łukʷałHELIOS SUN PAVILION

A Sculpture for Burien Town Center

Owner's Manual

James M Harrison - Artist
Dedicated June 13, 2009


łukʷał
HELIOS SUN PAVILION


BERINGIA
E
TAHOMA
łukʷał
HELIOS SUN PAVILION
THIS SCULPTURE IS DEDICATED TO THE INDOMITABLE AND GENEROUS SPIRIT OF THE DUWAMISH PEOPLE, THE INDIGENOUS PEOPLE OF THIS REGION, AND IS MEANT FOR THE ENJOYMENT OF ALL.
JAMES MALBON HARRISON - ARTIST
DEDICATED JUNE 13, 2009

Site Model- Burien Town Center
(showing proposed plaza location for sculpture)

The initial brief from the city asked for a sculpture that was:

- welcoming and safe
- reflective of it's environment
- built at an appropriate scale
- intellectually stimulating.

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James M Harrison Art & Design Studio LLC

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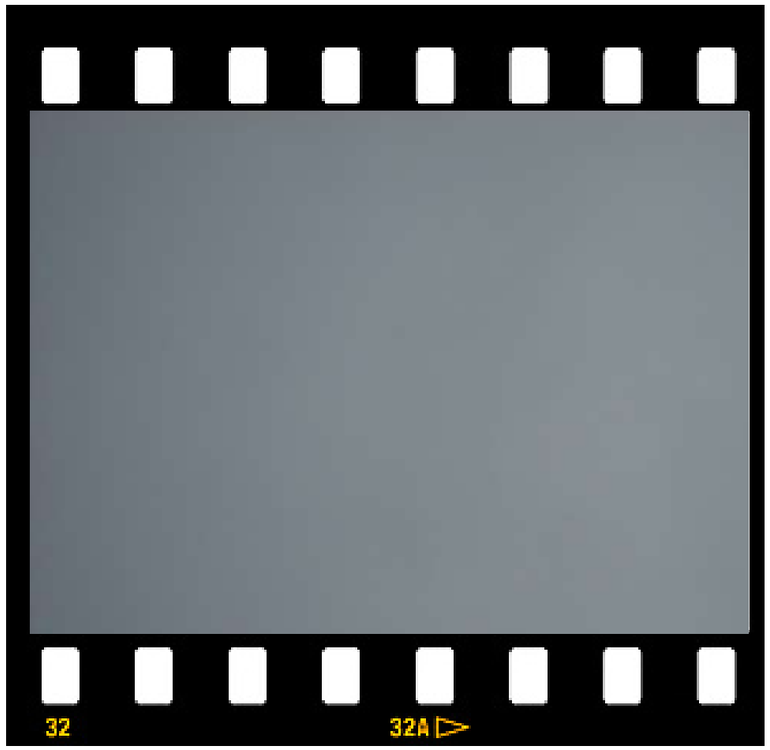
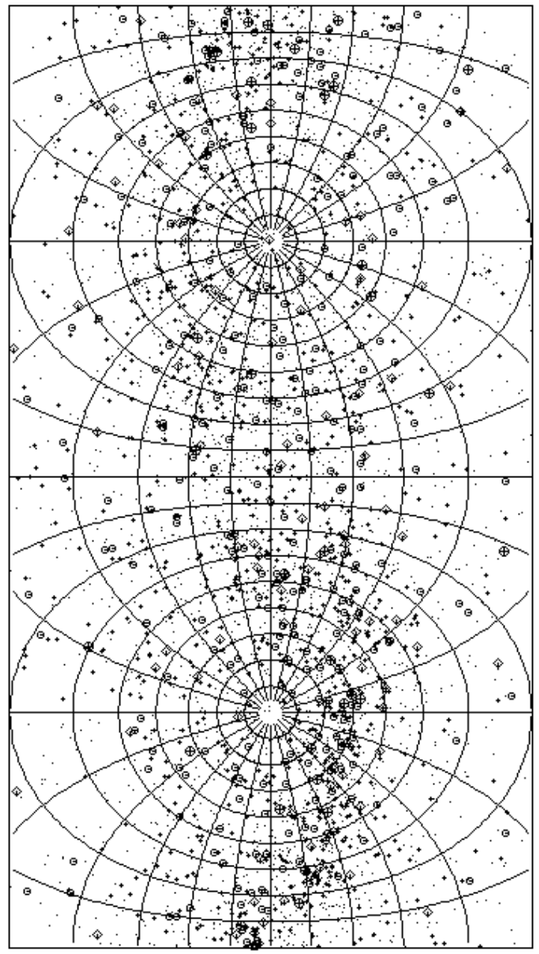
The Classic NW Grey Sky
+/- 35 months out of the year



How to hold color against a grey sky?

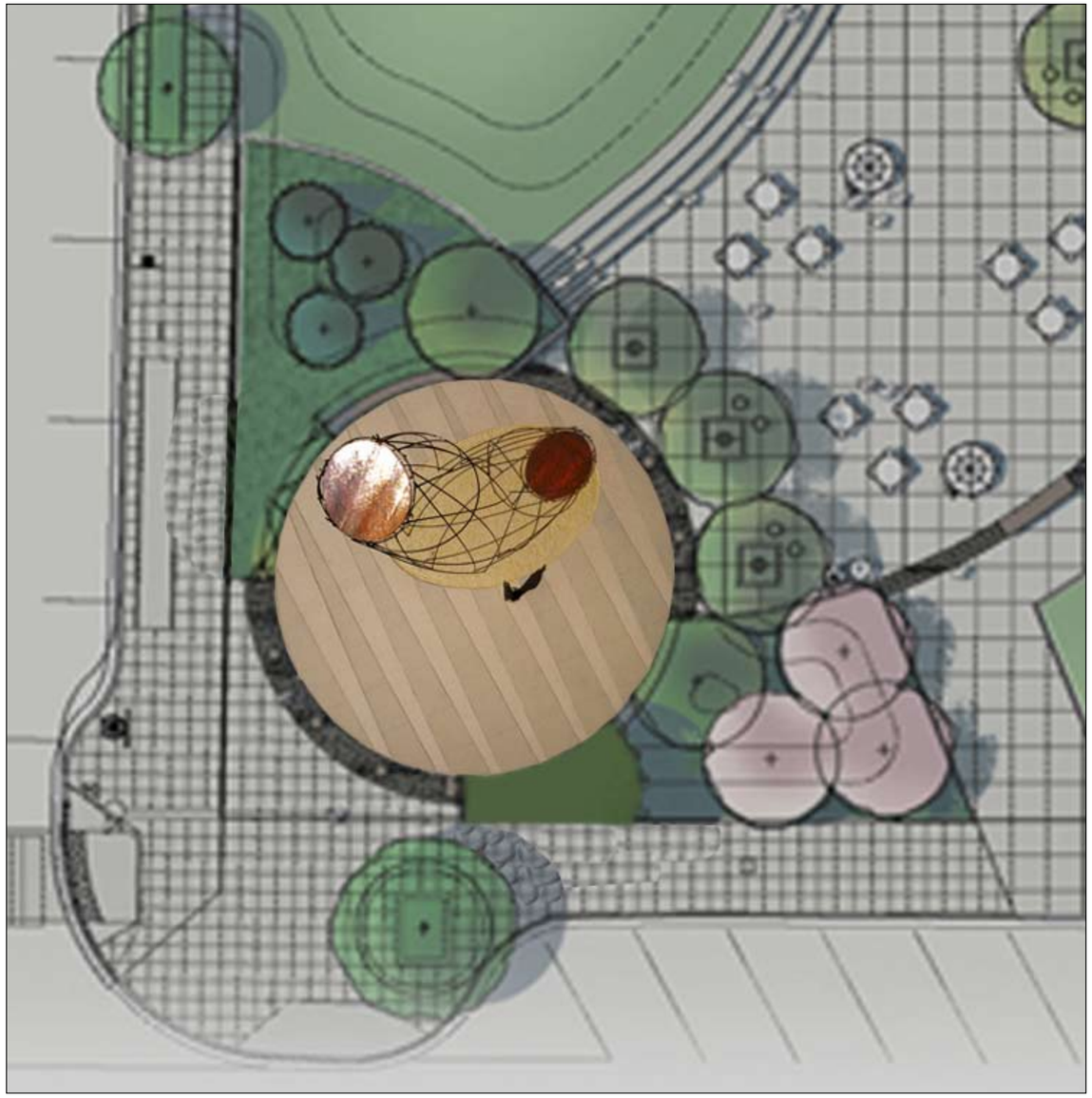


Conceptual Design

Star Charts + basket weaving + color for a grey sky

= the Sun Pavilion

First model



Plan view of first model showing integration into plaza

Final model


FIG. 1


FIG. 2


FIG. 3

Fabrication

Figure 1-Top ring of sculpture being fitted with mullions for glass
Fig 2- Templates for art glass.
Fig 3- My son Chris, age 6, shown with laminated art glass.

FIG. 4

Figure 4- Formwork for steel erection being assembled on top of footing. Note middle and bottom ring in position.

