APPENDIX C

WATER FOWL PROTECTION SYSTEM

APPENDIX C

WATER FOWL PROTECTION SYSTEM

The acidic solution contained within the evaporation ponds represents a potential threat to endangered birds and migratory waterfowl. Birds view these ponds as an opportunity to rest and feed. If allowed to land, the birds may become poisoned by contacting chemicals present in the evaporation ponds. This situation creates a liability under the Migratory Bird Treaty Act (U.S. Congress, 1976). In order to limit bird mortality, a bird netting system was designed to reduce water fowl access to the evaporation ponds. Design calculations are included in Appendix C-1. Details of the bird netting system are illustrated in Drawings 6 and 7.

The bird netting will be supported by strain wires that span between wooden poles located every 315 feet along the pond separation berms in the north to south direction, and wooden poles located every 48 feet along the pond separation berms in the west to east direction. Also, intermediate strain wires will be located at every 48 feet along the 315-foot span, which will limit the maximum span for the bird netting to 48 feet. In order to increase the effectiveness of the water fowl protection system, it is planned to enclose the evaporation ponds by placing bird netting along the perimeter of the pond network.

In design of the strain wires, factored weights of the bird netting and cable weight were considered. These factored loads were used to consider uncertainties related to wind and snow loads. The strain wire that spans the 315-foot distance was designed for a factor of safety (FS) of two (2). The wooden support poles (i.e., 25-foot long, class 10) were selected to resist the wind effects and tensions produced by the strain wires.

The strain wires were analyzed using the catenary equation (Au & Christiano, 1987; Ortiz-Berrocal, 1991), which was used to describe the shape of the displacements in the cable. A vertical deflection equal to 10 feet was assumed in order to calculate the maximum tensions in the strain wire. Calculations indicate that the embedment depth of 8.5 feet which was adopted for the wooden support poles will be sufficient to resist the considered loads.

The hardware and accessories for the installation of the bird netting were selected according to bird netting manufacturer recommendations, where the weakest element is the perimeter fastener (i.e., polyclip), which will be used to connect the netting to the strain wires.

It is anticipated that permanent maintenance will be required to keep the bird netting system in-place. Activities such as the removal of birds tangled in the net, replacement and repairs of netting sections damaged by extreme wind and snow events, and replacement and repair of fasteners, among other activities, should be taken into consideration in the operations maintenance plan.

The bird netting support design was checked for ice loading, assumed as 0.5 inches of ice per the San Miguel power company specifications for design of powerlines. The ice loading evaluation calculations are provided as Appendix C-2. The calculations indicate that the resultant tension in the polyclip fasteners due to ice loading is nearly 200 pounds, while the polyclips are only designed for a loading capacity of about 20 pounds. As a consequence, the polyclip fasteners will fail under the ice loading. However, the support system (i.e., wooden support poles and cables) for the bird netting is designed to accommodate ice loading conditions. This is the desired response of the bird netting system, as the design ice loading condition will fail the polyclip fasteners and hence the netting, but not fail the netting support system. Therefore, maintenance after an ice event would be required, including replacing and reattachment of polyclips and netting to the netting support system.

REFERENCES

U.S. Congress. 1976. *Migratory Bird Treaty Act.* 16 USC §703 et seq. November.

Au, T., and Christiano, P. 1987. *Structural analysis*, Prentice-Hall, Englewood Cliffs, New Jersey.

Ortiz-Berrocal, L. 1991. *Resistencia de Materiales*, McGraw-Hill, Madrid.

APPENDIX C-1

BIRD NETTING DESIGN CALCULATIONS

OBJECTIVE:

The objective is to design the birdnet support system for the evaporation pond.

GIVEN:

- Evaporation pond configuration;
- Material specifications for wooden support poles, cable supports and connections (see Attachment 2).

GEOMETRY:

- The evaporation pond diagram is shown in Figure 1
- Conceptual view partial section birdnetting frame Figure 2

MATERIAL PROPERTIES:

- Wood Pole
  - Allowable bending stress 500 psi (Assumed)

- Stainless steel cable Type 304 Dia. 3/32" 7x7
  - Breaking strength 920 lb
  - Weight per 1000 ft = 16 lb

- Stainless steel cable Type 304 Dia. 7/32" 7x19
  - Breaking strength 5,000 lb
  - Weight per 1000 ft = 86 lb

- Soil properties (per Golder 2007)
  - Density 89.9 lb/ft^3
  - Friction angle 33.7°
  - Lateral bearing 150 psf/ft (Assumed)

ASSUMPTIONS:

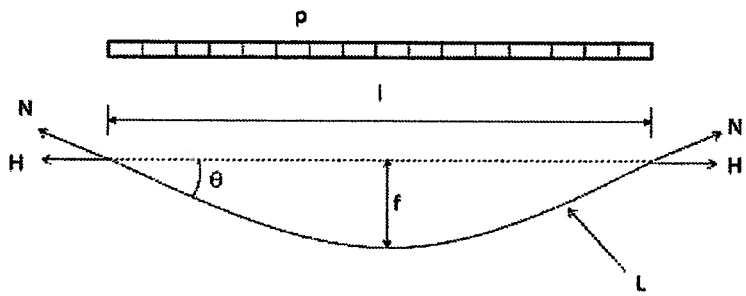
- The bird netting and installation hardware strength provided by the manufacturer allows a maximum span equal to 48 feet.

- The maximum cable dip is assumed to be 10 feet at the center of the 315-foot span.

- The distance between the cable and the ground is assumed to be 6 feet at mid span.

METHOD:

Cable analysis (Au and Christiano 1987; Ortiz-Berrocal 1991)



p = distributed load

H = horizontal component of reaction

N= normal reaction

f = dip

l = span

L= cable length

$$H = \frac{p\,l^2}{8f}$$

$$N = H\sqrt{1 + \frac{p^2}{H^2}\left(\frac{l}{2}\right)^2}$$

$$L = l + \frac{p^2 l^3}{24H^2}$$

Wind load

Simplified wind load method (International Code 2003)

Ultimate soil resistance

The permissible horizontal force at the pole is calculated using the following equation (Keshavarzian 2002):

$$W = \gamma * b * K_p^2 * \frac{E^3}{10 * (L - 0.6E)}$$

where:

γ = unit weight of soil (pcf)
b = width of pole at butt
K_p = coefficient of Rankine passive pressure
E = pole setting depth (ft)
L = pole length (ft)

CALCULATIONS:

The bird netting system is designed using standard of practice for this type of structure. In the design of the strain wires, factored weights of the bird netting and cable weight are considered. These factored loads are used to take into account uncertainties related to wind and snow loads. The wood poles are selected to resist the wind effects and tensions produced by the strain wires. The calculations are presented in Attachment 1.

RESULTS:

Calculations (Attachment 1) indicate that the resultant tension in the cable due to the considered load conditions is 2,800.6 pounds. A strain wire with a diameter of 7/32 inch type 304 7x19 strands with a breaking strength of 5,000 pounds was selected to resist the solicited tension. Wood poles of 25 foot in length with a diameter of 12 inch at the top and 18 inch at the bottom was selected to resist the resultant tension in the cable and lateral wind loads over the wood pole surface. The analysis of the wood pole foundation also indicates that an embedment depth of 8.5 foot provides sufficient resistance to the design loads.

REFERENCES:

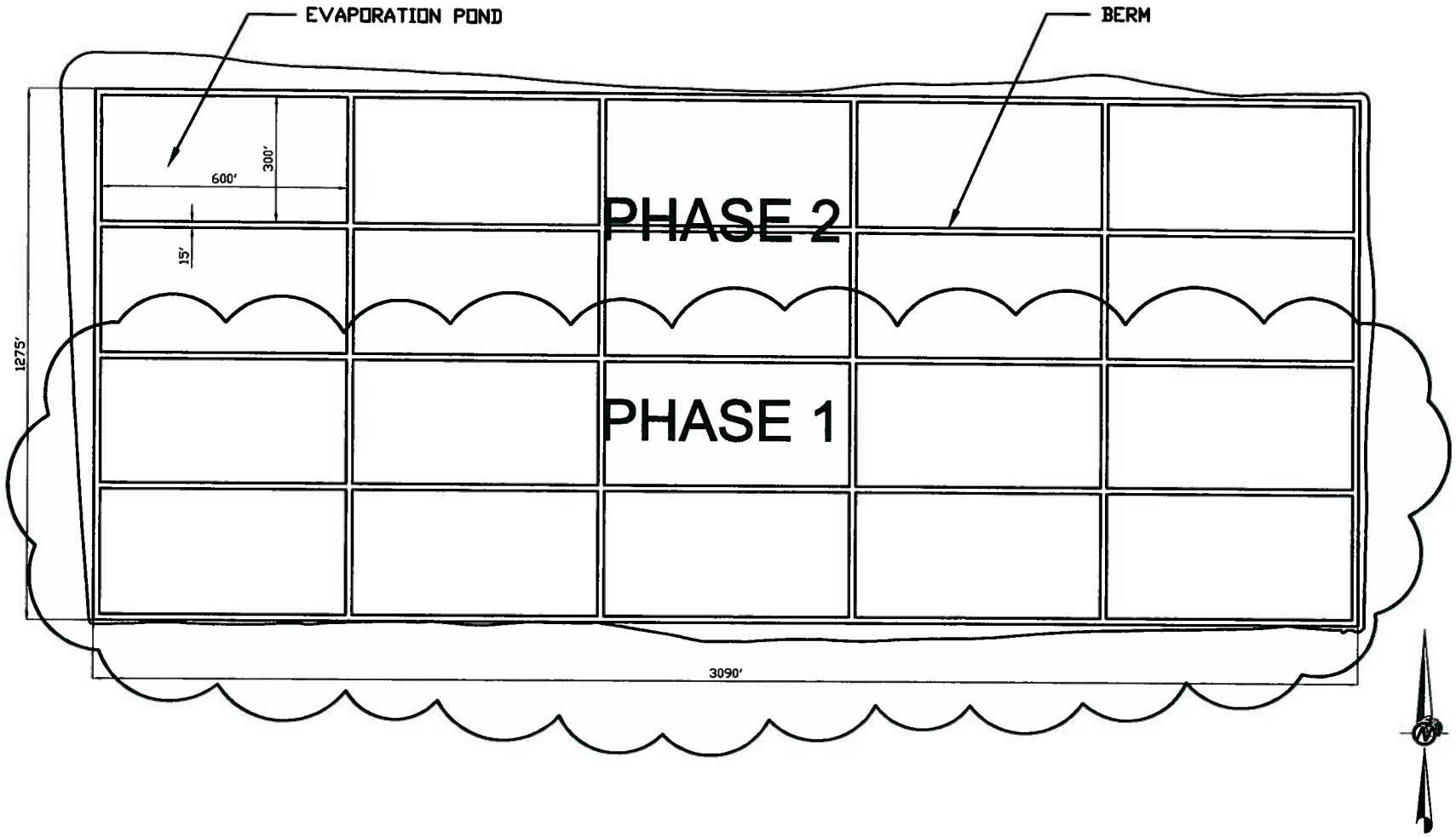
Au, T., and Christiano, P. (1987). *Structural analysis*, Prentice-Hall, Englewood Cliffs, NJ.

International Code, C. (2003). *International building code 2003*, International Code Council, Country Club Hills, IL.

Keshavarzian, M. (2002). "Self-supported wood pole fixity at ANSI groundline." *Practice Periodical on Structural Design and Construction*, 7(4), 147-155.

Ortiz-Berrocal, L. (1991). *Resistencia de Materiales*, McGraw-Hill, Madrid.

