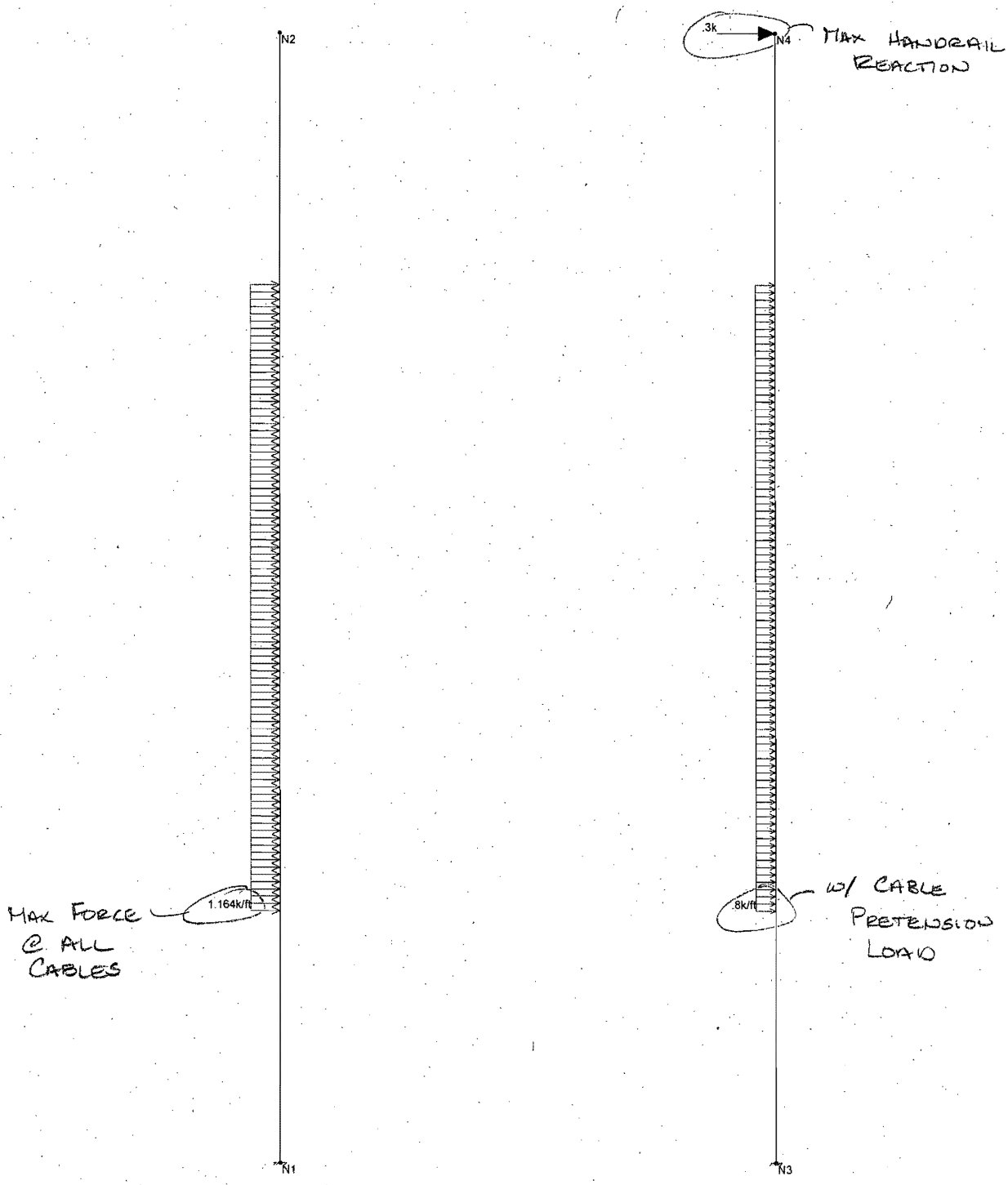
a =	$(Pl^2L/8EA)^{1/3}$ =	2.5	in	
T =	$Pl/4a$ =	0.091	kips	Non prestressed Cable Tension caused by load
T' =	$Pl/4a'$ =	0.291	kips	Cable Tension caused by load
T_o =	T' - T =	0.200	kips	Cable Pretension

EQUIV. UNIFORM LOADS?