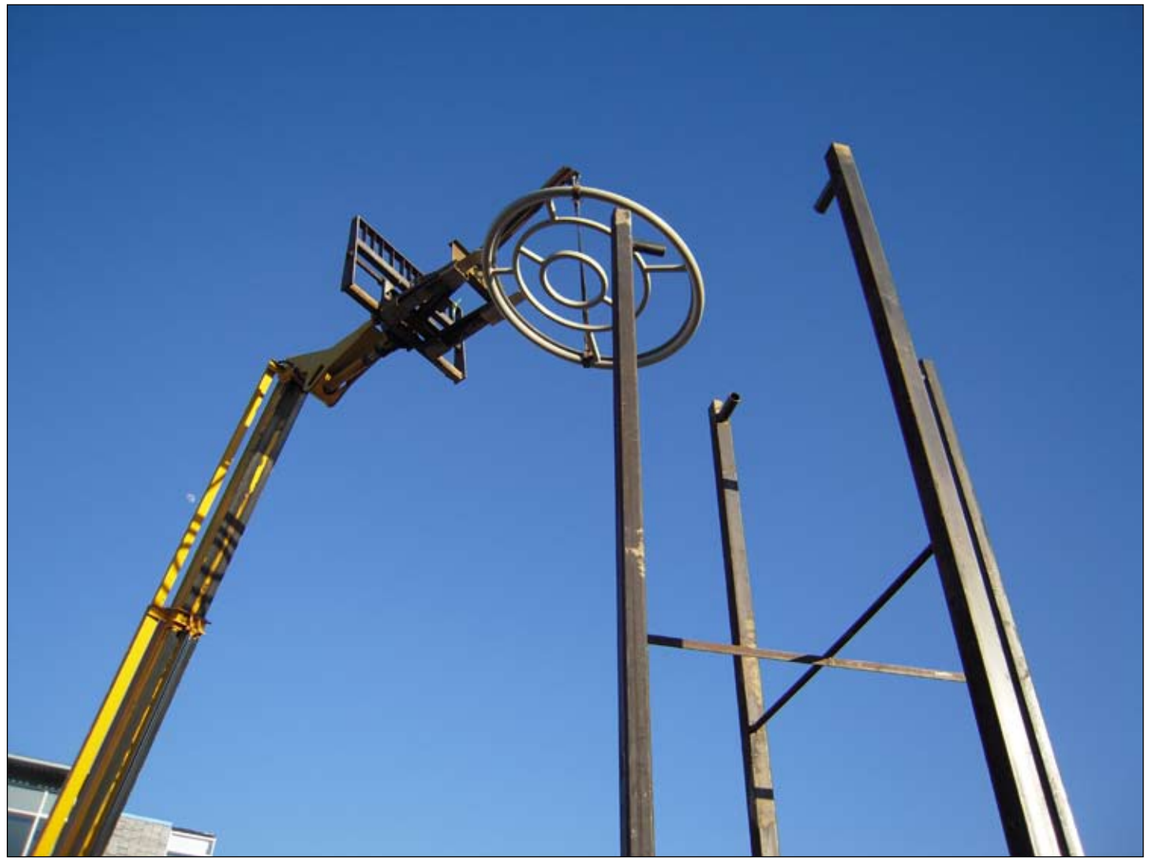


FIG. 5

Figure 5- Placement of top ring

Installation

FIG. 6

Figure 6 - The top, middle, and bottom ring are shown in position, as well as the first 3 of 16 ‘vertical’ pipes.

FIG. 7

Figure 7 - The base of each vertical pipe is welded onto a steel plate embedded into the footing.


FIG. 8


FIG. 9

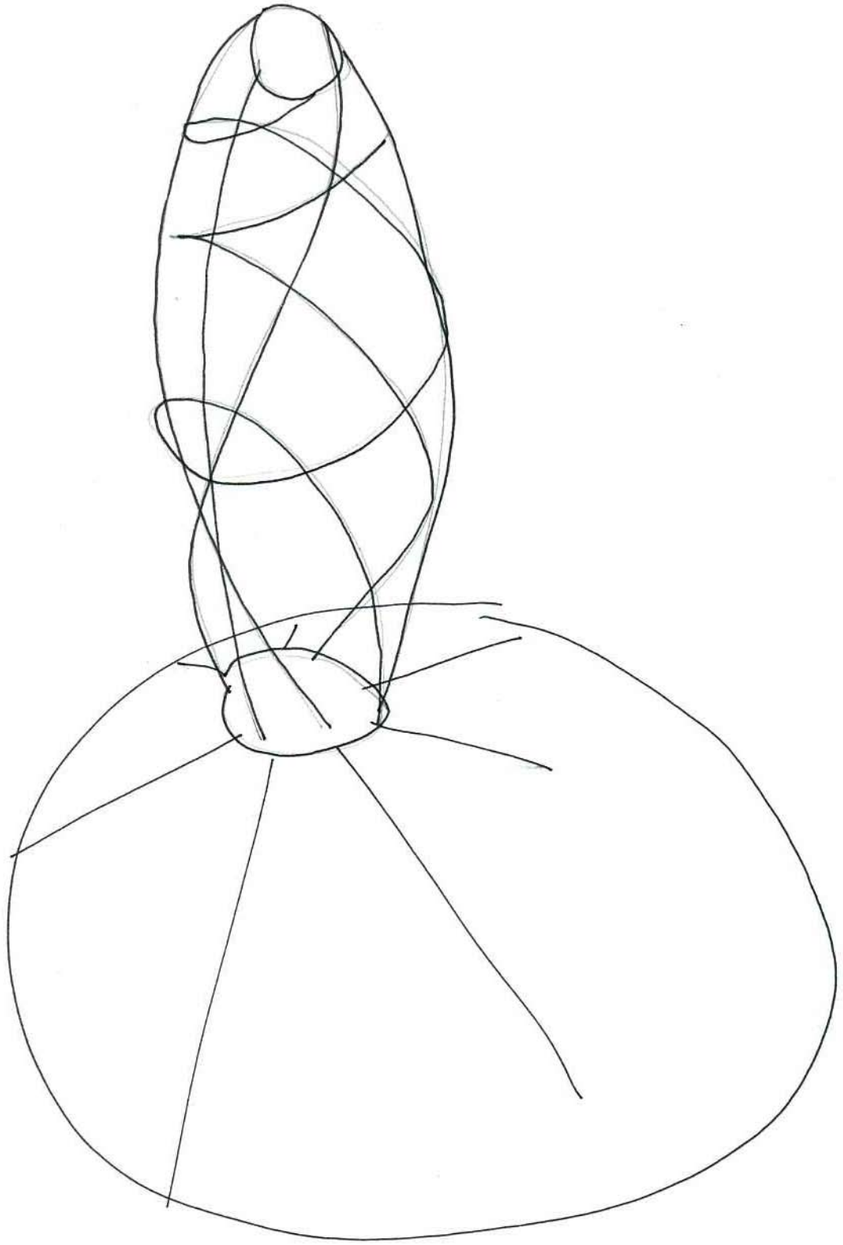

FIG. 10

Figure 8- Internal view of completed sculpture, prior to removal of form work.
Figure 9- The steel erectors, from Commercial Welding and Fabrication:
L to R: Sean, Randy, Dave
Figure 10- A view of the base, filled in with gravel. Note in ground light fixture in lower left

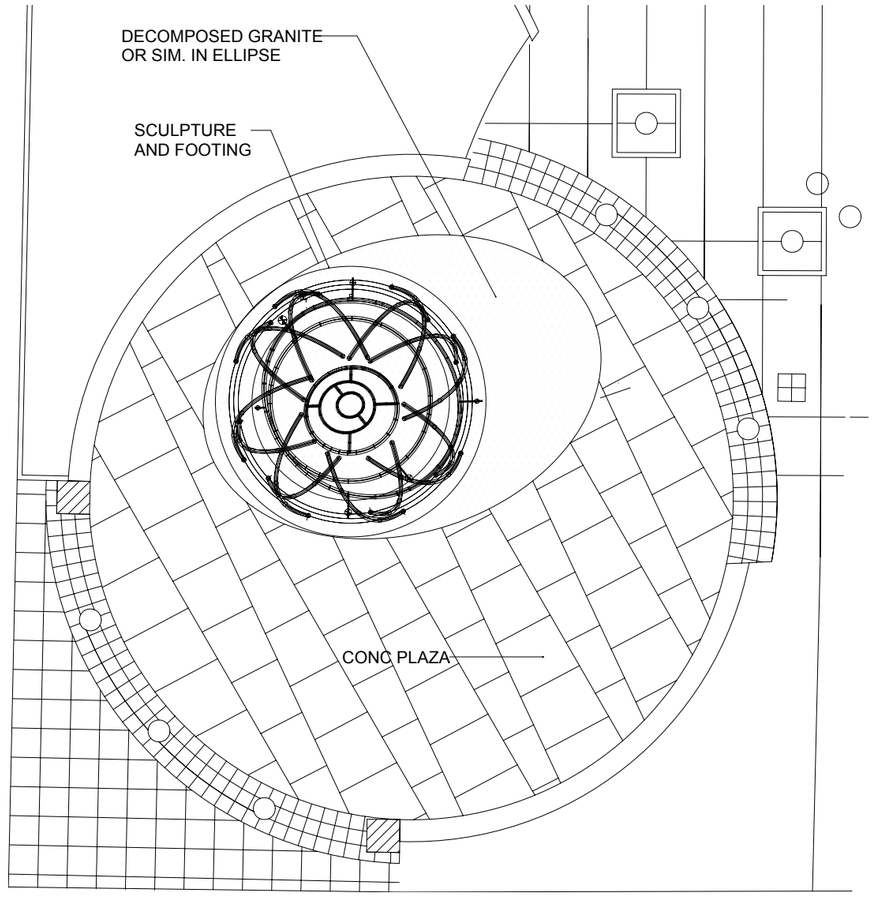

photo credit Steven Lenhart.