FIGURES



Golder Associates Denver, Colorado

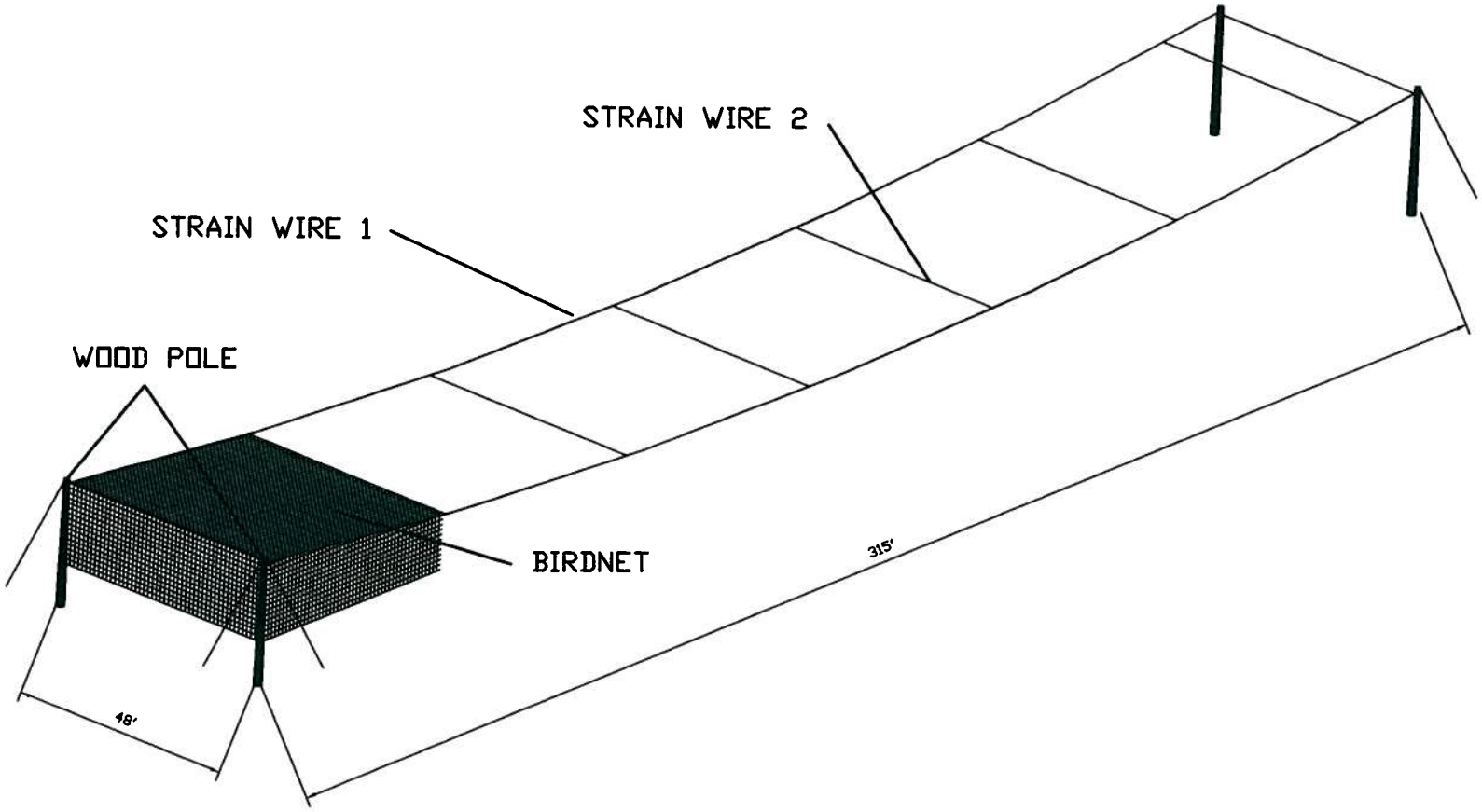
TITLE

EVAPORATION POND PHASE 1 AND PHASE 2

CLIENT/PROJECT

ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT - EVAPORATION POND
MONTROSE COUNTY, COLORADO

DRAWN EF	DATE APRIL15, 2008	JOB NO. 073-81694
CHECKED GG	SCALE N.T.S.	DWG. NO.
REVIEWED KFM	FILE NO.	FIGURE NO. 1



Golder Associates Denver, Colorado

TITLE

CONCEPTUAL VIEW
PARTIAL SECTION BIRDNETTING FRAME

CLIENT/PROJECT

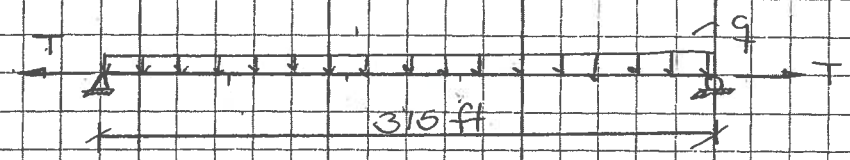
ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT - EVAPORATION POND
MONTROSE COUNTY, COLORADO

DRAWN EF	DATE APRIL15, 2008	JOB NO. 073-81694
CHECKED GG	SCALE N.T.S.	DWG. NO.
REVIEWED KFM	FILE NO.	FIGURE NO. 2

ATTACHMENT 1

Golder Associates	SUBJECT Bird net		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 1 of 9

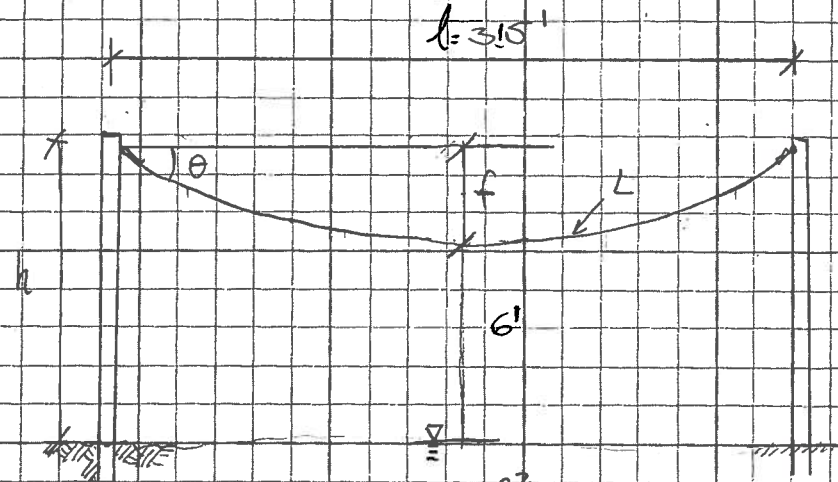
Objective: Calculate the tension in the primery cable.



$q = d \cdot w$ $\quad d = 50$ ft $\quad$ tributary width

$w = 0.028 \frac{lb}{ft^2}$ $\quad$ unit weight (net)

$$q = 50 \cdot 0.028 = 1.4 \frac{lb}{ft}$$



$$H = \frac{p l^2}{8f} \qquad L = l + \frac{p^2 l^3}{24 H^2}$$

$$N = H\sqrt{1 + \frac{p^2}{H^2} x^2}$$

$$N_{max} = H\sqrt{1 + \frac{p^2}{H^2}\left(\frac{l}{2}\right)^2}$$

$$L = l + \frac{p^2 l^3}{24 H^2}$$

Golder Associates	SUBJECT Birdnet		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 2 of 9

$f = 10'$

$H = \frac{Pl^2}{8f}$

Assume a cable weight $w_c = 0.2 \frac{lb}{ft}$

$P = 0.2 \frac{lb}{ft} + 1.4 \frac{lb}{ft} = 1.6 \frac{lb}{ft}$

$1.4P = 2.24 \frac{lb}{ft}$ (factored load)

$H = \frac{2.24 \, lb/ft \cdot 315 ft^2}{8 \cdot 10 ft} = 2778.3 \, lb$

$N_{max} = 2778.3 lb \sqrt{1 + \frac{2.24^2}{2778.3^2} \left(\frac{315}{2}\right)^2}$

$N_{max} = 2800.6 lb$

USE 7x19 ϕ 7/32" TYPE 304

$P_u = 5000 lb$

$P_n = 0.75 P_u = 0.75(5000) = 3750 lb > 2778.3 lb$ ok

$N \cos\theta = H$

$\cos\theta = \frac{H}{N} = \frac{2778.3}{2800.6} = 0.992$

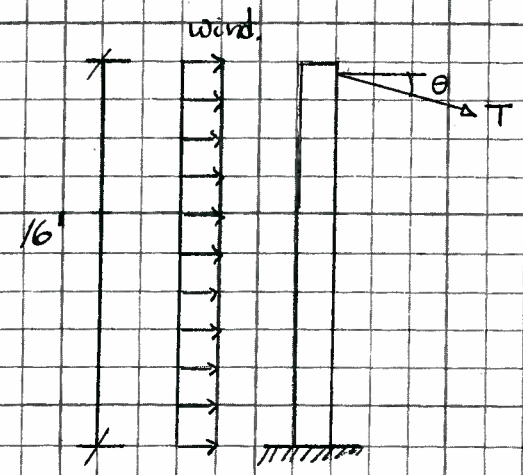
$\theta = 7.235°$

$L = 315 + \frac{2.24^2 \cdot 315^2}{24(2778.3)}$

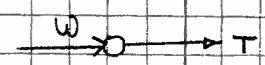
$L = 322.5 ft$

Golder Associates	SUBJECT Birdnet		
	Job No. 0.73-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 3 of 9

pole: $h = f + 6' = 10' + 6' = 16'$



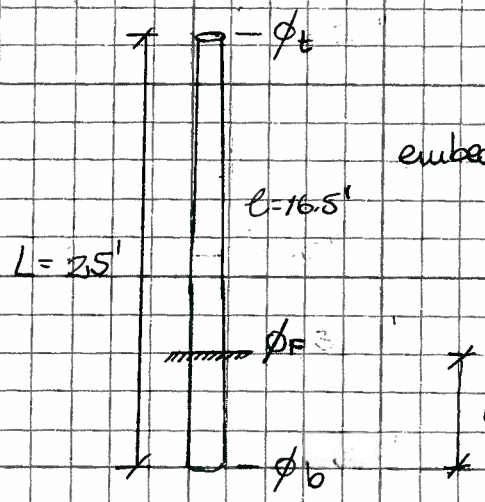
$\theta = 7.235°$
$T = 2800.6$ lb



Material: Wester Red Cedar

Pole dimensions

try Class 1



embedment $= 16 \cdot 0.25 = 4' < 6'$ (AASHTO)

assume $e = 6'$

use $L = 25'$

embedment $= 8.5'$

Wind pressure

$F = q_z G C_f A_f$ (6-28)

wind speed = 90 mph $\frac{d}{L} = \frac{30.3}{16} =$

$G = 0.85$

$C_f = 0.5$

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

$K_d = 0.95$

$K_z = 1.03$

$K_{zt} = (1 + K_1 K_2 K_3)^2 = 1.0$

$I = 0.87$

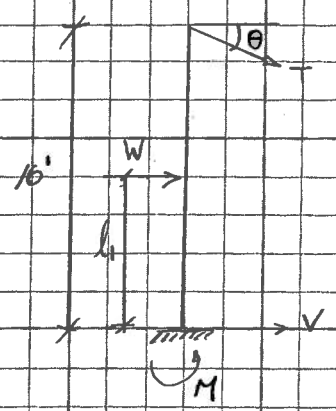
$A_f = 16.5' \cdot \frac{1}{2}(12 + 15.3) \cdot \frac{1}{12} = 18.768\ ft^2$

$q_z = 0.00256 \cdot 0.95 \cdot 1.03 \cdot 1 \cdot (90)^2 \cdot 0.87$

$q_z = 17.65\ \frac{lb}{ft^2}$

$F = 17.65 \cdot 0.85 \cdot 0.5 \cdot 18.77 = 140.8\ lb$

Golder Associates	SUBJECT Birdnet		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 5 of 9



$T = 2800.6$ lb
$\theta = 7.235$
$W = 140.8$ lb

$V = W + T\cos\theta = 140.8 + 2800.6(\cos 7.235)$

$V = 2{,}919.10$ lb

$M = T \cdot 16' + W\left(\frac{16.5'}{2}\right)$

$M = 2800.6 \cdot 16' + 140.8 \cdot \frac{16.5}{2}$

$M = 45{,}971.2$ lb-ft

From LPile:

$M_u = 105$ kips-in $= 8750$ lb-ft

$V_u = 2{,}919.10$ lb

$f_b = \frac{M}{S}$ $\quad S = \frac{I}{c}$ $\quad I = \frac{\pi r^4}{4}$ $\quad c = r$

$S = \frac{\pi r^4}{4r} = \frac{\pi r^3}{4}$ $\quad r = \frac{15.3''}{2} = 7.65''$

$S = \frac{\pi \cdot (7.65'')^3}{4} = 351.62 \text{ in}^3 = 0.203 \text{ ft}^3$

$f_b = \frac{8750}{0.203} = 43000 \frac{\text{lb}}{\text{ft}^2} = 298.6$ psi

$F_b' = F_b C_D C_M C_{Fu} C_r C_H$

$F_b = 500$ psi utility structure

Golder Associates	SUBJECT Birdnet		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 6 of 9

$F_b' = 500 \cdot 1 \cdot 0.85 \cdot 1.10 \cdot 1.15 \cdot 1 = 537.6$ psi

$F_b' > f_b$ ok

$V = 2919.10$ lb

$F_v = 65$ psi

$f_v = \frac{2919.10}{\frac{\pi}{4}(16.15)^2} = 14.25$ psi $< F_v$ ok.