$T' \approx 0.291\,K \cdot 12''/3'' = 1.164\ K/FT$

$T_o \approx 0.200K \cdot 12/3 = 0.800K/FT$

CABLE HANDRAIL END POST

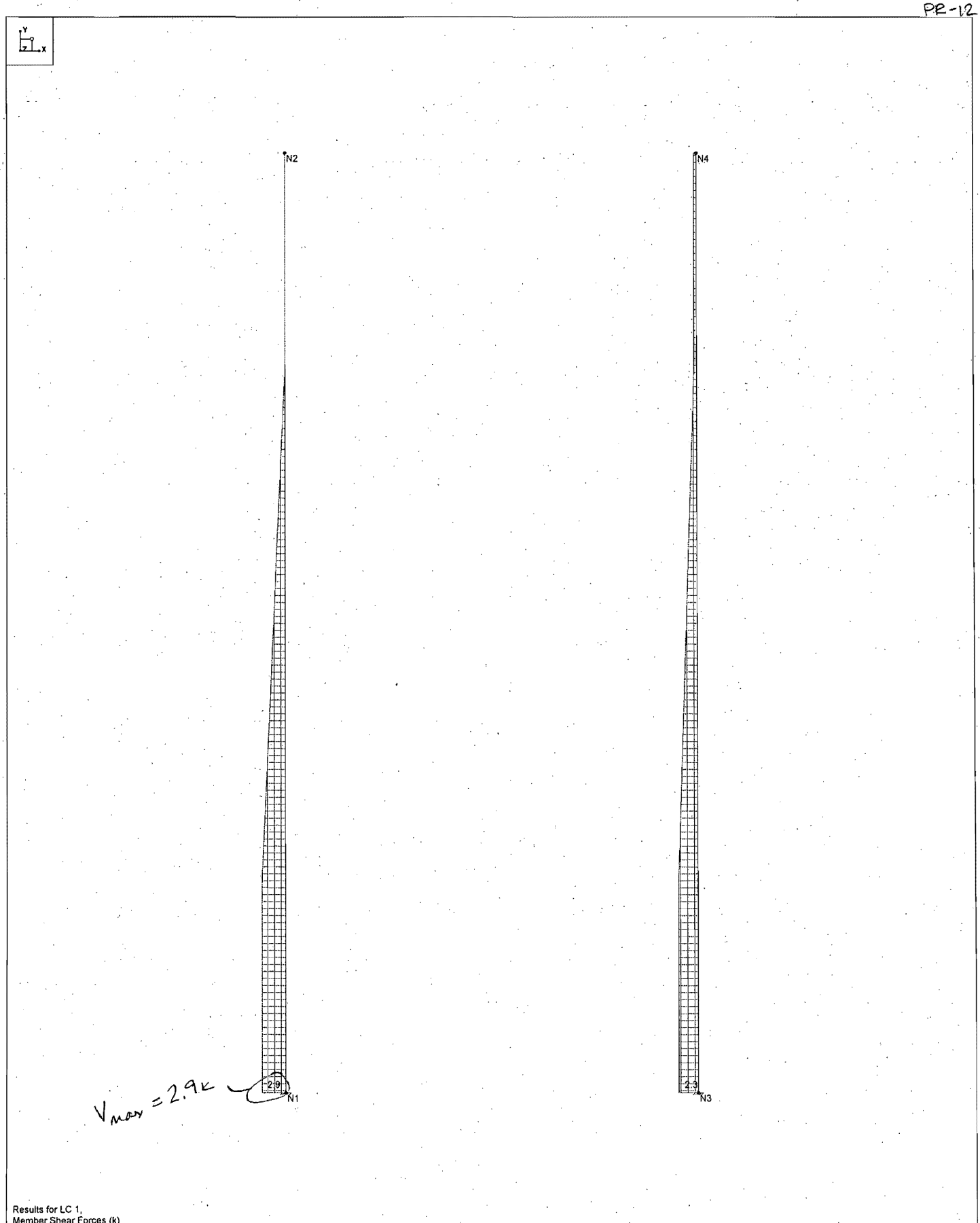


CASE 1

CASE 2

Loads: BLC 1,
Results for LC 1,

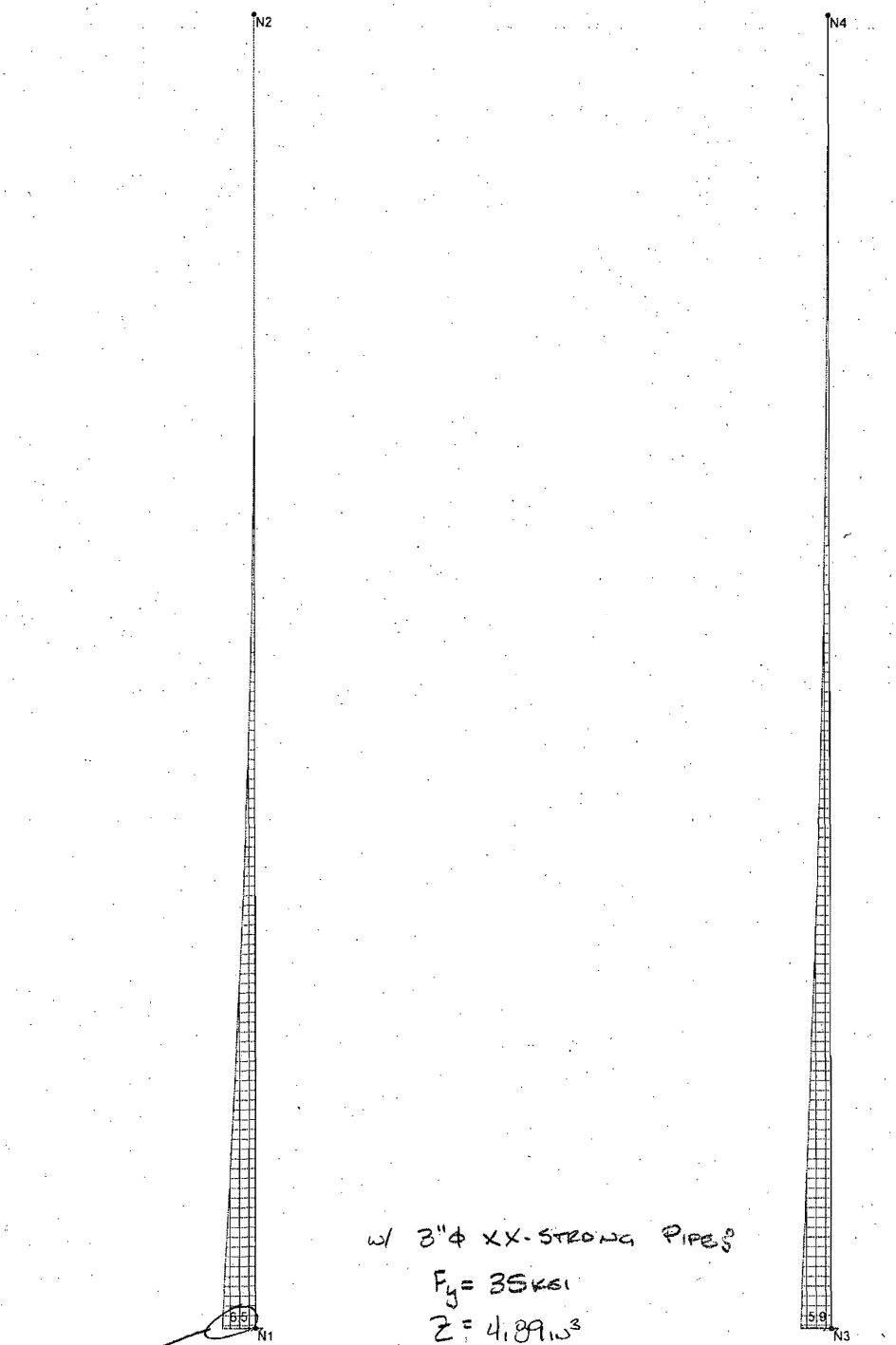
		SK - 1
		Jan 30, 2013 at 7:33 AM
		Handrail.r2d



$V_{max} = 2.9^{k}$

Results for LC 1,
Member Shear Forces (k)

		SK - 2
		Jan 30, 2013 at 7:33 AM
		Handrail.r2d



$M_{max} = 6.5 k\text{-}ft$

w/ 3"ϕ XX-STRONG PIPES

$F_y = 35 ksi$

$Z = 4.89 in^3$

$M_n/\Omega = (35 ksi)(4.89 in^3)/12/1.67$

$= 8.54 k\text{-}ft > M_{max} = 6.5 k\text{-}ft$ OK

PROVIDE 3" XX-STRONG END POSTS

Results for LC 1,
Member Bending Moments (k-ft)

		SK - 3
		Jan 30, 2013 at 7:33 AM
		Handrail.r2d

Project: OR Zoo Condor Exhibit
Project No.: 212044
Client: Place
Subject: Typ Fence Post