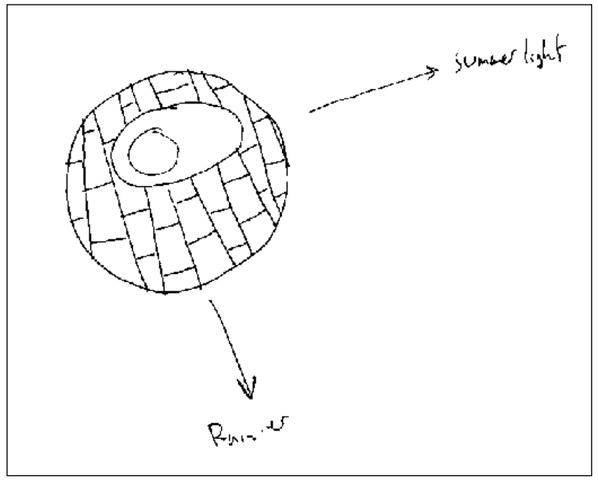
FIG. 11

Figure 11- Installation of laminated art glass. Note sculpture has final coat of paint at this point.

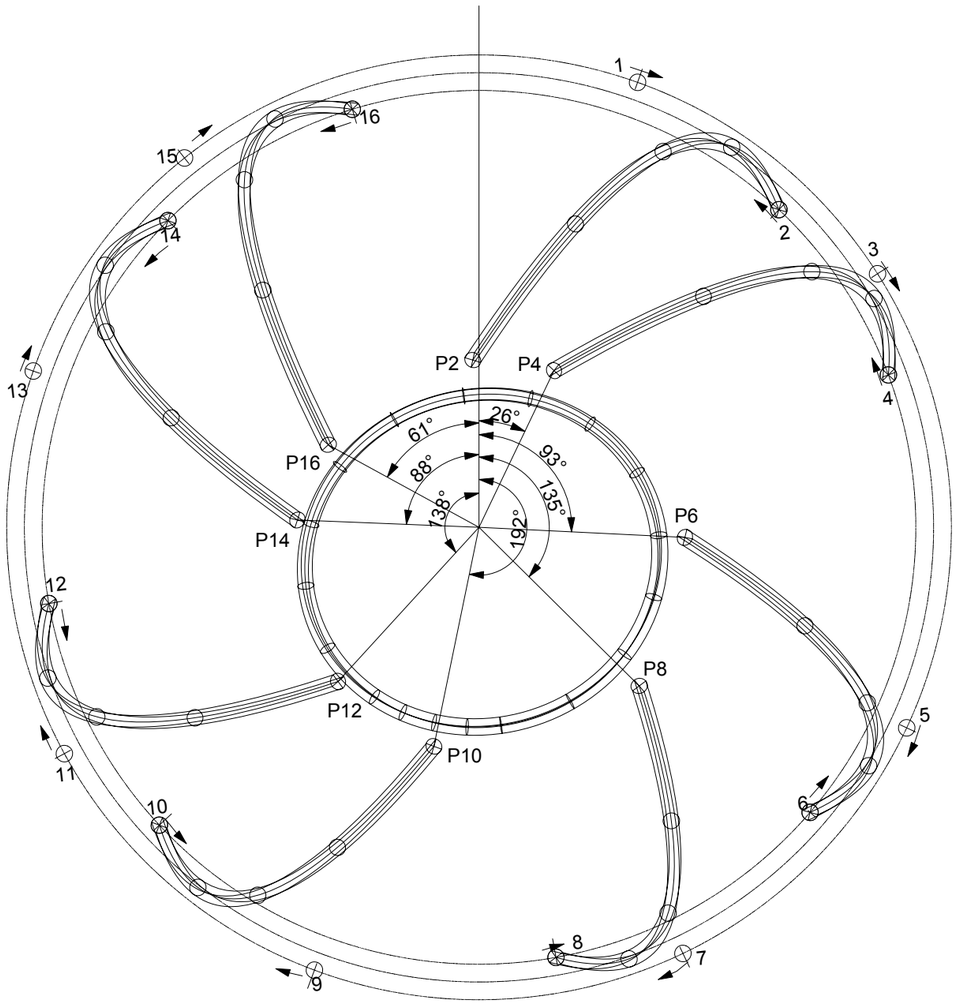


DRAWINGS

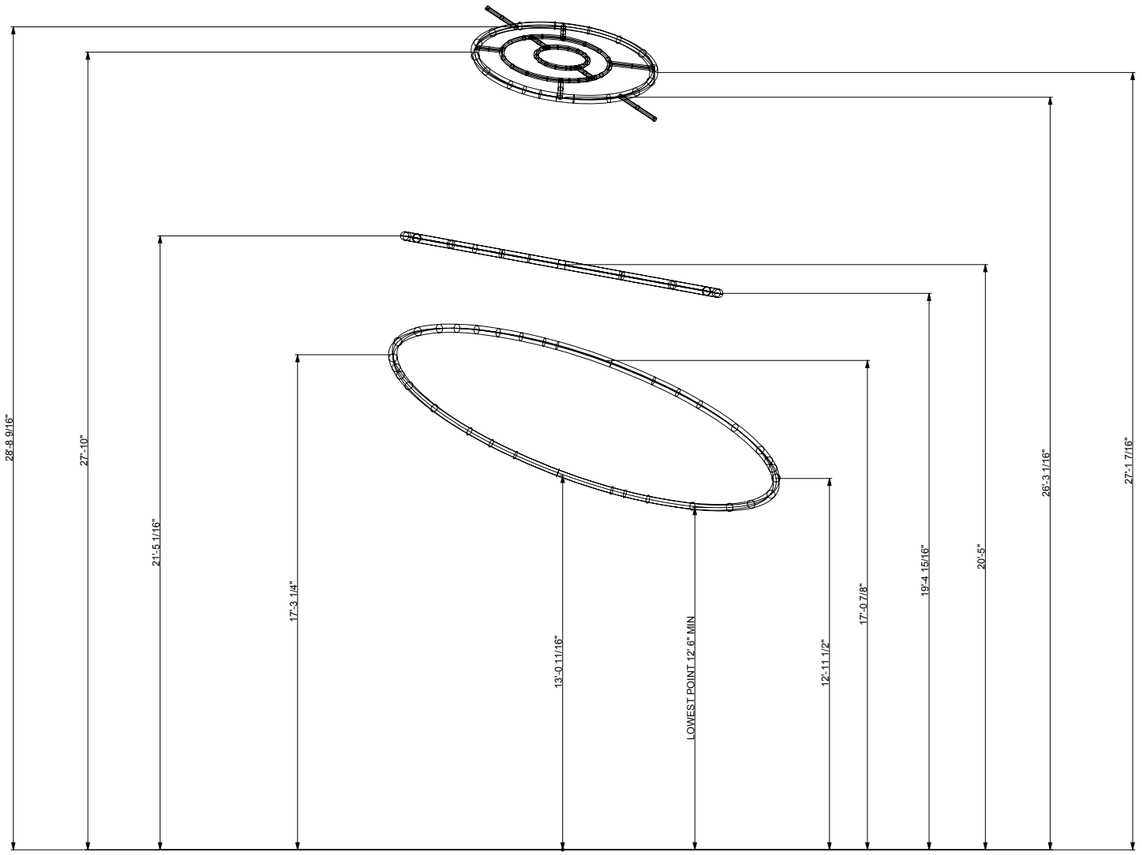




Plan view of plaza shown above, initial sketch concept shown below



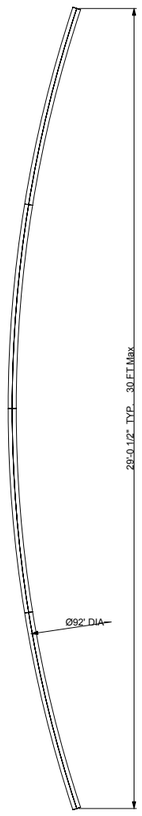
AZIMUTH ANGLES SHOWING WHERE INNER ROW OF VERTICAL PIPES MEETS TOP RING



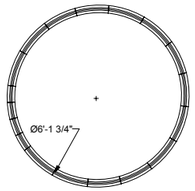
RING ELEVATIONS - APPROXIMATE (+/- 1 ft)

Plan view showing top and bottom location for inner row of ‘vertical’ pipes.
Outer row of ‘vertical’ pipes not show for clarity.