Golder Associates	SUBJECT Birdnet		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 7 of 9

Foundation Keshavarzian (2002)

$$W = \gamma \cdot b \cdot K_p^2 \cdot E^2 \cdot \frac{E}{10 \times (L - 0.6 \cdot E)}$$

$$\gamma = 89.9 \frac{lb}{ft^3}$$

$$\phi = 33.7° \quad (G4 - BH-47)$$

$$K_p = \tan^2\left(45° + \frac{\phi}{2}\right) = 3.49$$

$$W = 89.9 \cdot \frac{26.94}{12} \cdot 3.49^2 \cdot 8.5^2 \cdot \frac{8.5}{10 \cdot (16.5 - 0.6 \cdot 8.5)}$$

$$W = 13{,}242.8\ lb > 2{,}963.65\ lb \quad \underline{\underline{ok}}$$

Golder Associates	SUBJECT Birdnet		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 8 of 9

EYEBOLT

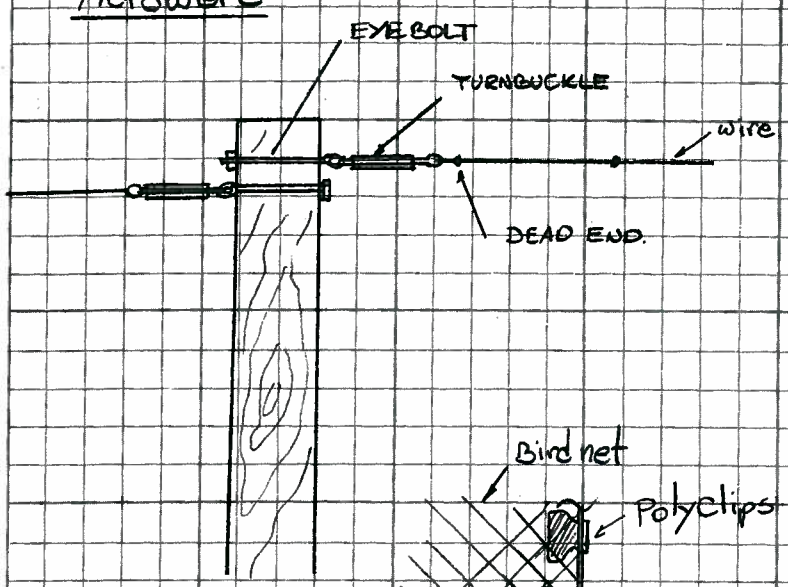
5/8" x 18" A325 (A36)

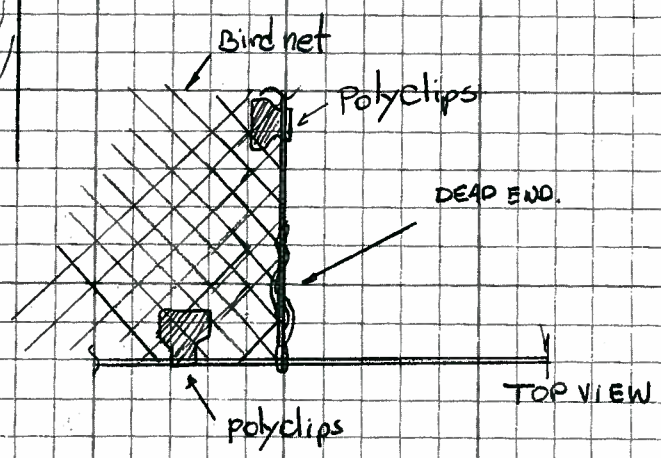
$A_b = \frac{\pi (5/8)^2}{4} = 0.3067$ $T_u = F_t A_b = 7{,}200$ lb

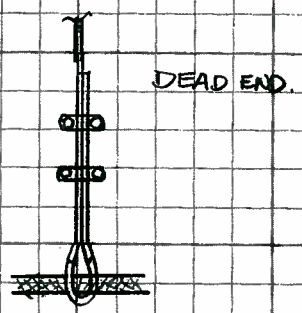
$\phi R_n = \phi F_t A_b = 0.75(90)\,0.3067 = 20.70$ kips > N ok

Golder Associates	SUBJECT Birdnet		
	Job No. 073-81694 Ref.	Made by EF Checked Reviewed	Date Sheet 9 of 9

Hardware







==========

LPILE Plus for Windows, Version 5.0 (5.0.21)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

(c) 1985-2005 by Ensoft, Inc.
All Rights Reserved

==========

This program is licensed to:

Enrique Farfan
Golder & Associates

Path to file locations: C:\Documents and Settings\EFarfan\My Documents\PROJECTS\073-81694\Bird-Nets\
Name of input data file: Pile.lpd
Name of output file: Pile.lpo
Name of plot output file: Pile.lpp
Name of runtime file: Pile.lpr

Time and Date of Analysis

Date: April 15, 2008 Time: 10: 3:49

Problem Title

073-81694 Piñon Ridge Project

Program Options

Units Used in Computations - US Customary Units, inches, pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100

```
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1
```

Pile Structural Properties and Geometry

```
Pile Length                                  =     102.00 in
Depth of ground surface below top of pile =        .00 in
Slope angle of ground surface                =        .00 deg.

Structural properties of pile defined using  2 points
```

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	15.30000000	2689.8970	183.8500	900000.00000
2	102.0000	17.00000000	4099.8200	226.9800	900000.00000

Soil and Rock Layering Information

```
The soil profile is modelled using  1 layers

Layer  1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer    =         .000 in
Distance from top of pile to bottom of layer =      102.000 in
p-y subgrade modulus k for top of soil layer =         .000 lbs/in**3
p-y subgrade modulus k for bottom of layer   =         .000 lbs/in**3

NOTE:  Internal default values for p-y subgrade modulus will be computed for
the above soil layer.


(Depth of lowest layer extends     .00 in below pile tip)
```

Effective Unit Weight of Soil vs. Depth

```
Distribution of effective unit weight of soil with depth
is defined using  2 points
```

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	89.90000
2	102.00	89.90000

```
**** WARNING - POSSIBLE INPUT DATA ERROR ****

Values entered for effective unit weights of soil were outside
```

the limits of 0.011574 pci (20 pcf) or 0.0810019 pci (140 pcf)
This data may be erroneous. Please check your data.

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 2 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	.00000	33.70	------	------
2	102.000	.00000	33.70	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves

---

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 2919.100 lbs
Bending moment at pile head = 45971.200 in-lbs
Axial load at pile head = .000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 2919.100 lbs

Specified moment at pile head = 45971.200 in-lbs
Specified axial load at pile head = .000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res p lbs/in
0.000	.132161	45971.2000	2919.1000	-.0029762	130.7409	0.0000
1.020	.129135	48948.6820	2782.4337	-.0029563	138.6368	-9.1296
2.040	.126130	51916.6655	2900.6922	-.0029352	146.4426	-17.8344
3.060	.123147	54866.0941	2878.2760	-.0029130	154.1342	-26.1190
4.080	.120188	57788.3486	2847.6213	-.0028897	161.6891	-33.9883
5.100	.117252	60675.2416	2809.1489	-.0028653	169.0862	-41.4478
6.120	.114342	63519.0123	2763.2740	-.0028399	176.3061	-48.5030
7.140	.111459	66312.3205	2710.4059	-.0028134	183.3308	-55.1598
8.160	.108603	69048.2404	2650.9479	-.0027860	190.1438	-61.4245
9.180	.105776	71720.2543	2585.2966	-.0027576	196.7298	-67.3035
10.200	.102978	74322.2455	2513.8420	-.0027283	203.0749	-72.8035
11.220	.100210	76848.4919	2436.9671	-.0026981	209.1665	-77.9315
12.240	.097473	79293.6585	2355.0478	-.0026671	214.9932	-82.6946
13.260	.094769	81652.7895	2268.4524	-.0026353	220.5448	-87.1003
14.280	.092098	83921.3013	2177.5416	-.0026027	225.8122	-91.1561
15.300	.089460	86094.9744	2082.6684	-.0025694	230.7876	-94.8698
16.320	.086856	88169.9449	1984.1777	-.0025355	235.4638	-98.2492
17.340	.084287	90142.6969	1882.4063	-.0025009	239.8352	-101.3026
18.360	.081754	92010.0537	1777.6826	-.0024657	243.8966	-104.0380
19.380	.079257	93769.1694	1670.3267	-.0024301	247.6443	-106.4638
20.400	.076797	95417.5201	1560.6501	-.0023939	251.0749	-108.5883
21.420	.074374	96952.8956	1448.9558	-.0023573	254.1864	-110.4201
22.440	.071988	98373.3900	1335.5381	-.0023203	256.9772	-111.9676
23.460	.069640	99677.3933	1220.6826	-.0022830	259.4467	-113.2394
24.480	.067331	100864.	1104.6660	-.0022454	261.5950	-114.2441
25.500	.065060	101931.	987.7565	-.0022075	263.4228	-114.9903
26.520	.062827	102879.	870.2133	-.0021695	264.9317	-115.4865
27.540	.060634	103706.	752.2870	-.0021313	266.1235	-115.7414
28.560	.058480	104413.	634.2195	-.0020929	267.0011	-115.7635
29.580	.056364	105000.	516.2440	-.0020546	267.5677	-115.5611
30.600	.054288	105466.	398.5850	-.0020162	267.8271	-115.1428
31.620	.052251	105813.	281.4586	-.0019778	267.7835	-114.5167
32.640	.050254	106041.	165.0726	-.0019395	267.4416	-113.6911
33.660	.048295	106150.	49.6263	-.0019013	266.8068	-112.6741
34.680	.046375	106142.	-64.6891	-.0018632	265.8845	-111.4737
35.700	.044494	106018.	-177.6904	-.0018254	264.6808	-110.0975
36.720	.042651	105779.	-289.2023	-.0017878	263.2020	-108.5534
37.740	.040847	105428.	-399.0574	-.0017504	261.4549	-106.8487
38.760	.039080	104965.	-507.0955	-.0017134	259.4464	-104.9909
39.780	.037351	104393.	-613.1643	-.0016767	257.1839	-102.9870
40.800	.035660	103714.	-717.1180	-.0016404	254.6749	-100.8440
41.820	.034005	102930.	-818.8185	-.0016044	251.9272	-98.5686
42.840	.032387	102044.	-918.1338	-.0015690	248.9489	-96.1673
43.860	.030804	101057.	-1014.9389	-.0015340	245.7482	-93.6465
44.880	.029258	99973.5368	-1109.1148	-.0014995	242.3335	-91.0122
45.900	.027745	98794.8951	-1200.5489	-.0014655	238.7134	-88.2703
46.920	.026268	97524.4170	-1289.1341	-.0014321	234.8968	-85.4262
47.940	.024824	96165.0614	-1374.7691	-.0013993	230.8924	-82.4855
48.960	.023413	94719.8880	-1457.3578	-.0013671	226.7092	-79.4531
49.980	.022035	93192.0516	-1536.8091	-.0013356	222.3565	-76.3339
51.000	.020689	91584.7974	-1613.0369	-.0013047	217.8433	-73.1324
52.020	.019373	89901.4562	-1685.9595	-.0012744	213.1791	-69.8531
53.040	.018089	88145.4399	-1755.4995	-.0012449	208.3731	-66.4998