Page -1-
Engineer: LLW
File: HandrailPoleEmbed.MCD
Date: 1/2013
Rev.:

Typical Post Embedded Pole Foundation:

(IBC sect. 1805.7.2.1)
nonconstrained pole

Depth of embedment [ft]: $d_p := 4$

Diameter of Footing [ft]: $b := 1.5$

Applied Lateral Force [lb]: $P_h := 300$

Height of Force above grade [ft]: $h := 3.5$

Lateral Soil Bearing Pressure [psf/ft]: $S_1 := 200$

Lateral Soil Bearing Pressure [psf]: $S := S_1 \cdot \min\left(\frac{d_p}{3}, 4\right)$ $S = 266.667$

Provide footing 1'-6" diameter, w/ 4'-0" embedment at typical handrail posts

End Post Embedded Pole Foundation:

(IBC sect. 1805.7.2.1)
nonconstrained pole

Depth of embedment [ft]: $d_p := 9.33$

Diameter of Footing [ft]: $b := 1.5$

Applied Lateral Force [lb]: $P_h := 2910$

Equivalent force for moment caused at top of foundation

Height of Force above grade [ft]: $h := 2.25$

Lateral Soil Bearing Pressure [psf/ft]: $S_1 := 200$

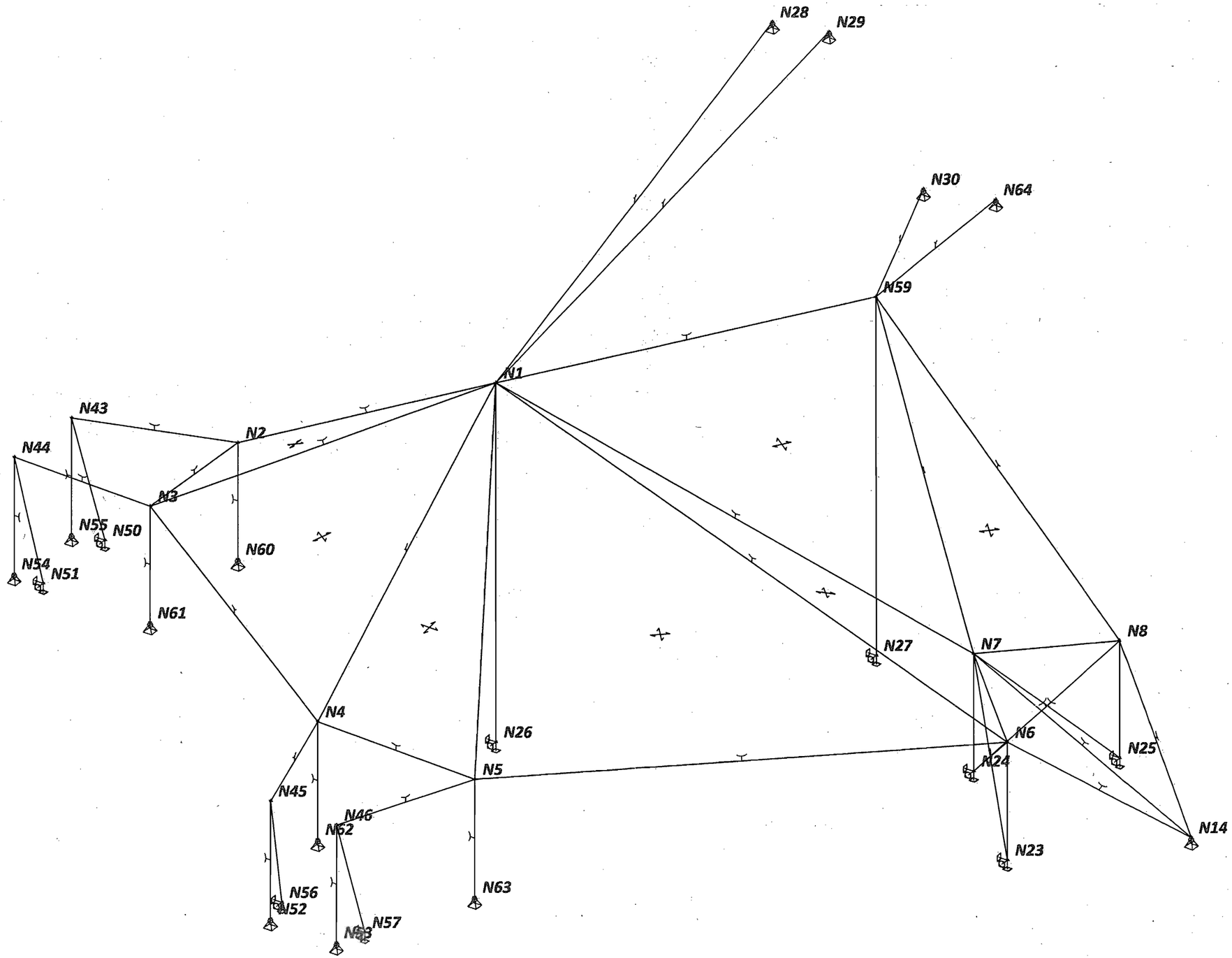
Lateral Soil Bearing Pressure [psf]: $S := S_1 \cdot \min\left(\frac{d_p}{3}, 4\right)$ $S = 622$