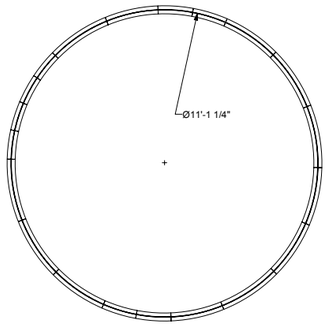
Elevations at each ring cardinal point



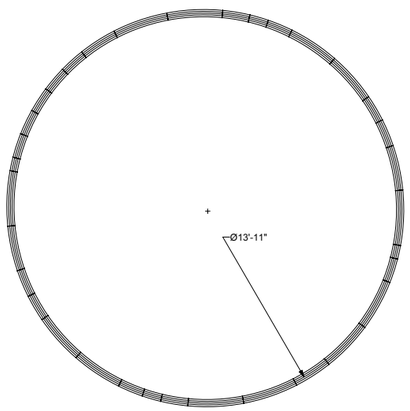
16 VERTICALS @ 92' DIA



TOP RING @ 6' DIA



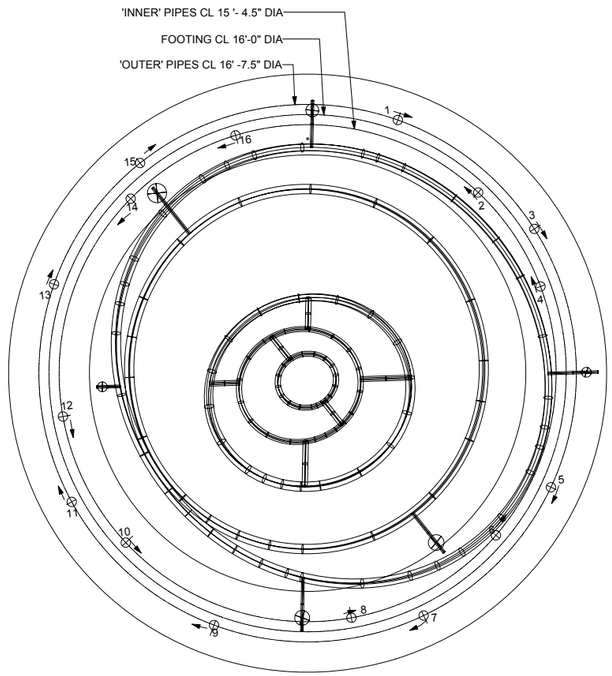
MIDDLE RING @ 11' DIA



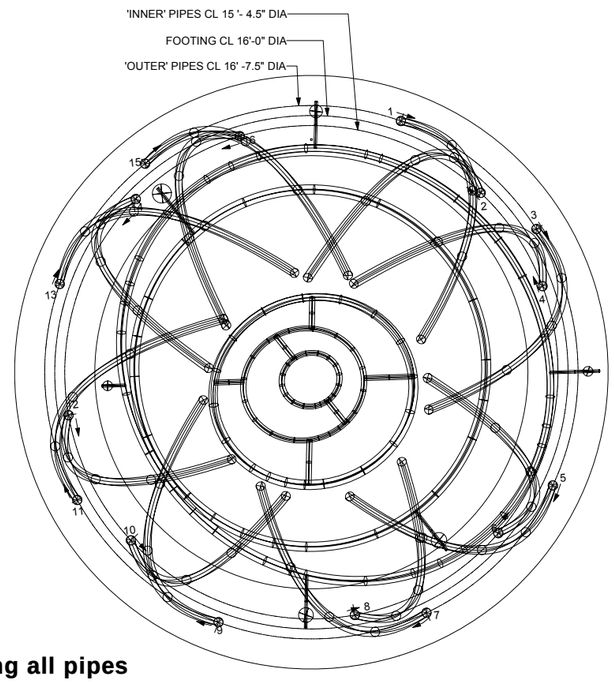
LOWER RING @ 13'-10" DIA

BURIEN SCULPTURE- FINAL STEEL RADII ALL PIPE 3" (3.5 O.D.) SCHEDULE 80 XTRA STRONG	JAMES M HARRISON ART & DESIGN STUDIO 503 997 2834 jamesmharrison@hotmail.com Jan 14, 2009

Pipe rolling diameters

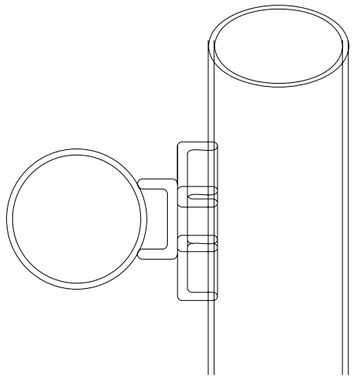


Plan showing footing and 3 ‘horizontal’ pipes

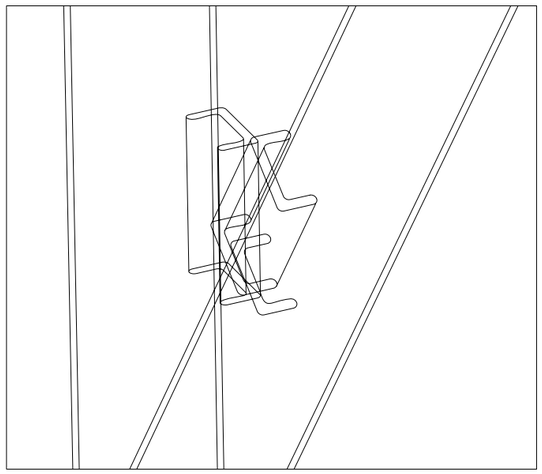


Plan showing all pipes

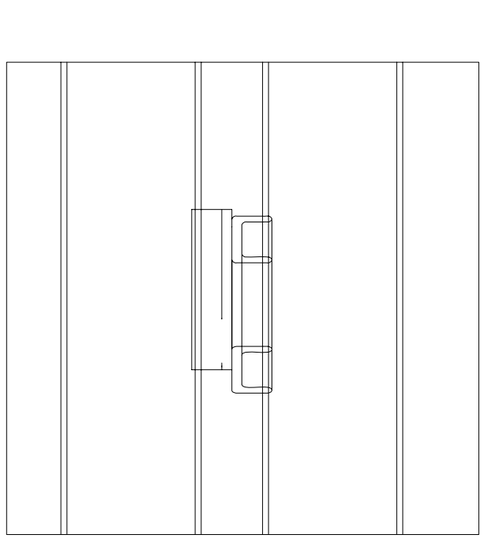
3" SCHED 80 PIPE (3.5" O.D.)
W/ CHANNEL OR BENT PLATE
AT CROSSING AS SHOWN.
WELDED.