54.060	.016834	86320.2373	-1821.5834	-.0012161	203.4348	-63.0764
55.080	.015608	84429.4099	-1884.1414	-.0011880	198.3736	-59.5865
56.100	.014410	82476.5887	-1943.1074	-.0011606	193.1992	-56.0331
57.120	.013240	80465.4707	-1998.4182	-.0011340	187.9210	-52.4194
58.140	.012097	78399.8156	-2050.0135	-.0011082	182.5486	-48.7479
59.160	.010979	76283.4431	-2097.8357	-.0010832	177.0917	-45.0211
60.180	.009887	74120.2307	-2141.8295	-.0010589	171.5598	-41.2412
61.200	.008819	71914.1109	-2181.9417	-.0010355	165.9626	-37.4101
62.220	.007775	69669.0697	-2218.1208	-.0010128	160.3098	-33.5293
63.240	.006753	67389.1445	-2250.3169	-.0009910	154.6109	-29.6004
64.260	.005753	65078.4232	-2278.4815	-.0009700	148.8757	-25.6242
65.280	.004774	62741.0423	-2302.5668	-.0009498	143.1138	-21.6019
66.300	.003816	60381.1869	-2322.5261	-.0009304	137.3347	-17.5339
67.320	.002876	58003.0891	-2338.3129	-.0009118	131.5483	-13.4207
68.340	.001955	55611.0285	-2349.8813	-.0008941	125.7640	-9.2624
69.360	.001052	53209.3313	-2357.1851	-.0008771	119.9915	-5.0589
70.380	.000166	50802.3709	-2360.1782	-.0008610	114.2405	-.8099582
71.400	-.000704	48394.5677	-2358.8140	-.0008457	108.5206	3.4849
72.420	-.001559	45990.3903	-2353.0452	-.0008312	102.8414	7.8265
73.440	-.002400	43594.3556	-2342.8236	-.0008175	97.2126	12.2157
74.460	-.003227	41211.0301	-2328.1004	-.0008045	91.6437	16.6535
75.480	-.004041	38845.0308	-2308.8251	-.0007923	86.1445	21.1412
76.500	-.004843	36501.0269	-2284.9461	-.0007809	80.7245	25.6803
77.520	-.005634	34183.7408	-2256.4103	-.0007702	75.3936	30.2723
78.540	-.006414	31897.9499	-2223.1628	-.0007603	70.1613	34.9189
79.560	-.007185	29648.4888	-2185.1468	-.0007511	65.0373	39.6221
80.580	-.007947	27440.2504	-2142.3039	-.0007426	60.0315	44.3836
81.600	-.008700	25278.1888	-2094.5733	-.0007347	55.1536	49.2057
82.620	-.009446	23167.3208	-2041.8922	-.0007275	50.4134	54.0905
83.640	-.010184	21112.7286	-1984.1956	-.0007210	45.8207	59.0402
84.660	-.010916	19119.5618	-1921.4159	-.0007151	41.3855	64.0571
85.680	-.011643	17193.0401	-1853.4836	-.0007098	37.1177	69.1435
86.700	-.012364	15338.4552	-1780.3265	-.0007050	33.0273	74.3018
87.720	-.013081	13561.1740	-1701.8700	-.0007008	29.1245	79.5344
88.740	-.013794	11866.6404	-1618.0372	-.0006971	25.4192	84.8437
89.760	-.014503	10260.3782	-1528.7486	-.0006939	21.9218	90.2319
90.780	-.015210	8747.9933	-1433.9225	-.0006912	18.6426	95.7015
91.800	-.015913	7335.1762	-1333.4749	-.0006889	15.5919	101.2546
92.820	-.016615	6027.7044	-1227.3194	-.0006870	12.7801	106.8935
93.840	-.017315	4831.4446	-1115.3675	-.0006854	10.2178	112.6201
94.860	-.018013	3752.3548	-997.5286	-.0006842	7.9157	118.4365
95.880	-.018711	2796.4863	-873.7103	-.0006833	5.8845	124.3444
96.900	-.019407	1969.9857	-743.8184	-.0006826	4.1350	130.3456
97.920	-.020103	1279.0967	-607.7571	-.0006822	2.6781	136.4414
98.940	-.020799	730.1613	-465.4291	-.0006819	1.5250	142.6331
99.960	-.021494	329.6213	-316.7362	-.0006817	.6867479	148.9217
100.980	-.022190	84.0194	-161.5791	-.0006817	.1746206	155.3080
102.000	-.022885	0.0000	0.0000	-.0006817	0.0000	161.7924