$$A := \frac{2.34 \cdot P_h}{S \cdot b} \qquad A = 7.298$$

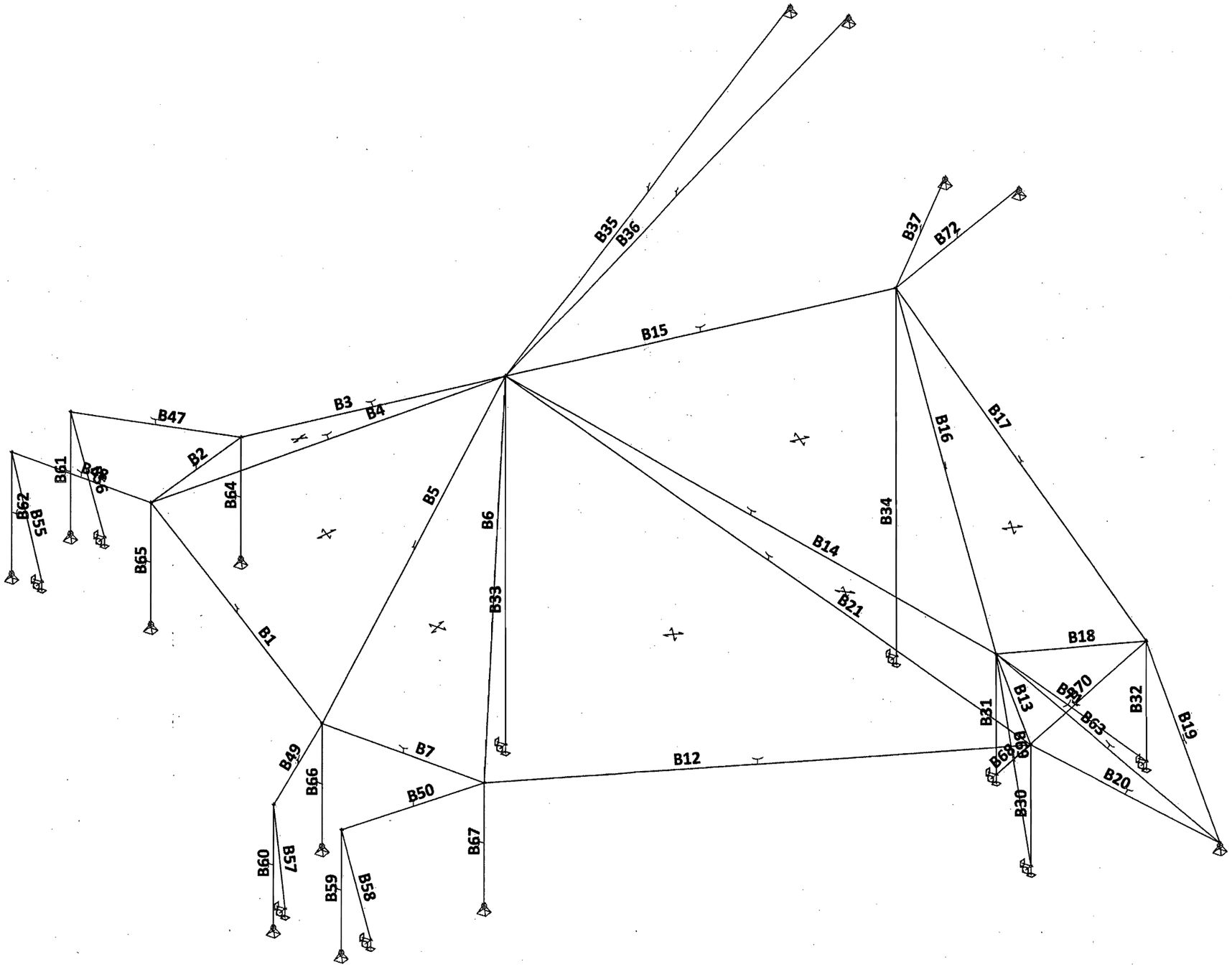
$$d := 0.5 \cdot A \cdot \left(1 + \sqrt{1 + 4.36 \cdot \frac{h}{A}}\right) \qquad d = 9.24 \quad =< \quad d_p = 9.33 \quad \text{OK} \qquad \text{(IBC eqn 18-1)}$$

Provide footing 1'-6" diameter, w/ 9'-4" embedment at end posts

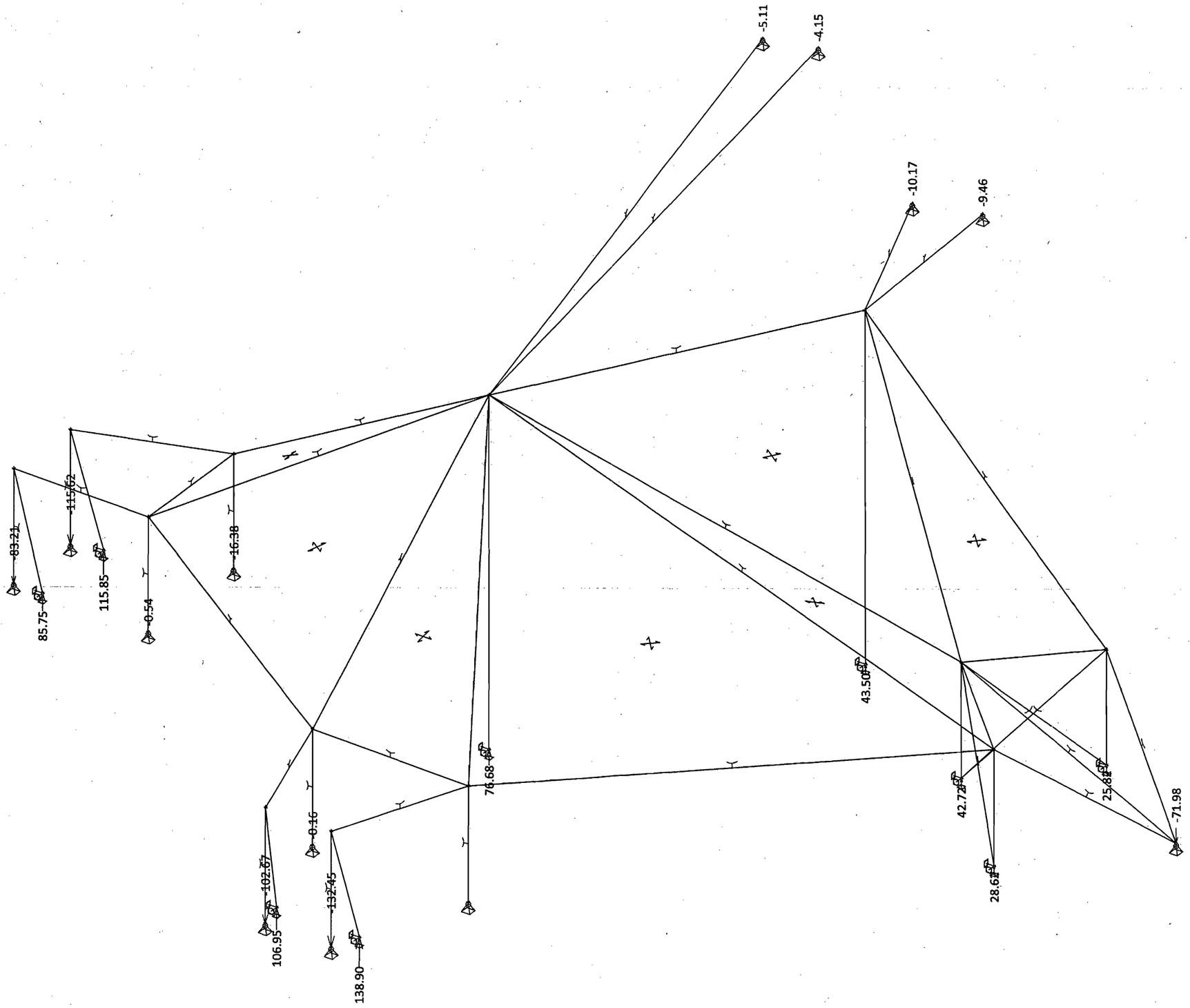
Model Nodes


N28
N29
N30
N64
N59
N1
N43
N2
N44
N3
N55
N50
N60
N54
N51
N61
N4
N26
N5
N45
N46
N62
N56
N52
N57
N63
N27
N7
N8
N6
N25
K24
N23
N14