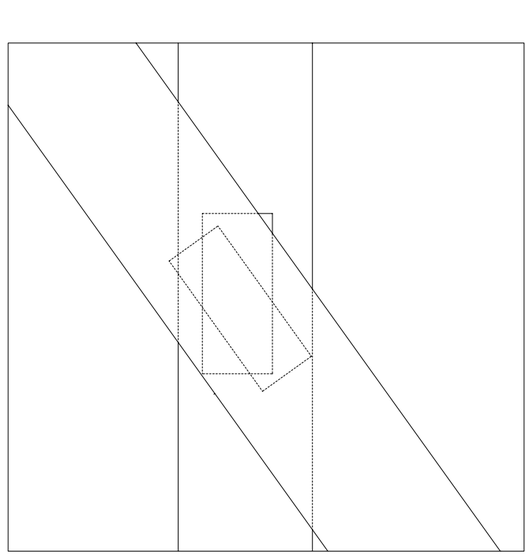
PLAN



PERSPECTIVE



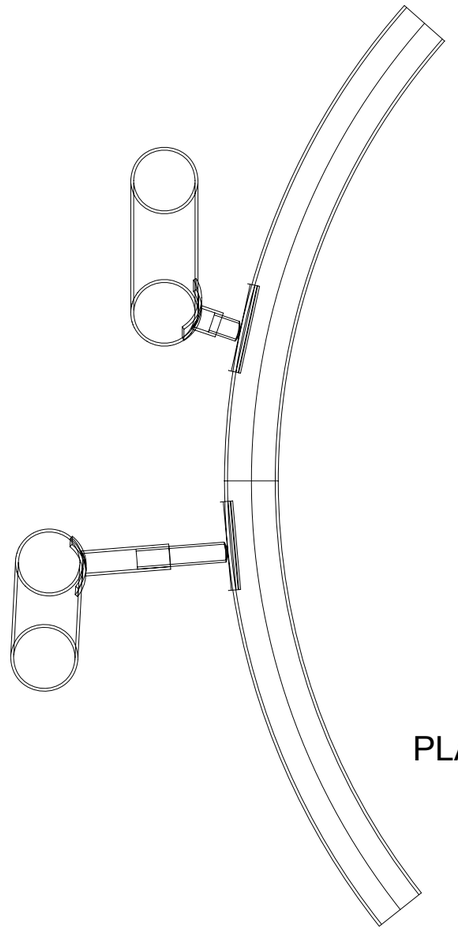
FRONT



RIGHT

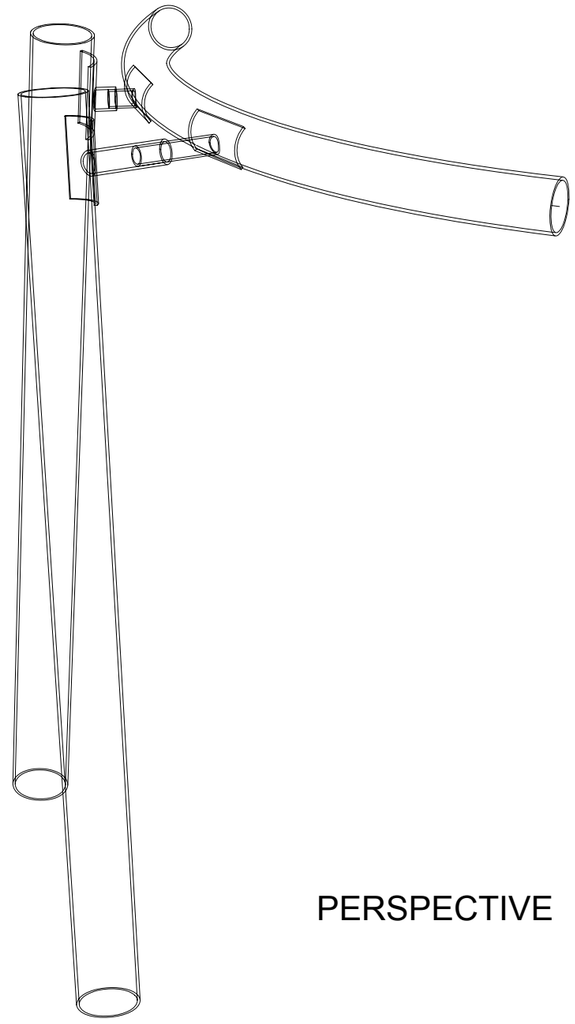
PIPE TO PIPE CONNECTION DETAIL- TYPICAL N.T.S.

BURIEN SCULPTURE JAMES M HARRISON ART & DESIGN
503 997 2834 DEC 10, 2008



PLAN

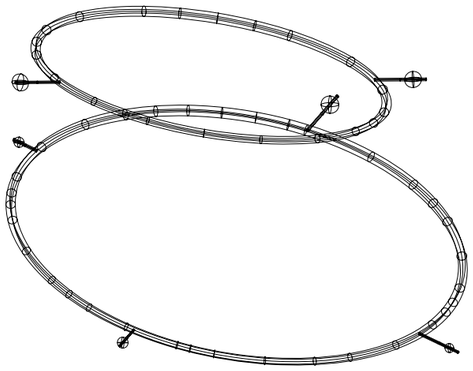
QUARTER ROUND PIPE PLATE W/
TELESCOPING PIPE STUB FOR FIELD
ADJUSTABILITY. WELDED.

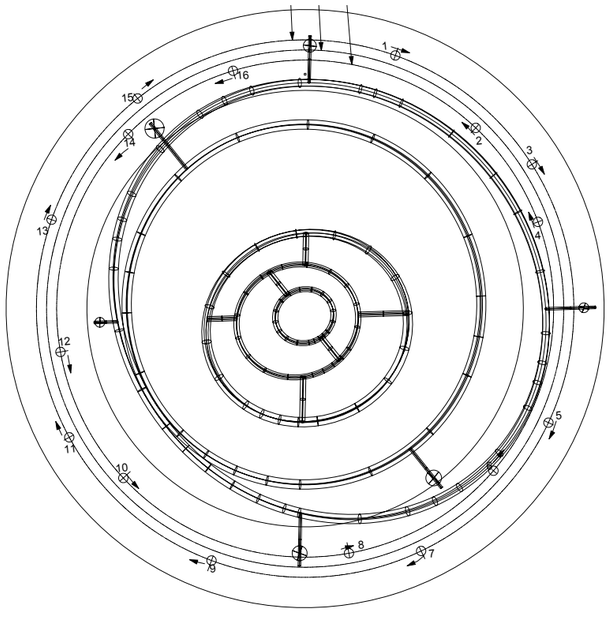


PERSPECTIVE

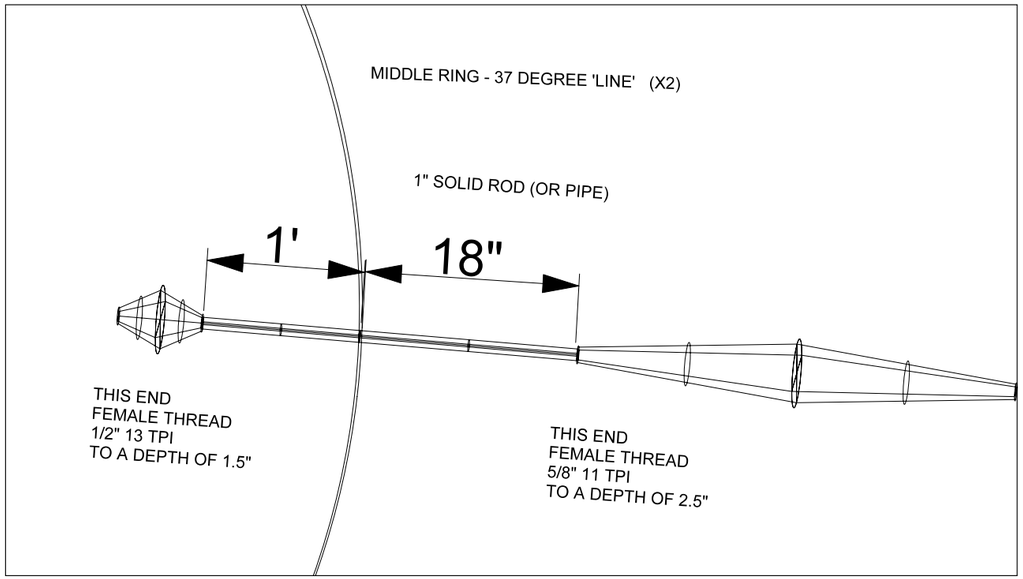
PIPE TO RING CONNECTION DETAIL- TYPICAL N.T.S.

