MILLER
CONSULTING
ENGINEERS

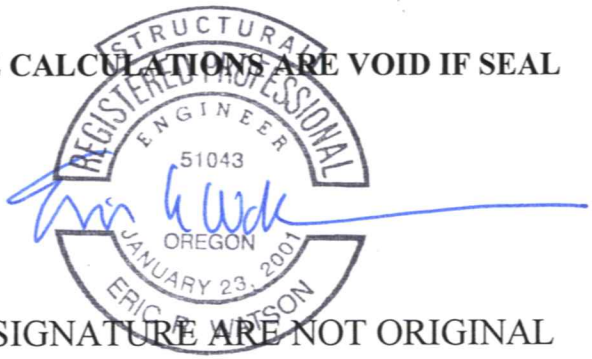
STRUCTURAL CALCULATIONS

Hanging Exhibit Displays
5675 SE International Way, Milwaukie, Oregon
Classic Exhibits

December 7, 2011
Project No. 100044
5 pages

Principal Checked:

THESE CALCULATIONS ARE VOID IF SEAL



AND SIGNATURE ARE NOT ORIGINAL

EXPIRES: 06-30-2012

***** LIMITATIONS *****

ENGINEER WAS RETAINED IN A LIMITED CAPACITY FOR THIS PROJECT.
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.

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Building Code: 2009 International Building Code

Soils Report: No **Soils Report by:** N/A **Dated:** N/A

Soil Bearing: N/A PSF **Retaining Walls:** No

Equivalent Fluid Pressure (active): N/A PCF **Passive bearing:** N/A PCF **Friction:** N/A

Structural System: Non-building Structure

Vertical System: N/A **Lateral Sys:** N/A

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

Lateral Design Parameters:

Wind Design: N/A _____ 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)

Seismic Design

Seismic Design Parameters based on USGS Seismic Hazard Curves for:

N/A

2% PE in 50 years, 0.2 sec SA = Ss

2% PE in 50 years, 1.0 sec SA = S1

(Site class B parameters are indicated on this page, for actual site class used in design, refer to seismic design summary)

Design Summary:

The following calculations are for the design of interior hanging displays. The displays vary in size and shape and are hung from existing structures. Information regarding the displays has been provided by the client. Pages 2-3 lists the maximum weight various display types using the heaviest display configuration. The maximum weight of all the various displays is 71 pounds which is the four-sided curve display. The calculations for the display members and connections where designed based off the 71 pound display. The existing structure is designed by others.

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Project Name: Hanging Exhibit Displays Project #: 100044

Location: 5675 SE International Way, Milwaukie, Oregon

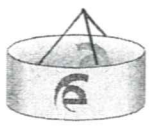
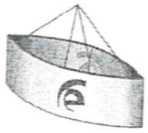
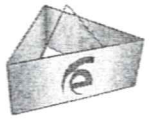
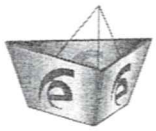
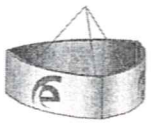
Client: Classic Exhibits

BY: CJM Ck'd: Date: 12/07/11

WEIGHTS OF DISPLAYS:

MEMBERS : 0.29 plf

SKIN : 0.04 psf

CONFIGURATION / SIZE	SURFACE AREA (ft^2)	TOTAL MEMBER LENGTH (ft)	WEIGHT
 3 WIRE Round	"15×60" $15^2\frac{\pi}{4} + 2\pi\left(\frac{15}{2}\right)\left(\frac{60}{12}\right)$ = 412 ft²	$15/2 \times 2\pi \times (2) + \frac{60}{12} \times (8)$ = 87 ft	412×0.04 + 87×0.29 = 42#
 4 WIRE Tapered Round	"15×60" 412 ft² (CONSERVATIVE)	$87 - \frac{60}{12} \times (4) =$ 67 ft	412×0.04 + 67×0.29 = 36#
 4 WIRE Oval	"15×60" → ASSUME 2' ARC $15.7 \times (2) \times \frac{60}{12} + 20.3 \times (2)$ = 198 ft²	$15.7 \times (4) + \frac{60}{12} \times (8)$ = 103 ft	198×0.04 + 103×0.29 = 38#
 3 WIRE Triangle	"16×60" $16 \times \frac{60}{12} \times (3) + (16 \times 0.707 \times 16)/2$ = 330 ft²	$16 \times (6) + \frac{60}{12} \times (6)$ = 126 ft	330×0.04 + 126×0.29 = 50#
 3WIRE Tapered Triangle	"15×60" $15 \times \frac{60}{12} \times (3) + (15 \times 0.707 \times 15)/2$ = 305 ft² (CONSERVATIVE)	$15 \times (6) + \frac{60}{12} \times (6)$ = 120 ft	305×0.04 + 120×0.29 = 47#
 3 WIRE Three-Sided Curve	"15×60" → ASSUME 1' ARC $15.2 \times (3) \times \frac{60}{12} + 10 \times (3) + \ldots$ $+ (15 \times 0.707 \times 15)/2$ = 338 ft²	$15.2 \times (6) + \frac{60}{12} \times (6)$ = 121 ft	338×0.04 + 121×0.29 = 49#