Member Labels



Envelope Maximum Vert Reactions



kpff Consulting Engineers Portland, Oregon	Project Zoo Condor	By LLW	Sheet No.
	Location	Date	PR-18
	Client Place	Revised	Job No.
		Date	212044

VIEWING LATERAL VERIFICATIONS - SLIDING CHECK

PER SOILS REPORT: DESIGN FRICTION FACTOR $\mu_f = 0.50$

DESIGN LATERAL PRESSURE $p_p = 230$ PCF (NEGLECTING TOP 1')

MESH COLUMN MAX REACTIONS:
@ NODE N57 PER PG 61 OF CALCS

$D_x = 17.02K$ $E_x = 20.5K$ $D_{LL_x} = 38.7K$ $W_{L_x} = 1.61K$
$D_z = 58.3K$

SHELTER SEISMIC REACTION (V_e) = 51.7K

CONTROLLING LOAD COMBO'S:

1) $D + 0.7D_L$ $F_x = (17.02K) + 0.7(38.7K) = \cancel{44.1K}$ $\times 2 = 88.2K$

2) $0.6D + 0.7D_L + 0.7W_L$ $F_x = 0.6(17.02K) + 0.7(38.7K) + 0.7(1.61K) = \cancel{38.4K}$ $\times 2 = 76.8K$

3) $(0.6 - 0.14S_{DS})D + 0.7E$ $F_x = (0.6 - .14(0.726))(17.02K)^{\times 2} + 0.7(20.5K^{\times 2} + 51.7K)$
$(0.6 - 0.14(0.726)) = 0.50 \times D^*$ $= \cancel{59.0K} = 81.8K$

THEREFORE, LOAD COMBO (3) CONTROLS
W/ $F_x = \cancel{59.0K}$ 81.8K AND 0.50 DL FACTOR *

SHELTER BASE FRICTION: (R_F)

STRUCTURE WEIGHT = 89K FROM SEISMIC CALCS

FOOTING WEIGHT = $2 \times (150PCF \cdot 2' \cdot 6' \cdot 17.25') = 62.1K$

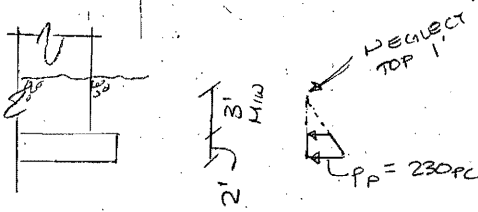
SLAB ON GRADE / SOIL WEIGHT = $(110PCF)(16')(14')(3') = 73.9K$ ← MIN SOIL TOP OF FOOTING

COLUMN DL VERT REACTION = $D_z = 58.3K$

$W_{TOT} = 89K + 62.1K + 73.9K + 58.3K = 283.3K$

$R_F = 0.50\,\mu_f\,W_{TOT} = 0.50(0.50)(283.3K) = 70.8K$
(0.50 ↑ COMBO (3) DL FACTOR)

PASSIVE PRESSURE RESISTANCE: (R_p)



AVERAGE PASSIVE ON FOOTING $\approx (230PCF)(5' - 2'/2) = 690PSF$

* CONSERVATIVELY CONSIDER PASSIVE P. ON FOOTINGS, NEGLECTING REST OF STRUCTURE

$R_p = (690PSF)(2')(6') \times 2 = 16.6K$

$R_p + R_F = 87.4K > 81.8K = F_x$ OK

THEREFORE, VIEWING SHELTERS ARE ADEQUATE FOR LATERAL SLIDING LOADS

STEEL COLUMN CONNECTION CALCS

PER AISC 5th K FOR HSS CONNECTIONS

HSS 12"Φ x 0.500

CHK SLENDERNESS:

$D/t = 12/0.500 = 24 << 40$ OK 5th K1.2

HSS PLASTIFICATION:

$R_n = 5.5 F_y t^2 (1 + 0.25 \frac{N}{D}) Q_f$ (EQN K1-2)

$Q_f = 1.0$, TYP [TA K1.1]

$R_n = 5.5(42\text{ksi})(0.500)^2(1+0.25\frac{N}{12})1.0$

$= 1.203(N + 48)$

N = LENGTH OF CONN. PL

$N = 9''$ MIN

$R_n = 1.203(9'' + 48) = 68.57\text{K}$

* $2R_n$ FOR THRU PL CONN.

$\Omega = 1.67$

$2R_n/\Omega = 2(68.57\text{K})/1.67 = 82.1\text{K}$

1" CABLE ASD TENSION = 47K < 82.1K OK

* THE OPPOSING LOADS ON THE THRU PL'S COUNTERACT ACT SO THE MAX NET SHEAR ON THE HSS IS REQ'D TO MEET HSS PLASTIFICATION LIMIT

$V_{MAX} = 5.13\text{K}$ @ B31 FOR NC4

$V_{MAX} = 5.13\text{K} << 2R_n/\Omega$ OK

** NOTE SMALL MAX NET SHEAR INDICATES CABLE LOADS ARE WELL BALANCED AMONG THE ENCLOSURE & BACKSTAY CABLES MEETING DESIGN INTENT

HSS 16"Φ x 0.625"

CHK SLENDERNESS:

$D/t = 16/0.625 = 25.6 << 40$ OK 5th K1.2

HSS PLASTIFICATION:

$R_n = 5.5 F_y t^2 (1 + 0.25 \frac{N}{D}) Q_f$ (EQN K1-2)

$R_n = 5.5(42)(0.625")^2(1+0.25\frac{N}{16"})1.0$

$= 1.4099(N + 64)$

$N = 12''$ MIN

$R_n = 1.4099(12+64) = 107.15\text{K}$

* $2R_n$ FOR THRU PL CONN.

$\Omega = 1.67$

$2R_n/\Omega = 2(107.15\text{K})/1.67 = 128.3\text{K}$

1 3/4" CABLE = 140K > 128.3K

(BACKSTAY CABLE @ VIEWING)

HOWEVER...