BURIEN SCULPTURE JAMES M HARRISON ART & DESIGN
503 997 2834 DEC 10, 2008

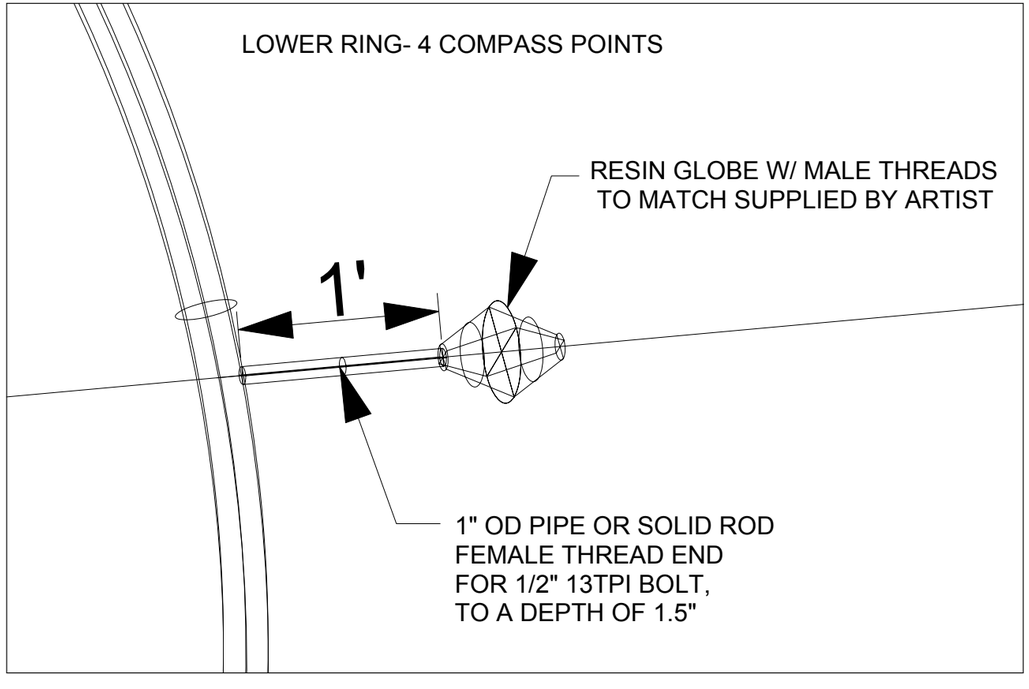




Locations of cast resin on middle and lower pipes

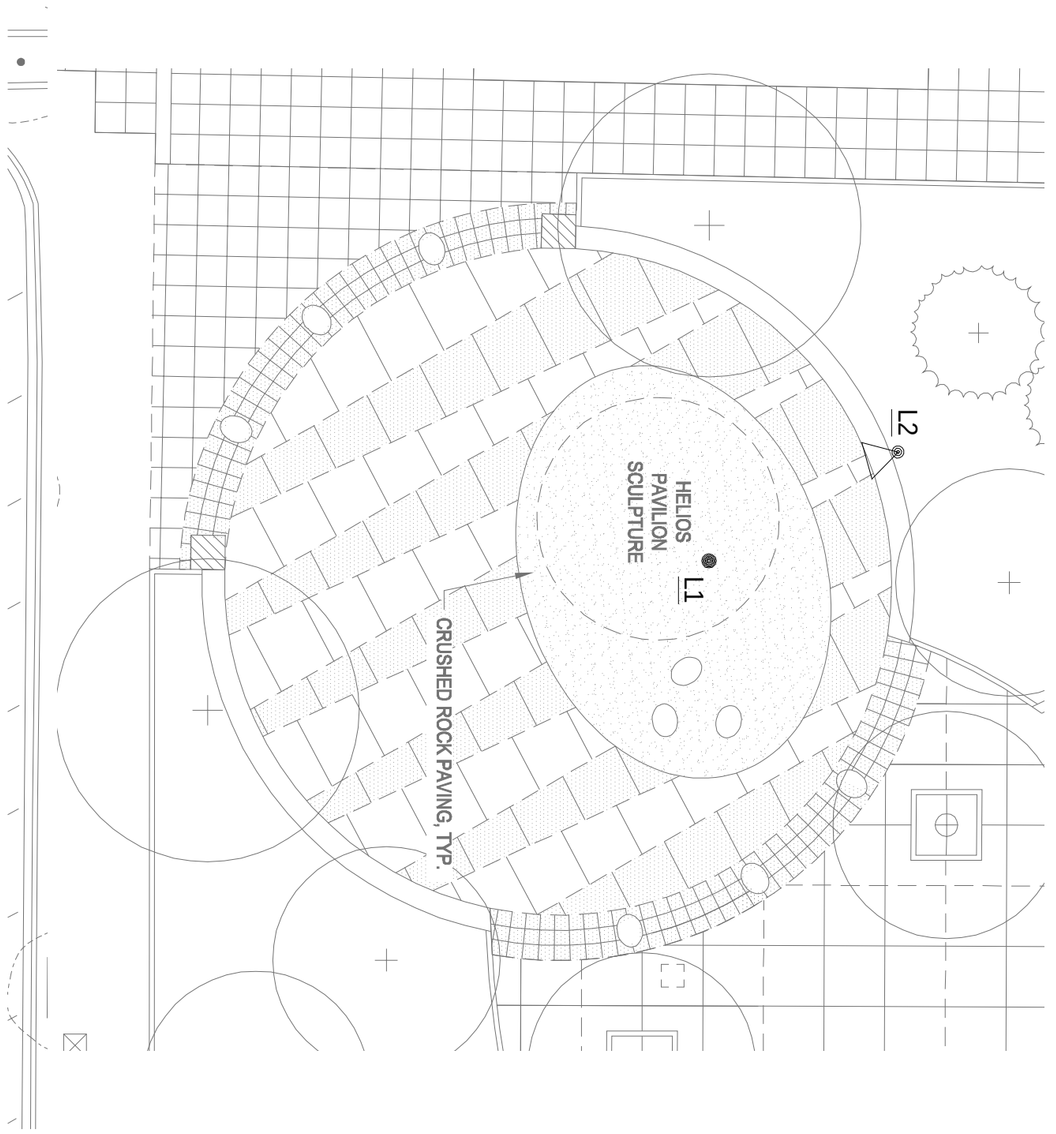


Middle Ring



Lower Ring

Lighting Plan



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DRAWING ISSUES:
11-24-2008

SHEET TITLE:
REVISIONS TO ENTRY PLAZA - LIGHTING

PROJECT:
BURIEN TOWN SQUARE PARK

PROJECT NO:
2003092.82

SCALE:
1"=10'-0"

SHEET NO:
EL-01-1

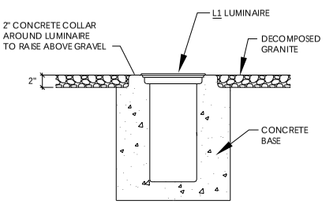
LUMINAIRE SCHEDULE

● L1 HID ADJUSTABLE IN-GRADE UPLIGHT
(79 input watts approx.)

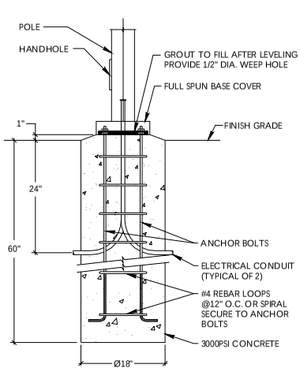
1. SIZE: 10.3 INCH DIAMETER TRIM WITH 7 INCH APERTURE X 17.3 INCH DEEP COLLAR HOUSING.
2. LAMPS: METAL HALIDE, ONE 70W CDM T6, 3000K.
3. BALLASTS: (VOLTAGE AS REQUIRED), ELECTRONIC, INTEGRAL.
4. MOUNTING: IN CONCRETE BASE, SEE DETAIL 1/EL-01-0. PROVIDE WITH HOUSING KIT FOR CONCRETE INSTALLATION.
5. LENS: FLAT CLEAR NON-SLIP GLASS, HUMAN TOUCH.
6. FINISH: AS SELECTED BY ARCHITECT.
7. DISTRIBUTION: NARROW, 10 DEGREES.
8. MANUFACTURER: LUMASCAPE LS343 SERIES, HYDREL OR APPROVED.

L2 HID OUTDOOR POLE MAST LIGHT
(158 input watts approx.)

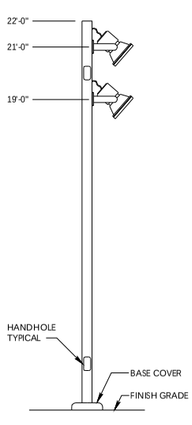
1. SIZE: 11 INCH DIAMETER X 14 INCH HEIGHT HEAD.
2. LAMPS: METAL HALIDE, TWO 70W CDM T6, 3000K.
3. MOUNTING: YOKE AND POLE HUB MOUNT, SEE DETAILS 3/EL-01-0 AND 4/EL-01-0.
4. BALLASTS: (VOLTAGE AS REQUIRED), (2) ELECTRONIC.
5. LENS: HORIZONTAL LINEAR SPREAD LENS.
6. FINISH: AS SELECTED BY ARCHITECT.
7. DISTRIBUTION: NARROW, 8 DEGREES.
8. POLE: 22 FOOT HEIGHT WITH 4 INCH DIAMETER ROUND NON-TAPERED ALUMINUM POLE.
9. POLE BASE: FLUSH, STEEL REINFORCED CONCRETE AS REQUIRED. FULL BASE COVER. SEE DETAIL 2/EL-01-0.
10. MANUFACTURER: BEGA 7869 MH SERIES OR APPROVED.



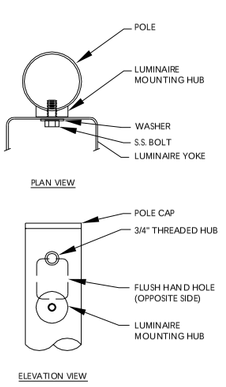
1 EL-01-0 TYPE 'L1' MOUNTING DETAIL
SCALE: N.T.S.



2 EL-01-0 TYPE 'L2' POLE BASE DETAIL
SCALE: N.T.S.



3 EL-01-0 TYPE 'L2' ORIENTATION DETAIL
SCALE: N.T.S.



4 EL-01-0 TYPE 'L2' MOUNTING DETAIL
SCALE: N.T.S.

architecture | interior design | landscape architecture | planning & urban design

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DRAWING ISSUES:
11-24-2008

SHEET TITLE:
REVISIONS TO ENTRY PLAZA
LUMINAIRE SCHEDULE AND DETAILS

PROJECT:
BURIEN TOWN SQUARE PARK

PROJECT NO:
2003092.82

SCALE:
N.T.S.

SHEET NO:
EL-01-0

February 6, 2009

Mr. James M. Harrison
James M Harrison Art and Design
3155 NE 73rd Avenue
Portland, OR 97213

Project: 'Burien' Sculpture – Burien, WA

Project #: 2008073.00

James:

The attached calculations, pages 1 through 33, dated February 6, 2009 verify the structural adequacy of the town square art structure located in Burien, WA. The project has been designed in accordance with the 2007 Washington State Building Code.

Respectfully,

catena consulting engineers

JOHN S. McDONALD STATE OF WASHINGTON 22324 REGISTERED PROFESSIONAL ENGINEER 2009.02.06

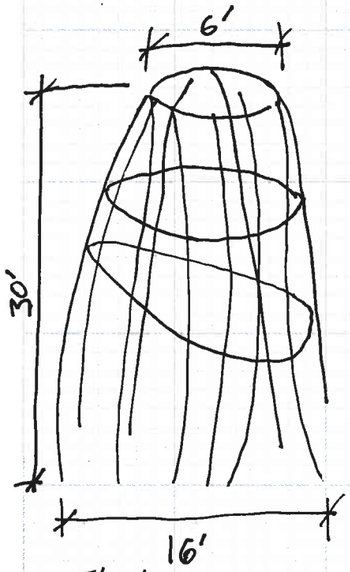
John S. McDonald, S.E.
Principal

Avery Morris
Engineer

catena consulting engineers

Project: Burien Sculpture | No: 2008073.00 | Page: 1
Subject: | By: AAM | Date: 2/6/09

Basis of Design



- 16 Vertical Pipes
- 3 Horizontal Rings
- Horizontal Mullions supporting glass @ Top Ring

- All Vert. pipes + horizontal rings are Pipe 3 x-strong.
- All mullions are HSS 2x2x¼.
- Welded connections

Elevation

- Wind load: $p = 19.8$ psf (ASCE 7-05)
- Earthquake: $S_{DS} = 0.977g$ $S_{D1} = 0.503g$ Site Class D
- Snow: 25psf

catena consulting engineers

Project:	No:	Page:
Burien	2008075.00	2
Subject:	By: AAM	Date: 11/7/08

- Create Model to determine effects of ice and wind on structure.