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =      .13216094 in
Computed slope at pile head       =     -.00297616
Maximum bending moment            =   106149.81638 lbs-in
Maximum shear force               =     2919.10000 lbs
Depth of maximum bending moment   =    33.66000000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =              5
```

Number of zero deflection points = 1

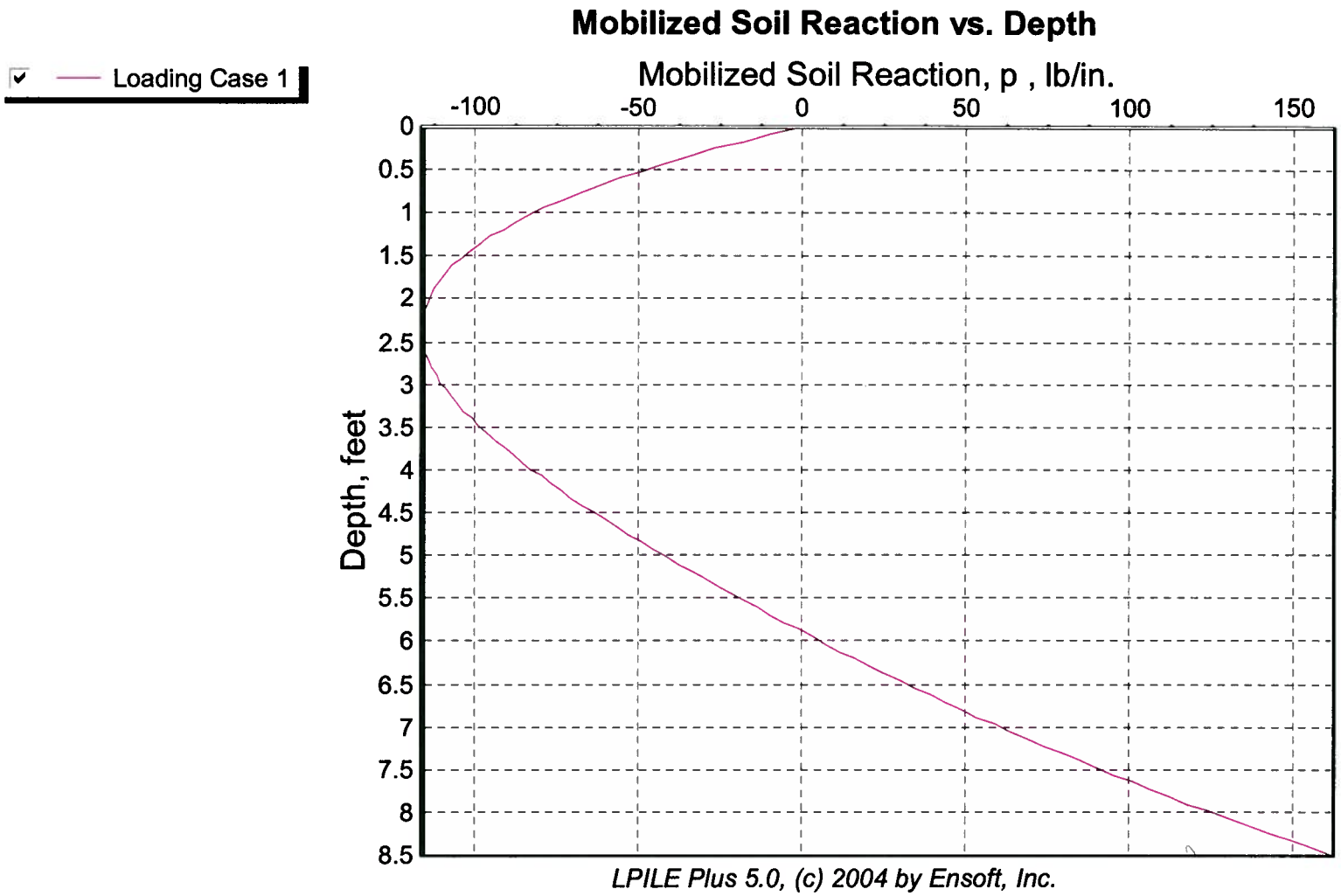
Summary of Pile Response(s)

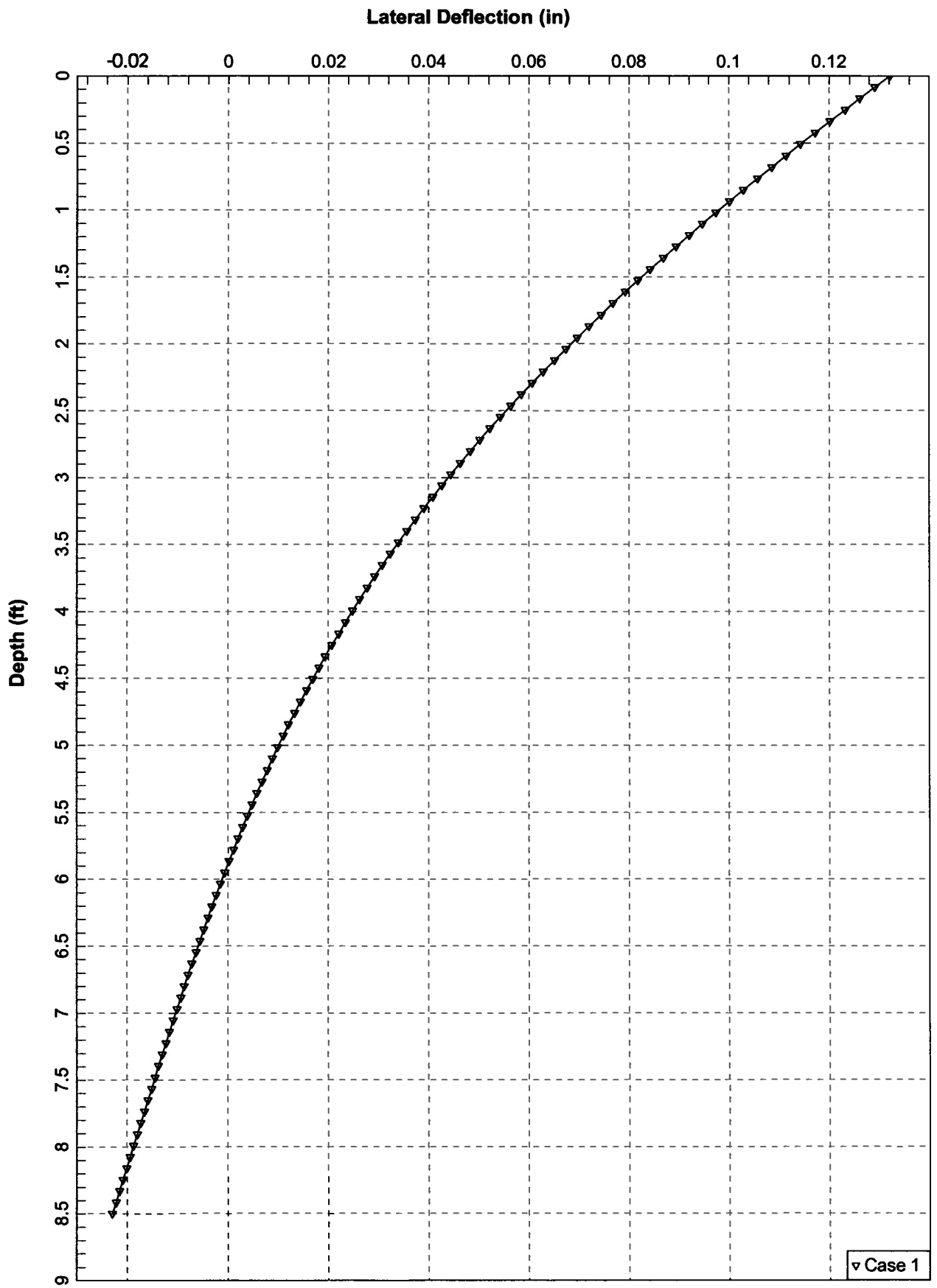
Definition of Symbols for Pile-Head Loading Conditions:

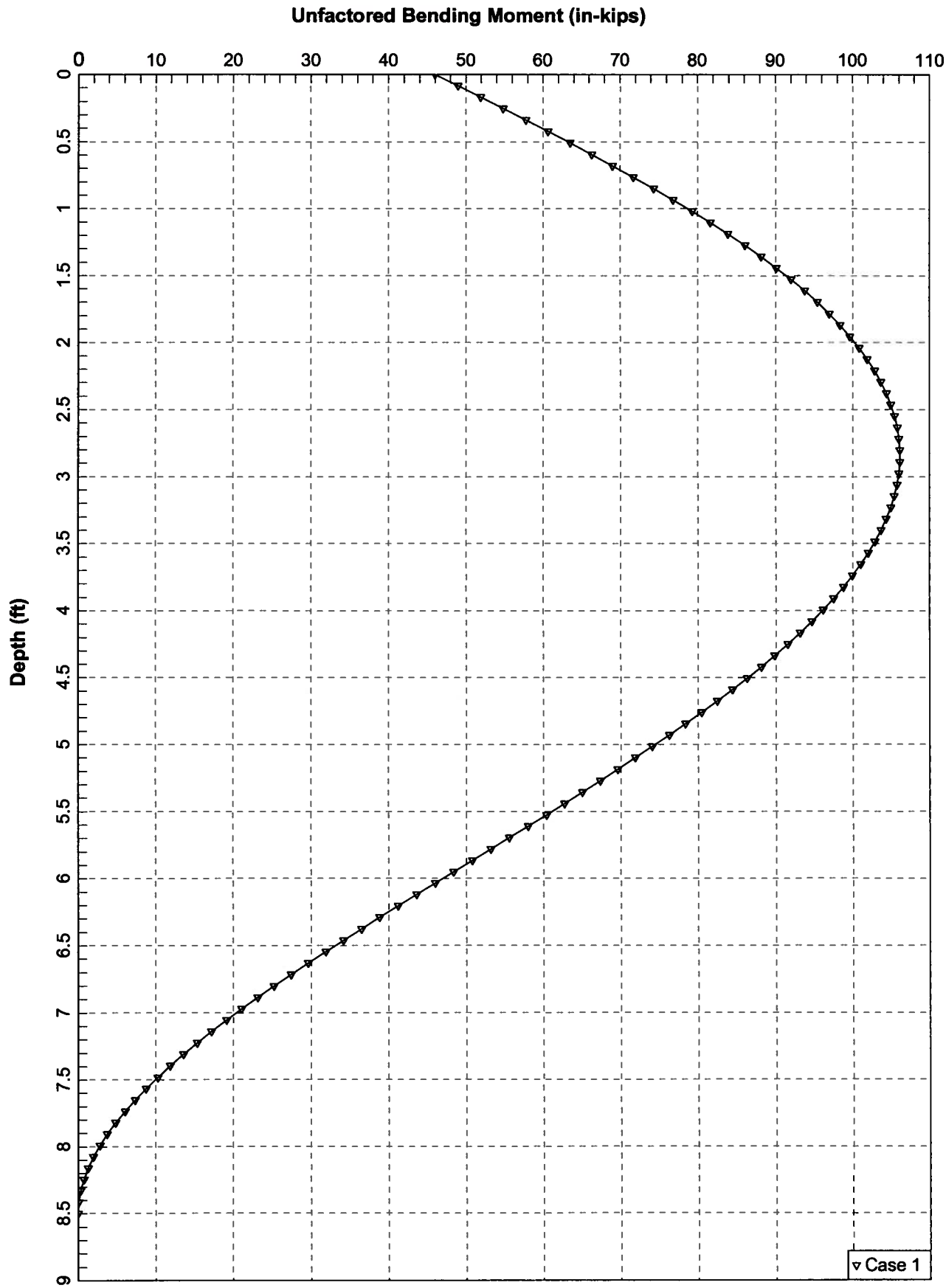
Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

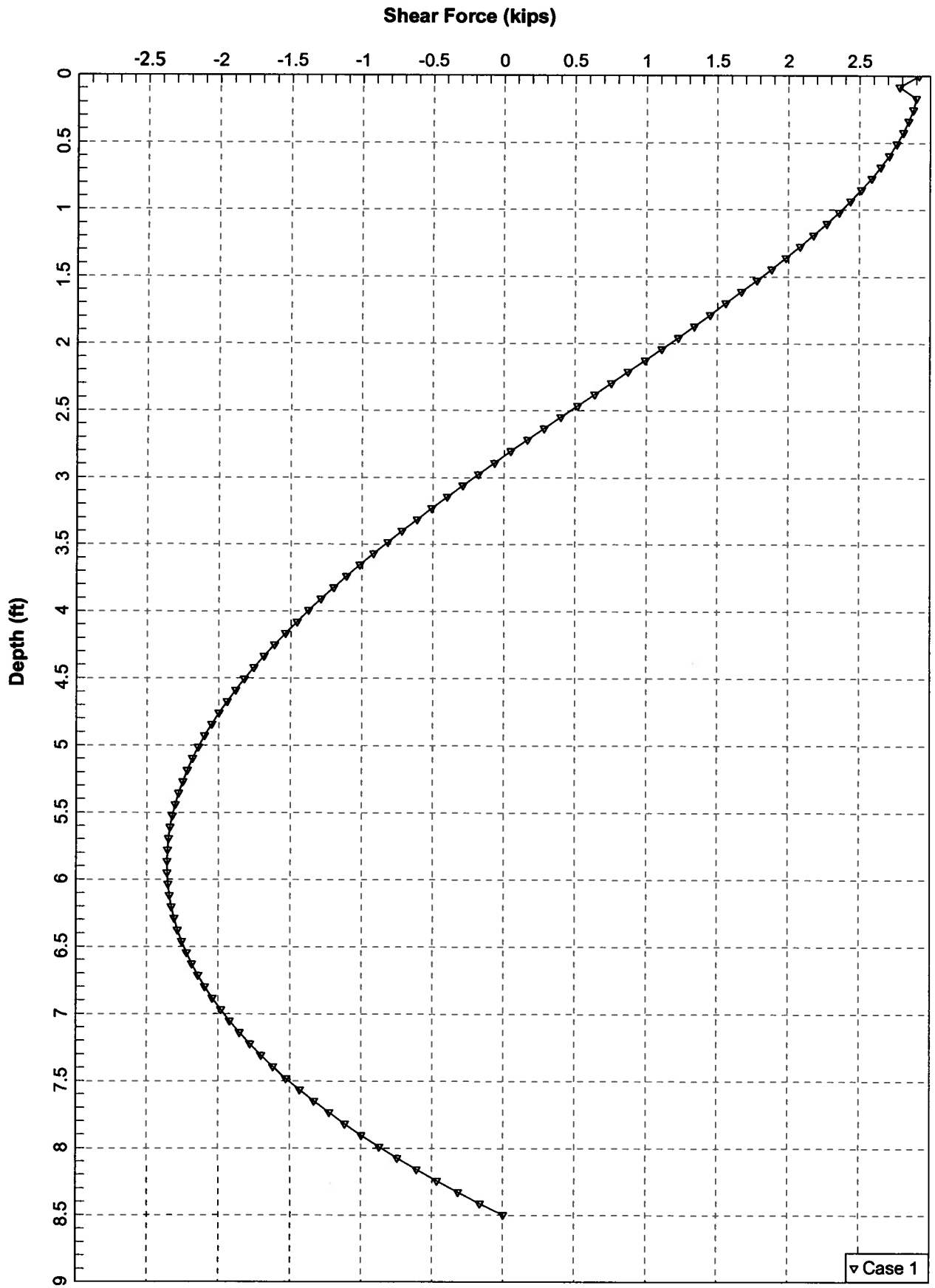
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 2919.100	M= 45971.	0.0000	.1321609	106150.	2919.1000

The analysis ended normally.

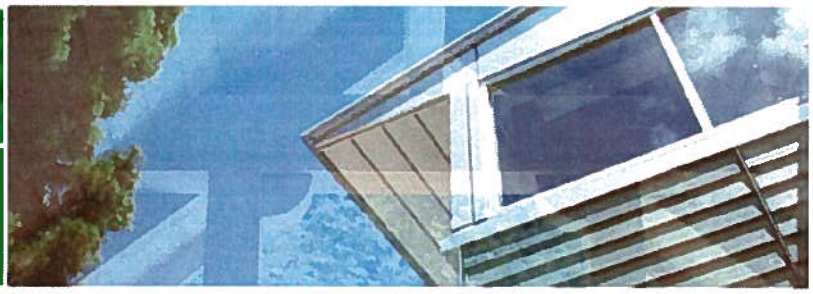

Mobilized Soil Reaction vs. Depth
Loading Case 1
Mobilized Soil Reaction, p , lb/in.
-100
-50
0
50
100
150
Depth, feet
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
LPILE Plus 5.0, (c) 2004 by Ensoft, Inc.


Lateral Deflection (in)
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12
Depth (ft)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 1


Unfactored Bending Moment (in-kips)
0
10
20
30
40
50
60
70
80
90
100
110
Depth (ft)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 1


Shear Force (kips)
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
Depth (ft)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
Case 1

ATTACHMENT 2



TECHNICAL SPECIFICATIONS

ENGINEERING DATA

Overview
Natural Properties
Engineering Data
Computer Calculators
Glossary
Guide to Finishing Cedar

WESTERN RED CEDAR EXPORT ASSOCIATION

Section Properties

Section properties are used in various design calculations. For convenience, the following are formulas to calculate the section properties of rectangular beam cross sections.

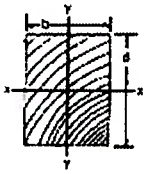
Definitions

Neutral axis, in the cross section of a beam, is the line in which there is neither tension nor compression stress.

Moment of Inertia (I) of the cross section of beam is the sum of the products of each of its elementary areas multiplied by the square of their distance from the neutral axis of the section.

Section Modulus (S) is the moment of inertia divided by the distance from the neutral axis to the extreme fiber of the section.

Cross Section is a section taken through the member perpendicular to its longitudinal axis.



Formulas

The following symbols and formulas apply to rectangular beam cross sections:

X-X= neutral axis for edgewise bending (load applied to narrow face)

Y-Y= Neutral axis for flatwise bending (load applied to narrow face)

b= breadth of rectangular bending member(in.)

d= depth of rectangular bending member (in.)

A= bd=area of cross section (in.2)

c= distance from neutral axis to extreme fiber of cross section (in.)

Ixx= bd3/12 = moment of inertia about the X-X axis (in.4)

Iyy= db3/12 = moment of inertia about the Y-Y axis (in.4)

rxx= Square root of (Ixx/A) = d/Square root of 12 = radius of gyration about the X-X axis (in.)

ryy= Square root of (Iyy/A) = b/Square root of 12 = radius of gyration about the Y-Y axis (in.)

sxx= Ixx /c = bd2/6 = section modulus about the X-X axis (in.3)

syy= Iyy /c = db2/6 = section modulus about the Y-Y axis (in.3)

Sizes of rough and dressed Western Red Cedar are shown in Tables 5 and 6.

Base Design Values (United States Only)

Since different sizes of visually-graded lumber have different values, the design values shown in Table 8 are tabulated in a base value approach. Base values are provided for a base size that depends on the grade. For Select Structural, No.1, No.2 and No.3 grades, the base strength values are published on a 2x12 basis. For Construction Standard and Utility grades, the base strength values are published on a 2x4 basis (the size factor is always 1.0).

For Stud grade, the base strength values are published on a 2x6 basis. These values are for use in the United States only.

To determine the value for a given size, the designer selects a base value for a given grade then multiplies the base value by a size factor from Table 9.

The base design values apply to Western Red Cedar manufactured by members of the Western Red Cedar Export Association and graded to National Lumber Grading Authority Rules (NLGA). Grades and sizes of Canadian dimension lumber are identical to those in use throughout the United States and conform to the requirements of applicable American Standards. Tabulated values are from *The U.S. Span Book for Canadian Lumber* published by the Canadian Wood Council (1-800-463-5091).

Span Tables

Spans for Western Red Cedar dimension lumber used as joists and rafters in residential and commercial structures are available from the Western Red Cedar Lumber Association, the Canadian Wood Council and the National Association of Home Builders. Please request publication *The U.S Span Book for Canadian Lumber*. Cost $10.

Table 1. Base Design Values For Use In The U.S.A. For Western Red Cedar - 2-4" Thick 2" and Wider

Base values in pounds per square inch (psi) - Use with Adjustment Factors (see Table 9)

Grade Fb	Extreme Fiber Stress in Bending Ft	Tension Parallel Parallel to Grain Fv	Horizontal Shear Fv	Compression		Modulus of Elasticity (million psi) E
				Perpendicular To Grain Fc (perp)	Parallel To Grain Fc	
Select Structural	950	450	65	350	1,100	1.1
No.1/No.2	575	275	65	350	825	1.1
No.3	350	150	65	350	475	1.0
Construction	675	300	65	350	1,050	1.0
Standard	375	175	65	350	850	0.9
Utility	175	75	65	350	550	0.9
Stud	450	200	65	350	525	1.0

Notes:

1. No.1/No.2 applies to either No.1 or No.2 grades.
2. Values for Utility grade apply only to 2" and 4" lumber.
3. For studs wider than 6" bearing the "Stud" grademark, use the property values and size factors for No.3 grade.

Table 2. Size Factors (CF) For Tabulated Design Values

Grades	Nominal Width (depth)(in)	Fb less than 4 in. thick	Fb 4 in. thick nominal	Ft	Fc	Other Properties
Select Structural No.1 No.2 & No.3	4 & less	1.5	1.5	1.5	1.15	1.0
	5	1.4	1.4	1.4	1.1	1.0
	6	1.3	1.3	1.3	1.1	1.0
	8	1.2	1.3	1.2	1.05	1.0
	10	1.1	1.2	1.1	1.0	1.0
	12	1.0	1.1	1.0	1.0	1.0
	14 & wider	0.9	0.9	0.9	0.9	1.0
Construction & Standard	4 & less	1.0	1.0	1.0	1.0	1.0
Utility	4	1.0	1.0	1.0	1.0	1.0
Stud*	4 & less	1.1	1.1	1.1	1.05	1.0
	5 & 6	1.0	1.0	1.0	1.0	1.0
MSR and plank decking All grades & sizes		1.0	1.0	1.0	1.0	1.0

Note: Factors are for Stud grade widths 6" and less. For studs wider than 6", use the design values and size factors for No.3 grade.

Table 3. Wet Use Factors (CM) For Tabulated Design Values

The recommended design values are for applications where the moisture content of the wood does not exceed 19%. For use conditions where the moisture content of dimension lumber will exceed 19%, the Wet Use Adjustment Factors below are recommended:

Property	Adjustment Factor
Fb Extreme Fiber Stress in Bending	0.85*
Ft Tension Parallel to Grain	1.0
Fc Compression Parellel to Grain	0.8**
Fv Horizontal Shear	0.97
Fc(perp) Compresion Perpendicular to Grain	0.67
E Modulus of Elasticity	0.9

Notes:

Bending Wet Use Factor = 1.0 where Fb Cf (base value size factor) does not exceed 1,150 psi.
Compression Parallel Wet Use Factor=1.0 where Fc Cf (base value size factor) does not exceed 750 psi.

Table 4. Flat Use Factors (Cfu)

Apply to Tabulated Design Values for Extreme Fiber Stress in Bending Where Lumber is used Flatwise Rather than on Edge.

