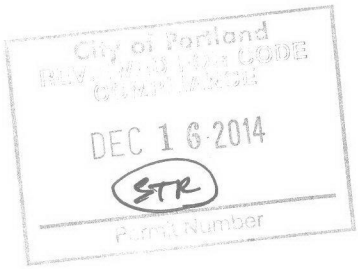
MILLER
CONSULTING
ENGINEERS

STRUCTURAL CALCULATIONS

Guardrail Design
6044 SW Madison Court, Portland, Oregon
Sibyl Jarrett

December 2, 2014
Project No. 120742
3 pages

Principal Checked: CM



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*** LIMITATIONS ***

Miller Consulting Engineers, Inc. was retained in a limited capacity for this project. This design is based upon information provided by the client, who is solely responsible for accuracy of same. No responsibility and or liability is assumed by or is to be assigned to the engineer for items beyond that shown on these sheets.

WinBeam

Project:

By: Date: Checked: Date: Page:

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Description:

  Distribution of 200 pound point load along
  intermediate guardrail supports

Units: English

Properties - X = feet, E = ksi, I = in^4
  X = 0; E = 29000; I = 0.5625; /.5x1.5 plate rail

Moment Releases - X = feet

Supports - X = feet, Displacement = inches, Rotation = radians

Springs - X = feet, VSpring = kip/inch, RSpring = kip in/rad
  X = 0; VSpring = .25649;
  X = 5.5; VSpring = .25649;
  X = 11; VSpring = .25649;

Point Loads - X = feet, PLoad = kips, Moment = kip ft
  X = 5.5; PLoad = .2;

Uniform Loads - XStart & XEnd = feet, UStart & UEnd = kip/ft
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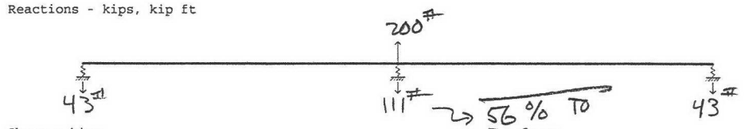
WinBeam

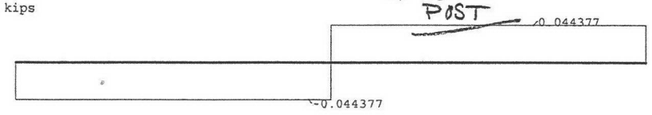
Project:

By: Date: Checked: Date: Page:

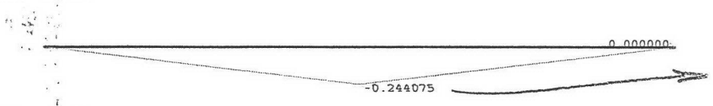
Reactions - kips, kip ft



Shear - kips



Moment - kip ft

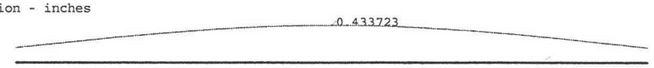


$M_{C\,RAIL} = 43_{\#} \cdot 16 > 244$ OK
($L_b = 5'6"$)

USE 1/2 x 1 1/2" PL

Rotation - radians

Deflection - inches



WinBeam 3.30 - Registered to Miller Consulting Engrs.

Building Code: 2014 Oregon Structural Specialty Code

Soils Report: Soils Report by: Dated:

Soil Bearing: N/A PSF Retaining Walls: Yes

Equivalent Fluid Pressure (active): PCF Passive bearing: PCF Friction:

Structural System: Non-building Structure

Vertical System: Lateral Sys:

Basic Design Loads:	Element				
	Load Type				
	Value (PSF)				
	Load Type				
	Value (PSF)				
	Deflection Criteria				

Lateral Design Parameters:

Wind Design: N/A Wind Speed (3 sec Gust): MPH

Exposure

Importance Factors I_W = 1.00 (wind) I_E = 1.00 (seismic) I_S = 1.00 (snow) I_i = 1.00 (ice) Occupancy Cat: II

(Iw = 1.0 with wind concurrent with ice)

Design Summary:

The following calculations are for the design of the guardrail rail, post and anchorage for the a 200 pound out-of-plane load.

MILLER Consulting Engineers

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Project Name: Guardrail Designs Project #: 120742