- Assume 4"ϕ members. - All connections fixed. except @ base ϕ - pinned.

- Determine ice loads due to freezing rain (ASCE 7-05 10.4)
  → nominal ice thickness, $t = 1.25"$

$t_d = 2.0 \cdot t \cdot f_z \cdot (K_{zt})^{0.35}$ (design ice thickness)

$f_z = 1.0 \quad K_{zt} = 1.0$

$t_d = 2.0 \cdot 1.25" = 2.5"$

$A_{ice} = \pi \cdot t_d (D + t_d) = \pi \cdot 2.5"(4" + 2.5") = 51.1 in^2 = 0.355 ft^2$

$\rho = 56 pcf$

$W_{ice} = 56 pcf \cdot 0.355 ft^2 = \underline{19.9 plf}$

- Determine wind load on structure. (Ch. 6)

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

$K_z = 0.70 \quad K_{zt} = 1.0 \quad K_d = 0.85 \quad V = 94.5 \quad I = 1.0$

$q_z = 0.00256 \cdot 1.1 \cdot 0.85 \cdot 94.5^2 \cdot 1 = 19.4 psf$

$\varepsilon < 0.1 \quad D = 4" + 2.5" = 6.5" \quad 6.5\sqrt{19.4} = 7.39 \rightarrow C_f = 1.2$

$p = q_z \cdot G \cdot C_f = 19.4 \cdot .85 \cdot 1.2 \cdot \frac{6.5"}{12"} = 10.7 plf$

• Base shear = $10.7 plf \cdot 30' \cdot (16+3) = 9.76^k$ > EQ base shear ∴ governs.

catena consulting engineers

Project Number:	**2008073.00**	**Page/of:**	
Project:	**Burien Sculpture**	**By:**	**AAM**
Subject:	**Base Shear**	**Date:**	

2006 IBC Equivalent Lateral Force Procedure Base Shear & Vertical Force Distribution
Per ASCE 7-05

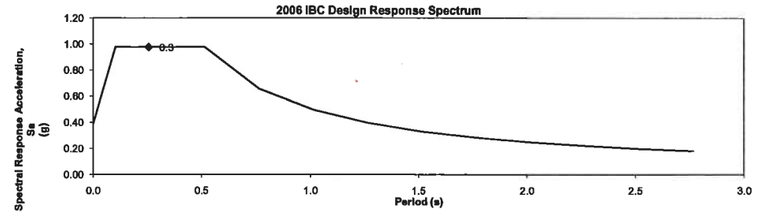
Occupancy Category = II. Other Structures → Seismic Importance Factor, I_E = 1
(Table 1604.5) Seismic Use Group = I
Site Class = D → Stiff soil profile = D
(Table 1613.5.2)
from ICC provided CD: S_s = 146.5 g% → Site Coefficient for S_s, F_a = 1.00
(MCE Spectral Response Acceleration @ 0.2-second Period) Site Coefficient for S_1, F_v = 1.50
from ICC provided CD: S_1 = 50.3 g% Modified Short Period Acceleration, $S_{MS} = F_a * S_s$ = 1.465
(MCE Spectral Response Acceleration @ 1.0-second Period) Modified 1 sec. Period Acceleration, $S_{M1} = F_v * S_1$ = 0.755
$2/3 * S_{MS} = S_{DS}$ = 0.977 g
Seismic Design Category per S_{DS} = D
$2/3 * S_{M1} = S_{D1}$ = 0.503 g
Seismic Design Category per S_{D1} = D
Seismic Design Category per S_{DS} & S_{D1} = D
(ASCE Table 12.8-1) Coefficient, C_U = 1.40

Basic Resisting System = Structural Steel Systems Not Detailed for Seismic → Response Modification Coefficient = 3 ..... R
System Overstrength Factor = 3 ..... Ωo
Lateral Resisting Elements = Structural Steel Systems Not Specifically Detailed for Seismic Resistance Deflection Amplification Factor = 3 ..... Cd
(ASCE Table 12.2-1) Numerical Coefficient, C_T = 0.02
Numerical Coefficient, x = 0.75
Structure Height, h_n (ft) = 30 Period per Substantiated Analysis, T = Second(s)
Structure Height Limit (ft) = 0 Approximate Fundamental Period, Ta = 0.26 Second(s)
Period Upper Limit, T_{max} ≤ 0.36 Second(s)
Design Period, T = 0.26 Second(s)

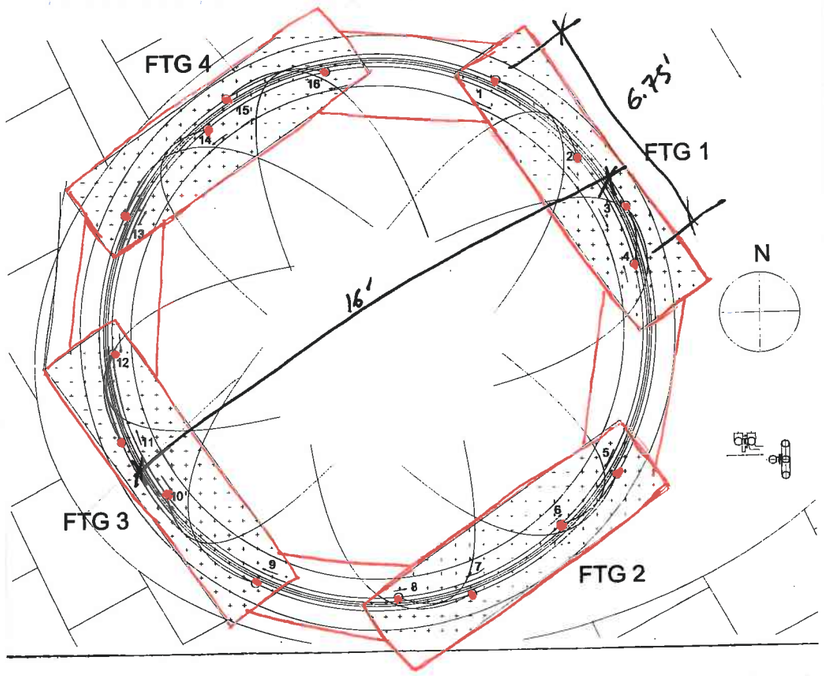
ASCE Formula (12.8-2) = $S_{DS} / (R/I) W$ = 0.326 W
... but not greater than:
ASCE Formula (12.8-3) = $S_{D1} / T / (R/I) W$ = 0.654 W
... and not less than:
ASCE Formula (12.8-5 and -6) = *0.01 W (or 0.5 S_1 / (R / I) W where S1 > 0.6g)* = 0.010 W

The Base Shear Coeff. : (12.8-2) need not exceed (12.8-3) and shall not be less than (12.8-5) → *DESIGN BASE SHEAR* = 0.326 W (E_h)
... using allowable stress design:
ASCE Section 2.4.1 → *TOTAL DESIGN BASE SHEAR* = 0.228 W (0.7 E_h)
IBC Section 1605.3.2 → *TOTAL DESIGN BASE SHEAR* = 0.233 W (E_h / 1.4)

Structure Weight, W (kips) = 6 → *DESIGN BASE SHEAR* = 2.0 kips



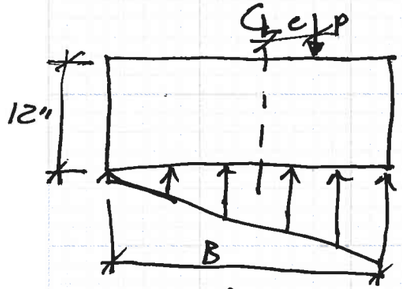
- Design strip footing.



- Use 18" Min. width.
- Use 12" Min thickness.
- Frost Line depth for Burien, WA: 12".

- Design footing for worst case loads.
  - From SAP Output,
    - Max. downward force = 7.779k LC 5: 1.2DL - 1.6 Wind Y
      DL = 0.748k ∴ unfactored force = $\frac{7.779^k - 1.2 \cdot 0.748^k}{1.6} + 0.748^k = 5.049^k$
    - Max. uplift force = 6.209k LC 7: 0.9DL + 1.6 Wind Y
      DL = 0.748k ∴ unfactored force = $\frac{6.29^k - 0.9 \cdot 0.748^k}{1.6} + 0.9 \cdot 0.748^k = 4.184^k$
    - Max lateral force = $\sqrt{1.416^2 + 1.584^k} = 2.125^k$
      LC 4/5: 1.2DL + 1.6 Wind DL = $\sqrt{0.111^2 + 0.124^2} = 0.166^k$
      unfactored force = $\frac{2.125^k - 1.2 \cdot 0.166^k}{1.6} + 0.166^k = 1.370^k$

- Strip Footing Design cont...
  - Assume min. length of I Segment (w/ 4 pt. loads) is 8'
  - Assume 4" max eccentricity.
- Consider downward loads



- Determine min. width reqd. to limit qmax to 1500psf.

$$q_{max} = \frac{P}{BL} + \frac{6M}{B^2 L}$$ ↑ take 1/3 increase for wind combo.