$V_{MAX} = 1.33\text{K}$ @ B58 FOR NC4

$V_{MAX} = 1.33\text{K} << 2R_n/\Omega$ OK

Cable Connection Info
Oregon Zoo Condor Habitat
KPFF Project #212044

Rope dia.	Rope Capacit	Thrd'd Sleeve	Clevis #	Clevis ASD Capacity		Pin Properties per AISC Pin dia.	a	p	Max PL edge	Hole dia. Standard	Oversized	Edge Dist. Req'd Standard	Oversized	Plate Calc L_c	F_y	F_u	For bearing at bolt holes (J3.10) $t_{min\ 1}$	$t_{min\ 2}$	$t_{PL\ min}$		Shear Yield or Rupture (J4.2) $t_{min\ 1}$	$t_{min\ 2}$	$t_{PL\ min}$		Rope dia.
(in)	(kips)	(in)		(kips)		(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(ksi)	(ksi)	(in)	(in)	(in)		(in)	(in)	(in)		(in)
3/8	6.86	0.75	2 1/2	12.5	ok	1	4	1.5	3.25	1.0625	1.25	1.75	1.875	1.21875	36	58	0.162	0.099	< 0.25		0.136	0.162	< 0.25	ok	3/8
1/2	12.09	1	3	25	ok	1.5	5.0625	1.75	4.1875	1.5625	1.8125	2.625	2.75	1.84375	36	58	0.188	0.116	< 0.25		0.160	0.188	< 0.25	ok	1/2
5/8	18.7	1.25	3	25	ok	1.5	5.0625	1.75	4.1875	1.5625	1.8125	2.625	2.75	1.84375	36	58	0.291	0.179	< 0.375		0.247	0.291	< 0.375	ok	5/8
3/4	26.7	1.5	3 1/2	30	ok	1.5	6	1.75	5.125	1.5625	1.8125	2.625	2.75	1.84375	36	58	0.416	0.256	< 0.5		0.353	0.416	< 0.5	ok	3/4
1	47	2	5	62.5	ok	2	7	2.5	5.75	2.0625	2.3125	3.5	3.625	2.46875	36	58	0.547	0.338	< 0.625		0.466	0.547	< 0.625	ok	1
1 1/8	59	2.25	6	90	ok	2.5	8	3	6.5	2.5625	2.8125	4.375	4.5	3.09375	36	58	0.548	0.339	< 0.625		0.468	0.548	< 0.625	ok	1 1/8
1 1/4	72.6	2.5	6	90	ok	2.5	8	3	6.5	2.5625	2.8125	4.375	4.5	3.09375	36	58	0.674	0.417	< 0.75		0.576	0.674	< 0.75	ok	1 1/4
1 3/8	87.27	2.75	7	114	ok	3	9	3.75	7.125	3.0625	3.3125	5.25	5.375	3.71875	36	58	0.674	0.418	< 0.75		0.577	0.674	< 0.75	ok	1 3/8
1 1/2	103.6	3	7	114	ok	3	9	3.75	7.125	3.0625	3.3125	5.25	5.375	3.71875	36	58	0.801	0.496	< 1		0.685	0.801	< 1	ok	1 1/2
1 3/4	125	4	8	225	ok	3.375	18.125	4.25	16	3.4375	3.6875	5.90625	6.03125	4.1875	36	58	0.858	0.532	< 1		0.735	0.858	< 1	ok	1 3/4
(2) 1 w/ shackle	94	2	5	62.5	ok	3.3			14.65	3.3625	3.6125	5.775	5.9	4.09375	36	58	0.660	0.409	< 1		0.565	0.660	< 1	ok	(2) 1 w/ shackle

OVERSIZED HOLES USED TYP

MIN PL THICKNESS USED AT EACH

Weld Sizing

Rope dia.	Rope Capacit	lmin	t req	tmin des	
(in)	(kips)	(in)	(in)	(in)	
3/8	6.86	4.25	0.054	3/16	ok
1/2	12.09	4.25	0.096	1/4	ok
5/8	18.7	5	0.126	1/4	ok
3/4	26.7	6	0.150	1/4	ok
7/8	36.18	6	0.203	1/4	ok
1	47	9	0.176	1/4	ok
1 1/8	59	9	0.221	1/4	ok
1 1/4	72.6	10	0.244	1/4	ok
1 3/8	87.27	10	0.294	5/16	ok
1 1/2	103.6	12	0.291	5/16	ok
1 3/4	125	14	0.301	5/16	ok
(2) 1 w/ shackle	94	12	0.264	5/16	ok

MIN LENGTH OF WELDED CONNECTIONS

City of Portland, Oregon
Bureau of Development Services
Site Development
FROM CONCEPT TO CONSTRUCTION

Charlie Hales, Mayor
Paul L. Scarlett, Director
Phone: (503) 823-6892
Fax: (503) 823-5433
TTY: (503) 823-6868
www.portlandoregon.gov/bds

PROJECT INFORMATION

Street Address:	**4001 SW CANYON RD**
Description of Work:	**12-219447 CO: NEW 425 SF CONDOR KEEPERS STRUCTURE AND HABITAT ENCLOSURE WITH ASSOCIATED SITE WORK** **12-219449 CO: NEW 185 SF VIEWING STRUCTURE** **12-219450 CO: NEW 185 SF VIEWING STRUCTURE**

PLAN REVIEW

Based on the plans and specifications submitted, the following items appear to be missing or not in conformance with the Oregon Structural Specialty Code, Oregon One and Two Family Dwelling Specialty Code and/or other city, state, or federal requirements.

Item #	Location on plans	Code Section	Clarification / Correction Required
1	File	OSSC 1704.7 PCC 24.20	FYI ONLY – NO ACTION REQUIRED AT THIS TIME Special Inspection will be required for this permit. The *Soils Special Inspections* form will be issued following a review of the materials requested below.
2			Please submit a stamped addendum to the geotechnical engineering report that includes the following. Please forward a pdf copy of the report and addenda to jason.butler-brown@portlandoregon.gov. A) A site plan showing boring locations referenced in the report, including those performed by others. B) The proposed development is located within a mapped Historic and/or Active landslide as shown on the DOGAMI *Landslide Inventory Map of the Southwest Quarter of the Portland Quadrangle, Multnomah and Washington Counties, Oregon, 2010,* IMS-33. An aerial image of the site with the inventory map overlay is below. The Veterinary Center is the building in the upper right corner of the image. C) Shallow foundation embedment is recommended to be a minimum of 12 inches. The regional frost depth is 18 inches. Please revise the report to recommend foundation embedment at or below the regional frost depth. D) Please include recommendations for the construction of the swale at the toe of the slope behind the existing retaining wall. E) Provide recommendations for the design and construction of drilled shaft in close proximity to the existing retaining wall. Please reference Detail 15/S5.1 which shows the 30 inch drilled pier