Location: 6044 SW Madison Court, Portland, Oregon

Client: Sibyl Jarrett

BY: CJM Ck'd: EWJ Date: 12/02/14 Page 1 of 3

Guardrail Post

Steel Column/Beam Design - AISC 13th Addition

Shape: HSS **Shape Capacity = 0.53 < 1.0**

Size: 1-1/2X1-1/2X1/8

ASD

Weight =	2.07	plf
Pr =	0.00	k, axial compression load
Mr_x =	0.37	ft-k, strong axis moment
Mr_z =	0.00	ft-k, weak axis moment
Vr_x =	0.00	k, strong axis shear
Vr_z =	0.00	k, weak axis shear
Tr =	0.00	ft-k, torsional load
K_x =	2.00	*(Table C-C2.2, pg 16.1-240)*
K_z =	2.00	*(Table C-C2.2, pg 16.1-240)*
L_x =	3.29	ft
L_z =	3.29	ft
Lv =	N/A	ft, (for round shapes)
KL/r x =	135.43	
KL/r z =	135.43	
E =	29000	ksi
Fy =	46	ksi
Ag =	0.61	in^2
t =	0.116	in
Z_x =	0.303	in^3
Z_z =	0.303	in^3
S_x =	0.251	in^3
S_z =	0.251	in^3
I_x =	0.188	in^4
I_z =	0.188	in^4
r_x =	0.583	in
r_z =	0.583	in

Section is Compact in the strong axis (x)

Section is Compact in the weak axis (y)

M = 0.369 ft-k = 0.2*3.29'*56%

Axial Capacity, Chapter E

Aeff =	0.39	in^2
Qa =	1	*(Section E7, pg 16.1-42)*
Fe_x =	15.61	ksi, *(Section E3 pg 16.1-33)*
Fe_z =	15.61	ksi, *(Section E3 pg 16.1-33)*
Fcr_x =	13.69	ksi, *(Section E3 pg 16.1-33)*
Fcr_z =	13.69	ksi, *(Section E3 pg 16.1-33)*
Pn_x =	8	k, *(Section E3 pg 16.1-33)*
Pn_z =	8	k, *(Section E3 pg 16.1-33)*

Moment Capacity, Chapter F

$Seff_x$ =	0.137388	in^3
$Seff_z$ =	0.25	in^3
Mn_x =	1.16	*ft-k, (Section F7 pgs 16.1-55,56)*
Mn_z =	1.16	*ft-k, (Section F7 pgs 16.1-55,56)*

Shear Capacity: Chapter G

kv =	5	*(Section G5, pg 16.1-68)*
Cv_x =	1.00	*(Section G2, pg 16.1-65)*
Cv_z =	1.00	*(Section G2, pg 16.1-65)*
Aw_x =	0.23	in^2, *(Section G5, pg 16.1-68)*
Aw_z =	0.27	in^2, *(Section G5, pg 16.1-68)*
Fcr =	N/A	ksi, *(Section G6, pg 16.1-68)*
Vn_x =	6.3	*k, (Section G2, pg 16.1-65)*
Vn_z =	7.4	*k, (Section G2, pg 16.1-65)*

Torsional Capacity: Chapter H

Fcr =	27.60	*ksi, (Section H3 pg 16.1-75)*
C =	0.44	torsional shear constant
Tn =	1.0	ft-k, *(Section H3 pg 16.1-74)*

Allowable Capacities: Rn / Ω (ASD); Rn * Φ (LRFD)

(ASD)	Pc, k	Mc, ft-k	Vc, k	Tc, ft-k
x-axis	**5.0**	**0.7**	**3.8**	**0.6**
z-axis		**0.7**	**4.4**	

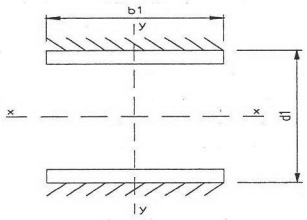
Interaction Equations:

Pr/Pc =	0.00	
Tr/Tc =		
	0.53	< 1.0 OK

Equation H1-1b, AISC 13 ed., pg 16.1-70

Use HSS 1-1/2X1-1/2X1/8

EQUAL RECTANGLES (weld on both outside faces)



Vy =		lb	
Mx =		ft-lb	
Vx =		lb	
My =	369	ft-lb	
Weld size, w =	0.1875	in	= 3/16 " weld
Effective Throat, E =	0.13	in	= 0.707*0.1875"
Width, b1 =	5	in	
Depth, d1 =	1.5	in	Distance between insides of weld
Outer depth of weld =	1.76	in	= 1.5"+2*0.13"
A =	1.30	in^2	= (1.76-1.5)*5
Ix =	0.87	in^4	= 5*(1.76^3-1.5^3)/(12)
Sx =	0.99	in^3	= 0.87/(1.76/2)
Iy =	2.76	in^4	= (0.1875*0.707*2)*5^3/12
Sy =	1.10	in^3	= 2.76/(5/2)
F =	21000	psi	
Vc =	**27300**	**lb**	= 21000*1.3
Mcx =	**1733**	**ft-lb**	= 21000*0.99/12
Mcy =	**1925**	**ft-lb**	= 21000*1.1/12

Capacity = 0.19 < 1.00 OK

Use 0.1875" fillet weld

Tension in top fastener:

T =	1154	lb	= 200*3.65'/(4.25"/12)*56%
Tc =	1685		

1154 < 1685 OK

Use Simpson DTT2Z at each post

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Project Name_____ Project #_____

Location_____

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By_____ Ck'd EW Date_____ Page 3 of 3