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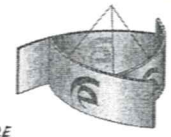
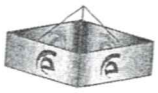
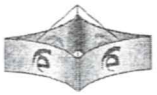
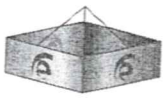
	SURFACE AREA (ft^2)	TOTAL MEMBER LENGTH (ft)	WEIGHT
 3 WIRE Pinwheel	"15×60" → ASSUME 1' ARC $15.2 \times \frac{60}{12} \times (3) + (12 \times 0.707 \times 12)/2$ $= 279\ ft^2$	$15.2 \times (6) + \frac{60}{12} \times (6)$ $= 121$ ft	$279 \times 0.04 + 121 \times 0.29$ $= 48^{\#}$
 4 WIRE Square	"15×60" $15 \times \frac{60}{12} \times (4) + 15 \times 15$ $= 525 ft^2$	$15 \times (8) + \frac{60}{12} \times (8)$ $= 160$ ft	$525 \times 0.04 + 160 \times 0.29$ $= 67^{\#}$
 4 WIRE Tapered Square	"15×60" $525\ ft^2$ (CONSERVATIVE)	160 ft	$67^{\#}$
 4 WIRE Four-Sided Curve	"16×60" → ASSUME 1' ARC $16.2 \times \frac{60}{12} \times (4) + [16 \times 16 - 10.7 \times (4)]$ $= 537\ ft^2$	$16.2 \times (8) + \frac{60}{12} \times (8)$ $= 170$ ft	$537 \times 0.04 + 170 \times 0.29$ $= 71^{\#}$
 4 WIRE Four-Sided Rectangle	"16×8×60" $[16 \times (2) + 8 \times (2)] \times \frac{60}{12} + 16 \times 8$ $= 368\ ft^2$	$16 \times (4) + 8 \times (4) + \frac{60}{12} \times (8)$ $= 136$ ft	$368 \times 0.04 + 136 \times 0.29$ $= 54$

MAX LOAD TO 3 WIRE DISPLAY = 50 # (TRIANGLE) ⇒ 16.67#/WIRE

MAX LOAD TO 4 WIRE DISPLAY = 71 # (FOUR-SIDED CURVE) ⇒ 17.75#/WIRE

TYPICAL DISPLAY SIZES VARY FROM 8' LONG × 36" TALL TO 16' LONG × 60" TALL. THE SIZES SHOWN IN THE PREVIOUS TABLE PROVIDE THE LARGEST WEIGHT FROM THE AVAILABLE SIZES FOR EACH CONFIGURATION. TYPICAL SIZES USED ARE AS LISTED IN THE 2007 AERO WHOLESALE CATALOG.