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			through the toe of the existing retaining wall footing and filled with non-shrink grout. How will the loading of the pier effect the performance of the existing wall? For example, if settlement occurs at the wall, will vertical and/or lateral loads carried by the wall be transferred to the pier?
3	4/A2.1	PCC 24.10.070	Detail 4/A2.1 shows lightweight soil on the roof of the keeper structure. Please forward a pdf copy of the section of the specifications detailing the requirements for this material to jason.butler-brown@portlandoregon.gov.
4	S0.1	PCC 24.10.070 OSSC 1810.3.3	Helical Piles are listed as a deferred submittal item. Site Development does not accept Helical anchors as deferred submittal items. A) Please revise the permit drawings to include detail drawings of the anchors stamped by a registered professional engineer licensed in the State of Oregon. The details must specify the manufacturer and part numbers for the various anchor components. B) Please submit stamped calculations demonstrating the geotechnical and structural capacity of the anchors. Structural calculations may not be required provided the manufacturer has an ICC report that approves this use. C) Please revise the permit drawings to include the load testing and acceptance criteria for the anchors and/or forward a copy of the appropriate section of the specifications to jason.butler-brown@portlandoregon.gov.
5	S0.1	OSSC 107.3.4.2 OSSC 1810.3.10	The micropiles are a deferred submittal and are not included in this building permit. The drawings and calculations are required to be stamped by an Engineer registered in Oregon, and approved by the Engineer of Record and geotechnical engineer of record prior to submittal to the Bureau of Development Services for review.
6	S0.1	PCC 24.10.070	The General Structural Notes refer to the project specifications for the micropile load testing. Please forward a copy of the micropile specifications that include the performance criteria and load testing and acceptance criteria to jason.butler-brown@portlandoregon.gov.
7	S0.1	PCC 24.10.070 OSSC 1810.3.11	The structural notes state that the micropile deferred submittal must include elevations and the complete installation details. Are structures with micropile support designed to resist lateral loads through friction? If so, please verify the micropile specifications require a free-stressing length, or similar means to prevent the micropile from supporting compressive loads.
8		PCC 24.10.070	Please revise the permit drawings to specify the design loads for the 30 inch and 42 inch diameter drilled shafts respectively. Please clearly identify the elevation at the top of the shafts, or specify the minimum embedment depths.

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9	File	PCC 24.10.070	The soil profile used in the December 12, 2012 KPFF LPile analysis does not match the subsurface profile recommended by the geotechnical engineer. Please submit a stamped letter stating that the geotechnical engineer has reviewed and takes no exceptions to the models.
10	S2.1	PCC 24.10.070	Please verify the locations of the 18 inch diameter drilled shaft supporting the gates at the west and east end of the enclosure. It appears the northern shaft at the west end is over the top of the private 8 inch sanitary sewer line. The southern shaft of the eastern gate appears to be a few inches from the sewer. A) Please verify the location of the shafts relative to the sewer. B) Please identify the elevation at the top of the shaft or specify a minimum embedment depth. C) Please revise the permit drawings to specify the design loading for the shafts.
11	File	PCC 24.10.070	Calculations for the 18 inch diameter drilled shafts supporting the gates were not located in the permit file. Please submit calculations stamped by the engineer demonstrating adequate embedment.
12	S2.1 A/S3.1	PCC 24.10.070	Please revise the permit drawings to identify the elevation of the top of the existing retaining wall footing.
13	L7.12	PCC 24.10.070	Please revise the permit drawings as necessary to specify the welded wire mesh reinforcing in the watercourse walls.

kpff Consulting Engineers

March 4, 2013

Mr. J.P. Paull
Place Studio, LLC
735 NW 18th Avenue
Portland, OR 97209

RE: Oregon Zoo Condor Habitat – 4001 SW Canyon Rd.
New 425 SF Condor Habitat Enclosure and Associated Site Work
Response to City of Portland Review Comments
Application #: 12-219447, 12-219449, 12-219450-000-00-CO

Dear J.P.:

Below is KPFF's response to the City of Portland's Site Development Checksheet Review Comments by Jason Butler-Brown, G.E., dated February 20,1013.

Item #	Location on plans	Code Section	Clarification / Correction Required
4.	S0.1	PCC 24.10.070 OSSC 1810.3.3	Helical Piles are listed as deferred submittal item. Site Development does not accept Helical Anchors as deferred submittal items. A) Please revise the permit drawings to include detail drawings of the anchors stamped by a registered professional engineer licensed in the State of Oregon. The details must specify the manufacturer and part numbers for the various anchor components. B) Please submit stamped calculations demonstrating the geotechnical and structural capacity of the anchors. Structural calculations may not be required provided the manufacturer has an ICC report that approves this use. C) Please revise the permit drawings to include the load testing acceptance criteria for the anchors and/or forward a copy of the appropriate section of the specifications to jason.butler-brown@portlandoregon.gov. **KPFF Response**: As discussed between Jason Butler-Brown and Lindsey Weisgerber on February 21, 2013, helical anchors will be accepted as a deferred submittal for this project only. The requirements of items (A) and (B) shall be fulfilled with that deferred submittal. C) Copies of the specifications are on file with the city and pdf copies of the sections requested shall be emailed.

111 SW Fifth Avenue, Suite 2500 · Portland, Oregon 97204-3628 (503) 227-3251 Fax (503) 227-7980

Seattle Tacoma Portland Eugene San Francisco Sacramento Los Angeles Irvine San Diego Phoenix Denver St. Louis New York