Nominal Width (inches)	Nominal Thickness (inches)	
	less than 4	4
less than 4	1.00	
4	1.10	1.00
5	1.10	1.05
6	1.15	1.05
8	1.15	1.05
10 & Wider	1.20	1.10

Note: These factors apply to all dimension lumber except tongue-and-grove decking grades. For T & G decking, the following adjustments may be used:

Nominal thickness	2"	3"	4"
Flat use factor	1.10	1.04	1.00

Table 5. Repetitive Member Factor (Cr)

Applies to Tabulated Design Values for Extreme Fiber Stress in Bending when members are used as joists, truss chords, rafters, studs, planks, decking or similar members which are in contact or spaced not more than 24" on centers, are not less than 3 in number and are joined by floor, roof or other load distributing elements adequate to support the design load.

1.15

Table 6. Duration of Load Adjustment (CD) For Tabulated Design Values

Load Duration	Factor
Permanent	0.9
Ten Years (normal load)	1.0
Two Months (snow load)	1.15
Seven Days	1.25
Ten Minutes (wind, earthquake)	1.6

Impact	2.0

Note: Confirm load requirements with local codes. Refer to Model Building Codes or the National Design Specification for high-temperature or fire-retardant treated adjustment factors.

Table 7. Horizontal Shear Adjustment For Tabulated Design Values

(CH) All horizontal shear base values are established as if a piece were split full length and as such the values are reduced from those permitted to be assigned in accordance with ASTM standards. This reduction is made to compensate for any degree of shake, check or split that might develop in a piece.

2 inches Thick (Nominal) Lumber		3 inches Thicker (Nominal) Lumber	
For convenience, the table below may be used to determine horizontal shear values for any grade of 2" thick lumber in any species when the length of split or check is known:		Horizontal shear values for 3" and thicker lumber also are established as if a piece were split full length. When specific lengths of splits are known and any increase in them is not anticipated, the following adjustments may be applied:	
When length of split on wide face does not exceed:	Multiply tabulated FV value by:	When length of split on wide face does not exceed	Multiply tabulated FV value by:
No split	2.00	No split	2.00
1/2 wide face	1.67	1/2 x narrow face	1.67
3/4 wide face	1.50	1 x narrow face	1.33
1 x wide face	1.33	1-1/2 x narrow face or more	1.00
1-1/2 wide face or more	1.00		

Table 8. Adjustments for Compression Perpendicular To Grain To Deformation Basis of 0.02"

Design values for compression perpendicular to grain are established in accordance with the procedures set forth in ASTM D 2555 and D 245. ASTM procedures consider deformation under bearing loads as a serviceability limit state comparable to bending deflection because bearing loads rarely cause structural failures. Therefore, ASTM procedures for determining compression perpendicular to grain values are based on a deformation of 0.04" and are considered adequate for most classes of structures. Where more stringent measures need be taken in design, the following permits the designer to adjust design values to a more conservative deformation basis of 0.02".

$$Y02=0.73Y04+5.60$$

Table 9. Design Values For Use In the U.S.A. For Visually Graded (NLGA) Western Red Cedar Timbers (5" 5" and Larger)

		Design Values in pounds per square inch (psi)					
Grade	Size Class-ification	Extreme Fiber Stress in Bending Fb	Tension Parallel to Grain F1	Shear Parallel to Grain FV	Compression Perpendicular to Grain Fc(perp)	Compression Parallelto Grain Fc	Modulus of Elasticity E
Select Strctl.	Beams and Stringers	1,150	675	65	425	850	1,000,000
No.1		925	475	65	425	700	1,000,000
No.2		625	300	65	425	450	800,000
Select Strctl.	Posts and Timber	1,050	700	65	425	900	1,000,000
No.1		875	575	65	425	800	1,000,000
No.2		500	350	65	425	550	800,000

Notes:

Allowable Extreme Fiber Stress in Bending applies only when Beams and Stringers are loaded on narrow face.

Where applicable see Tables 9 through 13 for conditions of use and adjustment factors.

Members of the Western Red Cedar Export Association provide western red cedar to Belgium, France, The Netherlands, United Kingdom, Australia, New Zealand, China, Japan and other markets around the world.

Web site design by Graphically Speaking in Vancouver

western red cedar poles - the premium utility pole

ANSI Dimensions | Shipping Weights

western red cedar

Bell Pole ensures product availability and on-time delivery.

Our sustainable forest resources, state-of-the-art treating facility and high volume production capabilities ensure on-time delivery of orders to customer standards and specifications.

With on-site inventory of various lengths and sizes, quick service can be provided in emergency situations.

Access to self-unloading trucks allows for delivery to distribution yards or job sites at a cost savings to our customers.

Pole Capacities:

Transmission poles

- have line capacities of 33kV or higher
- lengths range from 60 to 125 feet
- Class 1, 2, 3 or H series poles

Distribution poles

- are single pole structures
- lengths range from 25 to 55 feet
- Class 1 thorugh 7 poles are generally used

The benefits of western red cedar poles:

- **a naturally durable wood** - resistant to decay, fungi and insects.
- **long life** - has the best cost-to-life ratio. With treatment process their natural life can be extended up to 80 years.
- **strength and flexibility** - allow poles to withstand extreme weight and weather conditions.
- **straight grain** - prevents twisting after installation.
- **light weight** - at 30% less than other species - makes handling and installation easier, and fit more poles per load.
- **safer and easier** - for crews to climb because gaffs dig into them easily, for safe footing.
- **low conductivity**
- **selection** - good range of lengths suitable for transmission and distribution.

© Copyright 2008 Bell Lumber and Pole Company

ANSI dimensions of western red cedar poles

length (feet)	class														
	6	5	4	3	2	1	1	2	3	4	5	6	7	9	10
	minimum circumference at top (inches)														
	39	37	35	33	31	29	27	25	23	21	19	17	15	15	12
	minimum circumference at 6 feet from butt (inches)														
20							34	32	30	27	25	23	22	19	15
25							37	35	33	30	28	26	24	21	17
30							40	38	35	33	30	28	26	22	
35					48	46	43	40	38	35	32	30	28		
40			57	54	51	48	45	43	40	37	34	32			
45	65	62	59	56	54	51	48	45	42	39	36	33			
50	67	65	62	59	56	53	50	47	44	40	38				
55	70	67	64	61	58	55	52	49	45	42					
60	72	69	66	63	60	57	54	50	47	44					
65	75	72	68	65	62	59	55	52	48	45					
70	77	74	70	67	64	60	57	53	50	46					
75	79	76	72	69	65	62	58	55	51						
80	81	77	74	71	67	63	60	56	52						
85	83	79	76	72	69	65	61	57	54						
90	85	81	77	74	70	66	63	59	55						
95	86	83	79	75	72	68	64	60							
##	88	84	81	77	73	69	65	61							
##	90	86	82	78	74	70	66	62							
##	91	87	84	80	76	72	68	63							
##	93	89	85	81	77	73	69	64							
##	94	90	86	82	78	74	70	65							
##	96	92	88	83	79	75	71	66							

Tensioned Cable Installation Example

The information below provides the basic procedures for installing a tensioned cable system. This example shows an all steel surface. Your application may be different. If you have any questions contact **ABC/Nixalite**.

General Procedures

1. Install Corner Hardware.

Drill 9/32" dia. hole for corner hardware eyebolt. Secure with the supplied hex nut.

2. Install Cable Guide Hardware.

Install 24"o.c. Use 14S Driver Socket to seat sidewinders properly. Align sidewinder holes for cable.

3. Fasten Cable to Eyebolts.

Each connection - 2 rope clamps, 1 thimble.