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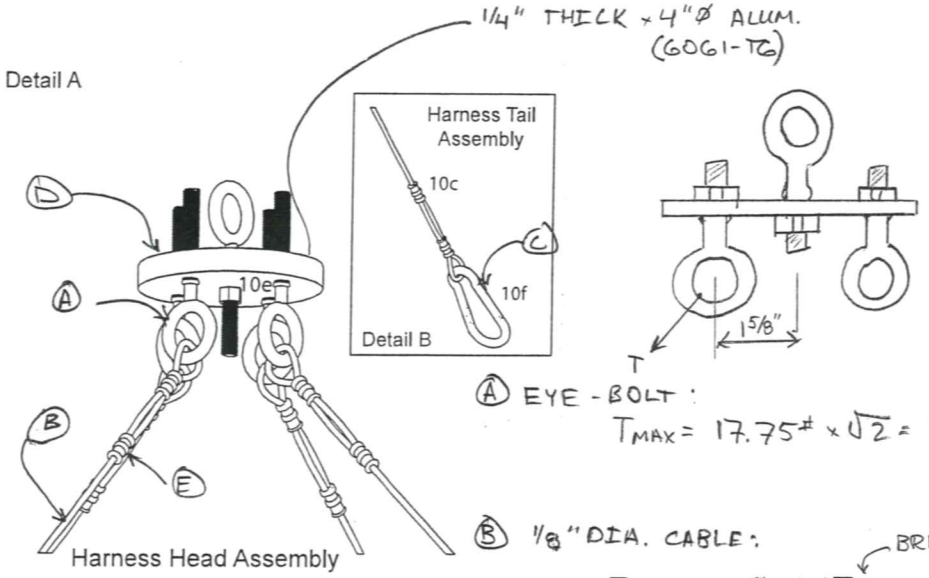
Location 5675 SE International Way, Milwaukie, Oregon

Client Classic Exhibits

By CJM Ck'd FMW Date 2/3/10 Page 3 of 5

CONNECTION CHECKS



Ⓐ EYE-BOLT:

$T_{MAX} = 17.75^{\#} \times \sqrt{2} = 25^{\#} < 450$ lb (EYE BOLT CAP. W/ 45° LOAD) OK

Ⓑ 1/8" DIA. CABLE:

$T_{MAX} = 25^{\#} < 1760/5 = 352^{\#}$ (BREAKING STRENGTH, F.S.) OK

Ⓒ INTERLOCKING SNAPS:

$T_{MAX} = 25^{\#} < 280^{\#}$ (WORKING CAPACITY) OK

Ⓓ 1/4" x 4" Ø 6061-T6 Ⓡ:

$M = 17.75 \times 1.625 = 29"\text{-lb}$

$f_b = 29/[0.25^2 \times 2"/6] = 1392$ psi < 28000 psi (F_b OF 6061-T6 PLATE) OK

Ⓔ OVAL SLEEVES:

$T_{MAX} = 25^{\#} < 900^{\#}$ OK

ASSEMBLIES ARE ADEQUATE TO SUPPORT ANY OF THE STANDARD DISPLAYS SHOWN IN THESE CALCULATIONS

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By: CJM Ck'd: EMW Date: 2/3/10 Page: 4 of 5

CHECK MEMBERS OF DISPLAY ⇒ 1¼"Ø ALUM. PIPE (⅛ WALL) w/ 1"Ø INSERT AT CONN.

CASE 1: SUPPORT CABLE ATTACHED TO TOP OF DISPLAY

WEIGHT TO CONNECTION = 17.75#

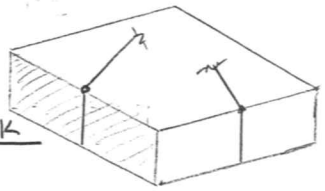
MOMENT IN MEMBERS: $M_x = 17.75/16 = 1.11 pf \times 16/2 \times \frac{16}{4} = 35.52'\text{-}lb/2 = 17.75'\text{-}lb$ PER MEMBER

"S." OF 1"Ø INSERT AT CONN.

$M_y = 17.75 \times 16/4 = 71'\text{-}lb$

$M_T = (71 + 17.75) = 88.75'\text{-}lb$

$M_c = 24000 \times 0.098175\left(\frac{14 - 0.754}{1}\right) = 1611/12 = 134'\text{-}lb > 89$ OK



CHECK ¼" SPRING PIN + 3/16" RIVET

$V = 17.75^{\#}$

¼" PIN → $V_c = 370^{\#} > 17.75^{\#}$ OK

3/16" RIVET → $V_c = 170^{\#} > 17.75^{\#}$ OK

MEMBERS OK TO SUPPORT DISPLAYS

CASE 2: SUPPORT CABLE ATTACHED TO MIDDLE OF VERTICAL MEMBER

$M = 17.75^{\#} \times \left(\frac{60}{12}\right)/4 = 22.19'\text{-}lb$

$M_c = 134'\text{-}lb$ OK

MEMBERS OK TO SUPPORT DISPLAYS

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