5.	S0.1	PCC 24.10.070 OSSC 1810.3.10	The mircopiles are a deferred submittal and are not included in this building permit. The drawings and calculations are required to be stamped by and Engineer registered in Oregon and approved by the Engineer of Record and geotechnical engineer of record prior to submittal to the Bureau of Development Services for review. **KPFF Response**: This item is for information only and shall be satisfied with submission of the deferred submittal to come.
6.	S0.1	PCC 24.10.070	The General Structural Notes refer to the project specifications for the micropile load testing. Please forward a copy of the micropile specifications that include the performance criteria and load testing acceptance criteria to jason.butler-brown@portlandoregon.gov. **KPFF Response**: The specification sections requested shall be emailed.
8.		PCC 24.10.070	Please revise the permit drawings to specify the design loads for the 30 inch and 42 inch diameter drilled shafts, respectively. Please clearly identify the elevation at the top of the shafts, or specify the minimum embedment depths. **KPFF Response**: See updated sheet S2.1 which indicates the requested information.
10.	S2.1	PCC 24.10.070	Please verify the locations of the 18 inch diameter drilled shaft supporting the gates at the west and east end of the enclosure. It appears the northern shaft at the west end is over the top of the private 8 inch sanitary sewer line. The southern shaft of the eastern gate appears to be a few inches from the sewer line. A) Please verify the location of the shafts relative to the sewer. B) Please identify the elevation at the top of the shaft or specify a minimum embedment depth. C) Please revise the permit drawings to specify the design loading for the shafts. **KPFF Response**: A) It is the understanding of the design team that the sewer line in question was damaged and relocated during the construction of the adjacent cougar exhibit and the existing site survey does not reflect that relocation. Based on the existing information available, we believe the shafts should stop above the sewer line. Notes have been provided in the civil drawings requiring the contractor to locate the existing lines prior to any site drilling or excavation work. B & C) Please see updated drawings for the requested information.
11.	S2.1	PCC 24.10.070	Calculations for the 18 inch diameter drilled shafts supporting the gates were not located in the permit file. Please submit calculations stamped by the engineer demonstrating adequate embedment. **KPFF Response**: Please see attached calculation sheets SD-RE1 and SD-RE2.

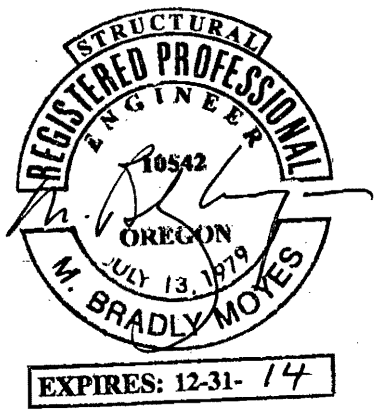
12.	S2.1/ A/S3.1	OSSC 107.2.1	Please revise the permit drawings to identify the elevation of the top of the existing retaining wall footing. **KPFF Response**: Please see the updated drawings with the requested information.

If you have any questions, please contact me.

Sincerely,

Lindsey Weisgerber, P.E.

LW:kw
212044/Plan Rev Response Comments 03-04-13.doc

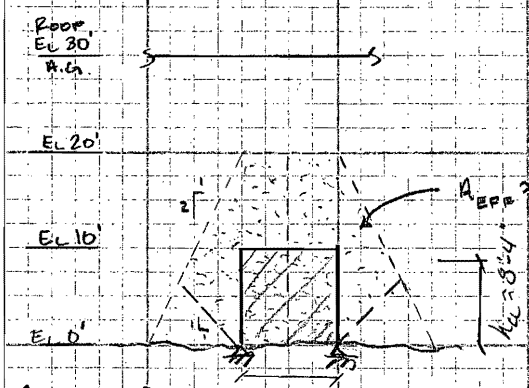


kpff Consulting Engineers
Portland, Oregon

Project OR Zoo - Condor	By LLW	Sheet No. SD-RE1
Location Portland, OR	Date 12/12	
Client PLACE	Revised	Job No. 212044
	Date	

GATE LOADS:

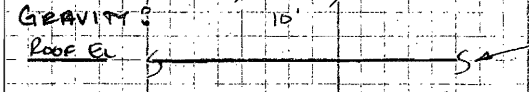
O.O.P.:



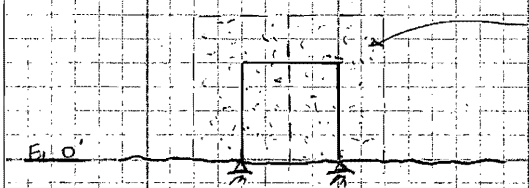
$A_{EFF} \approx 167\ FT^2$ PER COLUMN O.O.P.

$P_w \approx (2.62\ PSF)(167\ FT^2) = 438^{\#}$

GRAVITY:



GRAVITY LOADS TYPICALLY HANG FROM ROOF CABLES. CONSERVATIVELY USE 5' EFF. ALL AROUND GATE



$A_{EFF} \approx \begin{cases} 10' \cdot 15' - 10' \cdot 5' = 100\ FT^2 & \text{MESH} \\ 10' \cdot 5' = 50\ FT^2 & \text{GATE} \end{cases}$

$P_o \approx (20\ PSF)(50\ FT^2) = 1000^{\#}$ MAX GATE

$P_{ICE} \approx (7.1\ PSF)(150\ FT^2) = 1065^{\#}$ MAX ICE

Project: OR Zoo Condor Exhibit
Project No.: 212044
Client: Place
Subject: Gate Foundation

Page -1-
Engineer: LLW
File: .MCD
Date: 12/07/2012
Rev.:

Embedded Pole Foundation: (IBC sect. 1805.7.2.1) nonconstrained pole

Depth of embedment [ft]: $d_p := 5$

Diameter of Footing [ft]: $b := 1.5$

Applied Lateral Force [lb]: $P_h := 440$

Height of Force above grade [ft]: $h := 8.33$ Conservative elevation of lat force

Lateral Soil Bearing Pressure [psf/ft]: $S_1 := 230$ per Geotech

Lateral Soil Bearing Pressure [psf]: $S := S_1 \cdot \min\left(\frac{d_p}{3}, 4\right)$ $S = 383.333$

$$A := \frac{2.34 \cdot P_h}{S \cdot b} \qquad A = 1.791$$

$$d := 0.5 \cdot A \cdot \left(1 + \sqrt{1 + 4.36 \cdot \frac{h}{A}}\right) \qquad d = 5.0 \quad =< \quad d_p = 5 \quad \text{OK} \qquad \text{(IBC eqn 18-1)}$$

Check Foundation Bearing Pressure:

Allowable Soil Bearing Pressure [psf]: $q_a := 3000$ per Geotech

Foundation Bearing Area [ft^2]: $A_b := \frac{\pi}{4} \cdot b^2$ $A_b = 1.767$

Allowable Force from Bearing [lb]: $P_A := q_a \cdot A_b$ $P_A = 5301.438$ < $q_a = 3000$ OK

Check Skin Friction:

Skin Friction Resistance [psf]: $v_A := 245$ per Geotech

Friction Area [ft^2]: $A_f := (\pi \cdot b) \cdot d_p$ $A_f = 23.562$

Frictional Resistance [lbs]: $R_f := v_A \cdot A_f$ $R_f = 5772.677$ spec as max vert capacity of peir

$R_f = 5.77k \gg P_D + P_{ICE} = 2.07k$ OK

Provide footing 1'-6" diameter, w/ 5'-0" embedment