Push a thimble into the eyebolt. Make a loop by passing the cable through the eyebolt. Make sure there is 3"of extra cable.

Apply the first rope clamp 2" from eyebolt and lightly tighten the nuts. Apply the second rope clamp as close to the eyebolt as possible. Lightly tighten nuts. Take up slack in cable and torque all rope clamp nuts to 7.5ft.lbs.

4. Fasten Cable to Turnbuckles.

Run the cable through all cable guides before fastening the cable to the turnbuckle.

Open the turnbuckle to its maximum safe length. Push a thimble into the eyelet of the turnbuckle. Make a loop by passing cable through turnbuckle eye. Make sure there is 3"of extra cable. Apply the first rope clamp 2" from eyelet and lightly tighten the nuts. Apply second rope clamp as close to the eyelet as possible. Lightly tighten nuts.

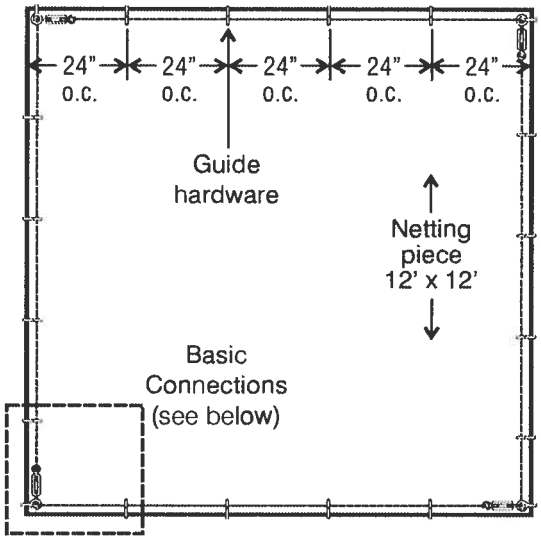
Adjust the length of the cable so the hook end of the turnbuckle will go through the corner eyebolt then torque all rope clamp nuts to 7.5ft.lbs.

5. Apply load and <u>Re-torque all clamps!</u>

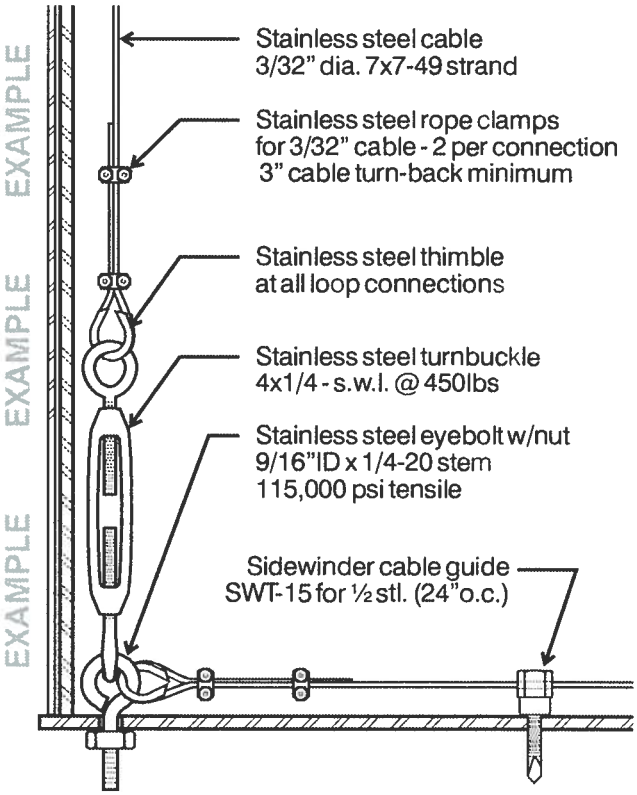
After the netting has been attached to cable with net rings, the installation is tensioned by tightening the turnbuckles. In tension, multi-strand cables will stretch in length and shrink in diameter (small amounts). This can lead to loose rope clamps. Be sure to re-torque all rope clamp nuts to 7.5ft.lbs.

Questions? Call ABC/Nixalite! 800.624.1189

Example Area (10' x 10')



Basic Cable Connections



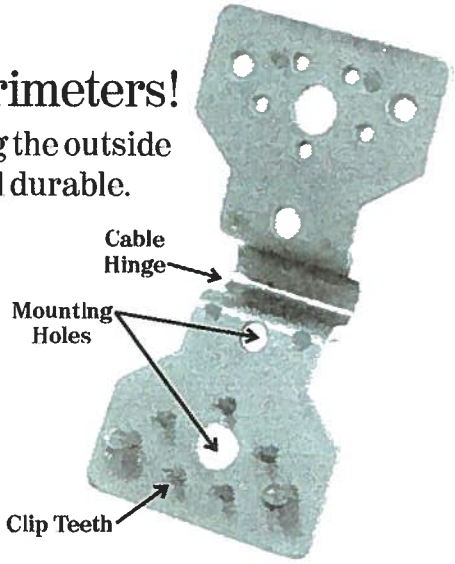
ABC Advanced Bird Control
P.O. Box 727, East Moline, IL 61244
Ph:888.212.8682 Fax:309.755.1865
www.abcbirdcontrol.com E:info@abcbirdcontrol.com

Nixalite® of America Inc
1025 16th Ave, East Moline, IL 61244
Ph:800.624.1189 Fax:800.624.1196
www.nixalite.com E:sales@nixalite.com

Copyright© 2005 by Nixalite® of America Inc, East Moline, IL 61244 - All rights reserved.
Nixalite® is a fully registered trademark of Nixalite® of America Inc - Printed with pride in the USA

Use **PolyClips** to secure bird netting perimeters!

PolyClips provide a low cost, easy-to-install method for fastening the outside edges of any bird netting installation. **PolyClips** are versatile and durable.



PolyClip Specifications:

Material:
Black, UV resistant polypropylene.

Overall Size:
Open: 1-3/4" wide, 3-1/2" long.
Closed: 1-3/4" wide, 2" long.

Mounting Hole Sizes
Large: 5/16" diameter.
Small: 3/16" diameter.

Cable Hinge: 1/4" diameter when PolyClip is closed. Maximum cable diameter: 7/32".

Clip 'Teeth': Clip Teeth are what grip the net fabric. Each PolyClip has 5 small guide teeth to align the clip when closing, 2 large clamping teeth to hold the clip together after closing.

Availability: Sold individually or in 250 count boxes.

PolyClip Installation Guidelines:

Use PolyClips to:
Secure the perimeter (outside edges) of a netting installation.

1. PolyClip Perimeter Spacing:
Flat surfaces: 12" center-to-center maximum.
Curved Surfaces: 6" center-to-center maximum.

NOTE: Mounting Hardware for PolyClips:
Many types of hardware can be used as long as it fits through the mounting holes in the PolyClip (see PolyClip Specs). ABC/Nixalite offers mounting hardware for all types of surfaces (sold separately).

2. Installing PolyClips on the surface first:
PolyClips have two halves, one side with 'teeth', one without. ALWAYS fasten side with 'teeth' to the mounting surface. This will allow proper closing and 'locking' of the clip. Roll the edge of the netting 2 or 3 times and insert it into the PolyClip. Snap the PolyClip shut over the netting.

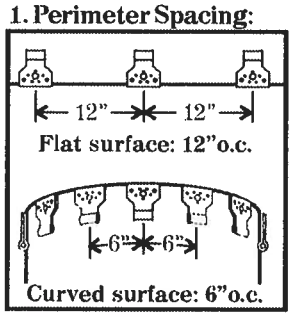
3. Roll netting edges:
The edges of the netting are ALWAYS rolled at least 2 times to allow the Poly Clip teeth to grip as much of the netting as possible. This applies for all bird netting installed with the PolyClips.

4. Installing PolyClips on netting first:
PolyClips can be closed over a rolled edge of netting, and then fastened to a mounting surface. Install the PolyClip so the side with teeth will be against the installation surface. Install mounting hardware through the mounting holes of the closed PolyClip. Not recommended for curved or complex surfaces.

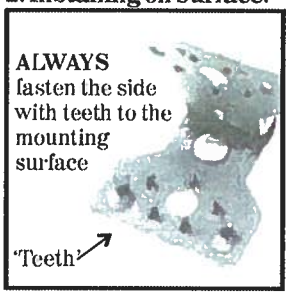
5. Installing PolyClips along a perimeter cable:
Some netting installations use a tensioned cable support system. PolyClips have a cable hinge just for this type of installation. With the PolyClip open, position the cable inside the cable hinge (max. cable diameter of 7/32"). Close PolyClip over the cable and the rolled edge of the bird netting. Follow the recommended PolyClip center-to-center spacing.

Have Questions or Need Help?:
Call ABC/Nixalite for assistance.

1. Perimeter Spacing:



2. Installing on surface:



3. Roll netting edges:

Roll netting 2 or 3 times, insert, close PolyClip

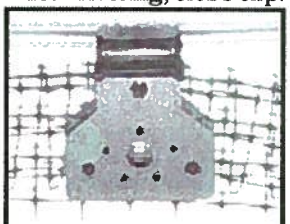
4. Installing on netting:

Roll netting, close PolyClip over netting, fasten.

5. Installing on cables:

Position cable at back of the Cable Hinge.

5. Roll netting, close clip:



Roll netting, close PolyClip over netting and cable.

www.nixalite.com Ph 800.624.1189 Fx 800.624.1196

ABC/**Nixalite**®
1025 16th Avenue, East Moline, IL. 61244
P: 309.755.8771 F: 309.755.0077
Email: birdcontrol@nixalite.com

Copyright © 2005 by Nixalite® of America Inc, East Moline, IL 61244 - All rights reserved.
Nixalite® is a fully registered trademark of Nixalite® of America Inc - Printed with pride in the USA

WIRE ROPE

West Coast Wire Rope

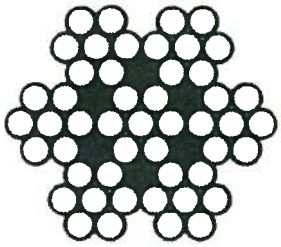
STAINLESS STEEL CABLE
(TYPE 304 7X7, 7X19)

2

According to Federal Specification RR-W-410D, preformed, right regular lay, strand core.

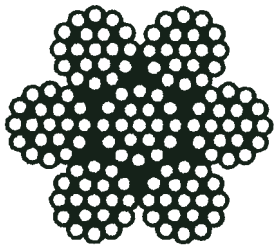
Small diameter 7x7 and 7x19 construction wire rope is sometimes referred to as "aircraft cable". IT IS NOT INTENDED FOR AIRCRAFT USE but designed for industrial and marine applications.

Read important warnings and information on pages 6 - 7 and 12 preceding wire rope section.



7 X 7

Diameter In Inches	7 X 7 STAINLESS STEEL CABLE	
	Approx. weight per 1000 Ft. in pounds	Breaking strength in Pounds*
1/16	7.5	480
3/32	16	920
1/8	28	1,700
5/32	43	2,400
3/16	62	3,700
1/4	106	6,100



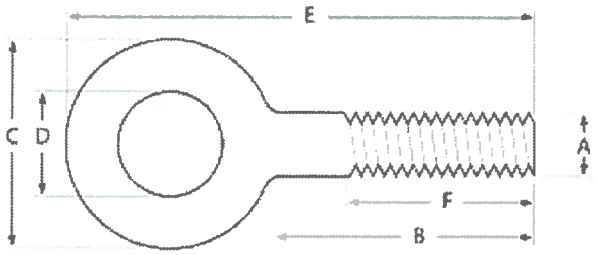
7 X 19

Diameter In Inches	7 X 19 STAINLESS STEEL CABLE	
	Approx. weight per 1000 Ft. in pounds	Breaking strength in Pounds*
3/32	17.4	920
1/8	29	1,760
5/32	45	2,400
3/16	65	3,700
7/32	86	5,000
1/4	110	6,400
5/16	173	9,000
3/8	243	12,000
7/16	356	16,300

*Listed for comparison only. Actual operating loads may vary, but should never exceed the recommended design factor or 20% of catalog Breaking Strength.

Email: info@boltdepot.com
Toll Free: **1-866-337-9888**

Dimensions of Forged Eye Bolts



Length (B)	Outside Eye Diameter (C)	Inside Eye Diameter (D)	Overall Length (E)	Thread Length (F)
		1/4-20 (A)		
2	1	1/2	3-7/32	1-1/2
3	1	1/2	4-7/32	1-1/2
4	1	1/2	5-7/32	2
5	1	1/2	6-7/32	2-1/2
6	1	1/2	7-7/32	3
		5/16-18 (A)		
2-1/4	1-1/4	5/8	3-23/32	1-1/2
3-1/4	1-1/4	5/8	4-23/32	1-1/2
4-1/4	1-1/4	5/8	5-23/32	2-1/2
5	1-1/4	5/8	6-15/32	2-1/2
6	1-1/4	5/8	7-15/32	3
		3/8-16 (A)		
2-1/2	1-1/2	3/4	4-1/4	1-1/2
3	1-1/2	3/4	4-3/4	1-1/2
4	1-1/2	3/4	5-3/4	2
4-1/4	1-1/2	3/4	6	2
4-1/2	1-1/2	3/4	6-1/4	3
5	1-1/2	3/4	6-3/4	3
6	1-1/2	3/4	7-3/4	3
8	1-1/2	3/4	9-3/4	4
10	1-1/2	3/4	11-3/4	4

1/2-13 (A)				
2	2	1	4-3/16	1-5/8
3-1/4	2	1	5-7/16	2
4	2	1	6-3/16	3
4-1/2	2	1	6-11/16	3
6	2	1	8-3/16	3
8	2	1	10-3/16	4
10	2	1	12-3/16	4
12	2	1	14-3/16	4
5/8-11 (A)				
4	2-1/2	1-3/8	6-5/8	3
4-1/2	2-1/2	1-3/8	7-1/8	3
6	2-1/2	1-3/8	8-5/8	3
8	2-1/2	1-3/8	10-5/8	4
10	2-1/2	1-3/8	12-5/8	4
12	2-1/2	1-3/8	14-5/8	4
15	2-1/2	1-3/8	17-5/8	6
18	2-1/2	1-3/8	20-5/8	6
24	2-1/2	1-3/8	26-5/8	6
3/4-10 (A)				
4	2-13/16	1-1/2	6-7/8	3
4-1/2	2-13/16	1-1/2	7-3/8	3
6	2-13/16	1-1/2	8-7/8	3
8	2-13/16	1-1/2	10-7/8	4
10	2-13/16	1-1/2	12-7/8	4
12	2-13/16	1-1/2	14-7/8	4
15	2-13/16	1-1/2	17-7/8	6
18	2-13/16	1-1/2	20-7/8	6
24	2-13/16	1-1/2	26-7/8	6
7/8-9 (A)				
5	3-1/2	1-3/4	8-1/4	3
6	3-1/2	1-3/4	9-1/4	3
8	3-1/2	1-3/4	11-1/4	4
10	3-1/2	1-3/4	13-1/4	4
12	3-1/2	1-3/4	15-1/4	4
18	3-1/2	1-3/4	21-1/4	6

24	3-1/2	1-3/4	27-1/4	6
1-8 (A)				
6	4	2	9-5/8	3
8	4	2	11-5/8	4
10	4	2	13-5/8	4
12	4	2	15-5/8	4
15	4	2	18-5/8	6
18	4	2	21-5/8	6
24	4	2	27-5/8	6
1-1/4-7 (A)				
6	4-7/16	2-3/16	10-1/2	3
8	4-7/16	2-3/16	12-1/2	4
12	4-7/16	2-3/16	16-1/2	4
18	4-7/16	2-3/16	22-1/2	6
24	4-7/16	2-3/16	28-1/2	6
1-1/2-6 (A)				
6	5-3/16	2-1/2	11-1/4	3
12	5-3/16	2-1/2	17-1/4	4
18	5-3/16	2-1/2	23-1/4	6
24	5-3/16	2-1/2	29-1/4	6
2-4-1/2 (A)				
12	6-7/8	3-1/4	19	4

Copyright © 2000-2008 Bolt Depot
www.boltdepot.com • info@boltdepot.com • Toll free: 1-866-337-9888

Making Cable Loop Connections:

The following steps guide you through the process of creating simple loop connections. Use these steps to fasten the net cable to Corner Hardware and Turnbuckle Eyelets.

Connections with Wire Rope Clamps:

1. Push 1 thimble onto the eyelet of the eyebolt, screw eye or turnbuckle.
2. Slide 2 wire rope clamps over the end of the cable.

3. Pass the cable through the eyelet (on the thimble) and then back through both clamps. Have at least 3" of lapped cable (the 'tag' end).
4. Position back clamp 2" from the eyelet and tighten 'finger tight'. Position front clamp tight against the eyelet and tighten 'finger-tight'.

5. Take up cable slack by pushing the front clamp towards the eyelet while pulling on the tag end of the cable. Tighten all clamps.

Email: info@boltdepot.com
Toll Free: **1-866-337-9888**

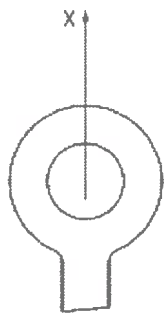
Forged Eye Bolt Working Load Limits

Important:

Working load limits for eye bolts are based on a straight vertical lift in a gradually increasing manner.

Standard forged eye bolts should **not** be used with angular lifts. If an angular lift is required, a properly seated shoulder pattern **machinery** eye bolt **must** be used.

Load limits are based on a safety factor of 5 to 1.



Diameter	Straight Pull (lbs)
1/4 - 20	500
5/16 - 18	800
3/8 - 16	1,200
1/2 - 13	2,200
5/8 - 11	3,500
3/4 - 10	5,200
7/8 - 9	7,200
1 - 8	10,000
1-1/4 - 7	13,500
1-1/2 - 6	20,000
2 - 4-1/2	35,000

✓ FS = 5

Copyright © 2000-2008 Bolt Depot
www.boltdepot.com • info@boltdepot.com • Toll free: 1-866-337-9888

APPENDIX C-2

ICE LOADING EVALUATION

Golder Associates	Subject Piñon Ridge Project	Made by EF	Job No 073-81694
	Evaporation Pond Design	Checked by DLG	Date 5/29/08
	Bird Netting Design	Approved by KHM	Sheet No 1 of 3

OBJECTIVE:

Calculate the force developed at the bird netting fastener (polyclip) due to ice forming in the bird netting, and calculate the capacity of the strain wire that supports the bird netting, considering ice forming on the cable.

GIVEN:

- Evaporation pond netting design configuration.

GEOMETRY:

- Conceptual view of the birdnetting frame (see Figure 1).

MATERIAL PROPERTIES:

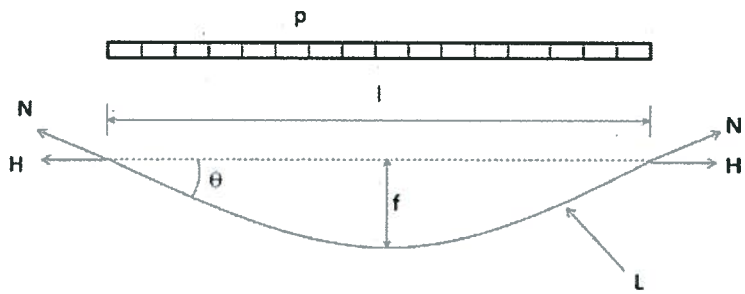
- Polyclip
  - Tension resistance 20 lb (per personal correspondence with George Winthurst of Nixalite)
- Stainless steel cable Type 304 Dia. 7/32" 7x19
  - Breaking strength 5,000 lb
  - Weight per 1000 ft = 86 lb

ASSUMPTIONS:

- The maximum bird netting dip is assumed to be 0.5 feet at the center of the 50-foot span.
- A 0.5-inch ice coating is assumed to be formed on the bird netting and the stainless steel cable per San Miguel power line design specifications.

METHOD:

Cable analysis (Au and Christiano 1987; Ortiz-Berrocal 1991)



p = distributed load

H = horizontal component of reaction

N= normal reaction

f = dip

l = span

L= cable length

$$H = \frac{p\,l^2}{8f}$$

$$N = H\sqrt{1 + \frac{p^2}{H^2}\left(\frac{l}{2}\right)^2}$$

$$L = l + \frac{p^2 l^3}{24H^2}$$

CALCULATIONS:

The calculations are presented in Attachments 1 and 2.

RESULTS:

Calculations (Attachments 1 and 2) indicate that the resultant tension in the fastener due to an ice coating is 196.5 pounds while the resistance of the polyclip is 20 pounds. As a consequence the fastener will fail under the considered load condition.

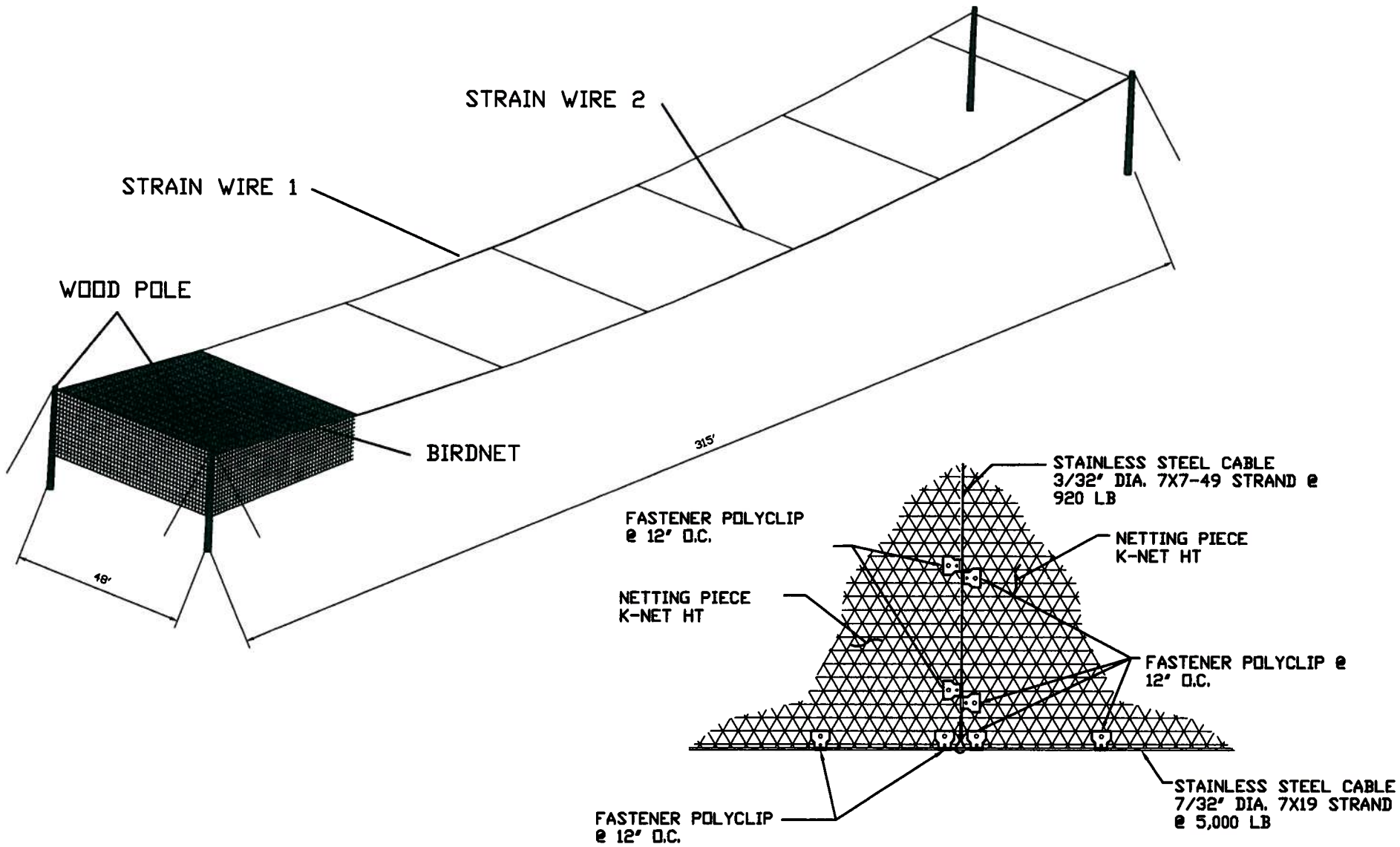
Considering the load combinations under the load and resistance factor design (LFRD) methodology, the factored load taking into account 0.5-inches of ice over the cable (2.05 pounds per foot) is less than the factored load considering only the bird netting and the cable weight (2.24 pounds per foot). Because the factored load excluding netting (i.e. assumes clip failing) is less than the cable design factored load (i.e., netting plus cable weight), the calculations indicate that the cable is adequately design to resist the ice load condition.

REFERENCES:

Au, T., and Christiano, P. (1987). *Structural analysis*, Prentice-Hall, Englewood Cliffs, NJ.

Ortiz-Berrocal, L. (1991). *Resistencia de Materiales*, McGraw-Hill, Madrid.

FIGURES



Golder Associates Denver, Colorado

TITLE

CONCEPTUAL VIEW
PARTIAL SECTION BIRDNETTING FRAME

CLIENT/PROJECT

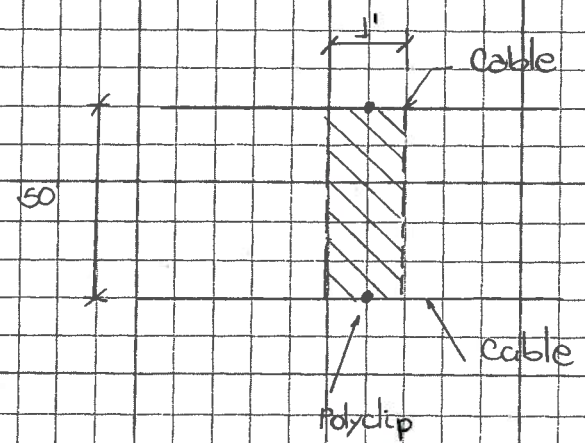
ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT - EVAPORATION POND
MONTROSE COUNTY, COLORADO

DRAWN EF	DATE APRIL15, 2008	JOB NO. 073-81694
CHECKED GG	SCALE N.T.S.	DWG. NO.
REVIEWED KFM	FILE NO.	FIGURE NO. 1

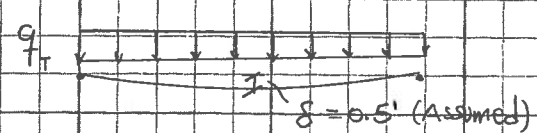
ATTACHMENT 1

Golder Associates	SUBJECT Bird net		
	Job No. 073-81694. Ref.	Made by EF Checked DG Reviewed KM	Date Sheet 1 of 1

Objective: Calculate the force at the fastener (polyclip) when ice is considered in the bird net



tributary width = 1'



net $w_n = 0.0218 \frac{lb}{ft}$

Ice $\gamma = 57.22 \frac{lb}{ft^3}$

Ice thickness = 0.5"

$$q_{net} = 1 \cdot 0.0218 = 0.0218 \frac{lb}{ft}$$

$$q_{ice} = 1 \cdot \frac{0.5}{12} \cdot 57.22 \left(\frac{100-88}{100}\right) = 0.2861 \frac{lb}{ft}$$

$$q_T = 0.0218 + 0.2861 = 0.3141$$

$P = q_T$

$$H = \frac{Pe^2}{8f} = \frac{0.3141 \cdot 50^2}{8 \cdot 0.5'} = 196.31 \text{ lb}$$

$$N_{max} = H \sqrt{1 + \frac{P^2}{H^2}\left(\frac{\ell}{2}\right)^2}$$

$$N_{max} = 196.3 \sqrt{1 + \frac{0.3141^2}{196.31^2}\left(\frac{50}{2}\right)^2}$$

resistance

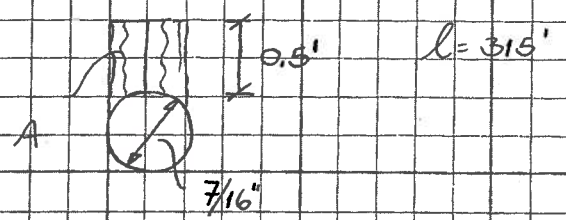
$N_{max} = 196.46$ lb / per polyclip > 20 lb OK

polyclip will fail.

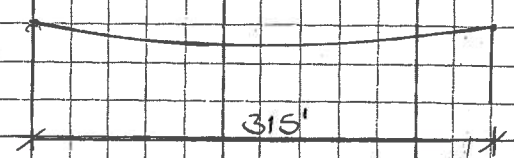
ATTACHMENT 2

Golder Associates	SUBJECT Birdnet		
	Job No. 0.73-81694 Ref.	Made by EF Checked DCF Reviewed KFM	Date Sheet 1 of 1

Objective: Calculate the tension in the cable due to Ice forming in the primary cable.



$l = 315'$



net $w_n = 0.028 \frac{lb}{ft^2}$

tributary width = 50'

$$q_{net} = 50 \cdot 0.028 = 1.4 \frac{lb}{ft}$$

Cable weight $w_c = 0.2 \frac{lb}{ft}$

Ice $\gamma = 57.2 \frac{lb}{ft^3}$

Area Ice $A = \frac{0.5}{12} \cdot \frac{7}{16} \cdot \frac{1}{12} = 1.52 \times 10^{-3} ft^2$

$$q_{Ice} = 1.52 \times 10^{-3} ft^2 \cdot 57.2 \frac{lb}{ft^3} = 0.0869 \frac{lb}{ft}$$

$q_T = 1.2(q_{net} + w_c) + 1.6(q_{ice})$ LRFD factors

$q_T = 1.2(1.4 + 0.2) + 1.6(0.0869) = 2.05 \frac{lb}{ft} < 1.4(q_{net} + w_c)$

The distributed load (q_T) considering Ice is less than the factored load only considering the dead load. So the tension developed in the cable due to Ice will be less that the designed load