$P = 4.5.049^k = 20.20^k$ $L = 8'$

$M = P \cdot e = 20.2^k \cdot \frac{4"}{12"} = 6.733^{k\text{-ft}}$

$$q_{max} = \frac{20.2^k}{B \cdot 8'} + \frac{6 \cdot 6.733^{k\text{-ft}}}{B^2 \cdot 8'} = 1.5\,ksf \cdot 4/3$$

$B_{min} = 2.34' \rightarrow 28"$

$$q_{min} = \frac{20.2^k}{2.34' \cdot 8'} - \frac{6 \cdot 6.733^{k\text{-ft}}}{(2.34')^2 \cdot 8'} = 157\,psf$$

- Consider lateral sliding.
  - Use code min. 130psf resistance.

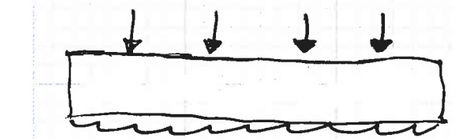
$130\,psf \cdot 8' \cdot 2.34' = 2.43^k > 1.37^k \cdot 1.5 = 2.06^k$ OK

- Check one-way shear.

$\phi V_c = \phi 2\sqrt{f_c'}\, b d = 0.75 \cdot 2 \cdot \sqrt{3000 psi} \cdot 28" \cdot 12" = 27.61^k$

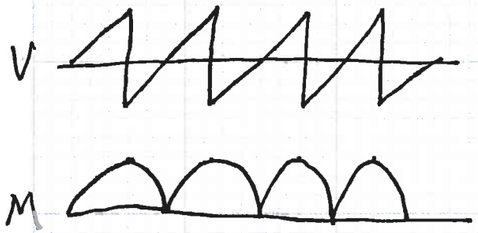
$27.61^k > 20.20^k$ ∴ Shear will not govern footing design.

- Design long bars.



$q_u = \frac{7.779^k}{2.34' \cdot 8'} = 416 psf$

$M_u = 416 \cdot 2.34 \cdot \frac{2^2}{2} = 1947^{\#\text{-ft}}$



$\frac{M_u}{\phi b d^2} = \frac{1947^{\#\text{-ft}}}{0.9 \cdot 234' \cdot (\frac{9"}{12'})^2} = 16.4$

→ Use $\rho_{min} = 0.0033$ (for flexure)

$A_s = 0.0033 \cdot 9" \cdot 28" = 0.8316 in^2$

→ Use (3) #5 ($A_s = 0.91 in^2$)

- Design short bars.

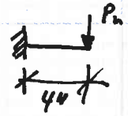
Use $\rho_{min} = 0.0018$ (for temp.)

$A_s = 0.0018 \cdot 18" \cdot 9" = 0.2916 in^2$

Use #5 @ 18" oc.

→ Design embed and base plates.

Assume PL ___ x 12 x 0'-12".



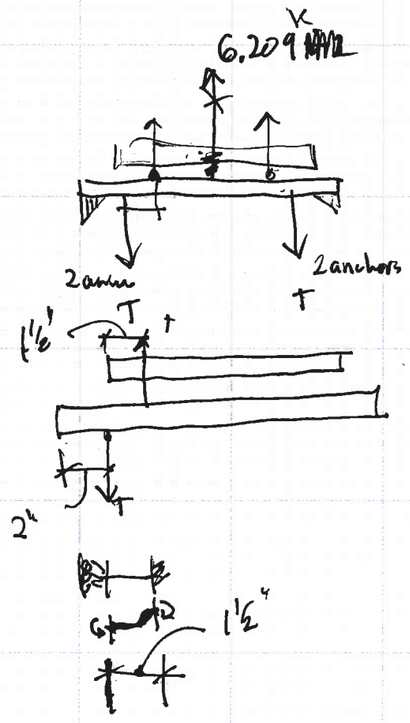
$P_u = 2 \cdot 6.209^k = 12.42^k$

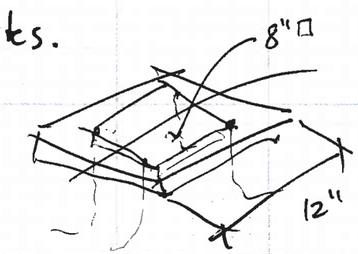
$M_u = 12.42^k \cdot 4" = 49.67^{k\text{-in}}$

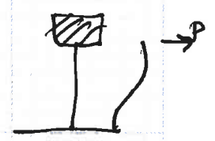
$Z_{reqd} = \frac{M_u}{\phi F_y} = \frac{49.67^{k\text{-in}}}{0.9 \cdot 36 ksi} = 1.533 in^3$

$t_{reqd} = \sqrt{\frac{4Z}{b}} = \sqrt{\frac{4 \cdot 1.533}{12"}} = 0.715" \rightarrow 3/4"$

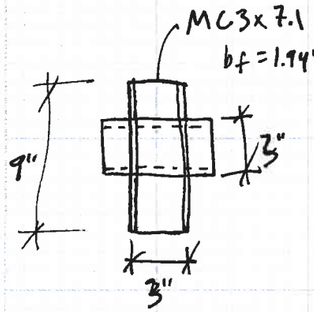
→ Use PL 3/4 x 12 x 0'-12" for embed and base plates.







- Design conn. of pipes to pipes. Pipes intersect at all different angles and orientations. Determine worst case loading and worst case connection orientation.



- Weld all around (4 sides)
- Worst case (least amt. of weld) shown to left.

- Max. Forces were found in SAP output. Direction of moments, shears, and torsion is varied. Consider multiple scenarios.

Worst-case loading: $M_1 = 7.6^{k\text{-}in}$ $M_2 = 19.3^{k\text{-}in}$ $M_3 = 2.64^{k\text{-}in}$

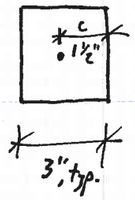
$V_1 = 0.19^k$ $V_2 = 0.14^k$ $V_3 = 0.05^k$

$$S_w = bd + \frac{d^2}{3} = 3" \cdot 3" + \frac{3"^2}{3} = 12 in^2$$

$$J_w = \frac{(b+d)^3}{6} = \frac{(3"+3")^3}{6} = 36 in^3$$

- Pipe conn design cont...

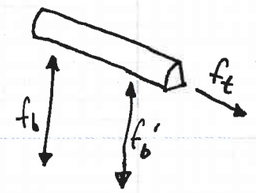
case 1 - assume M_1 is twisting.



M_1: $f_t = \frac{T \cdot c}{J_w} = \frac{7.6^{k\text{-}in} \cdot 1\frac{1}{2}"}{36 in^3} = 0.317^{k/in}$

M_2: $f_b = \frac{M_2}{S_w} = \frac{19.3^{k\text{-}in}}{12 in^2} = 1.61^{k/in}$

M_3: $f_b' = \frac{M_3}{S_w} = \frac{2.64^{k\text{-}in}}{12 in^2} = 0.22^{k/in}$



$$f_r = \sqrt{f_t^2 + (f_b + f_b')^2} = \sqrt{0.317^2 + (1.61 + 0.22)^2}$$

$$f_r = 1.86^{k/in}$$

- Neglect shears since so small.

$\phi F_r = \phi 0.6 \cdot 0.707 \cdot w \cdot F_{EXX} = 0.75 \cdot 0.6 \cdot 0.707 \cdot 5/16" \cdot 70^{ksi}$

$\phi F_r = 6.96^{k/in} > f_r$ OK

case 2 - Assume M_2 is twisting.

M_1: $f_b = \frac{M_1}{S_w} = \frac{7.6^{k\text{-}in}}{12 in^2} = 0.633^{k/in}$

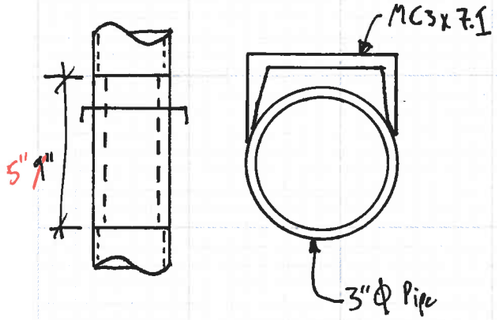
M_2: $f_t = \frac{T \cdot c}{J_w} = \frac{19.3^{k\text{-}in} \cdot 1\frac{1}{2}"}{36 in^3} = 0.804^{k/in}$

M_3: $f_b' = \frac{M_3}{S_w} = \frac{2.64^{k\text{-}in}}{12 in^2} = 0.22^{k/in}$

$f_r = \sqrt{0.804^2 + (0.633 + 0.22)^2} = 1.17^{k/in} < 6.96^{k/in}$ OK

* Use 5/16" fillet welds all around.

- Check weld connecting pipe to MC3.



$S_w = bd = 3" \cdot 9" = 27\ in^2$ (5" → 15")

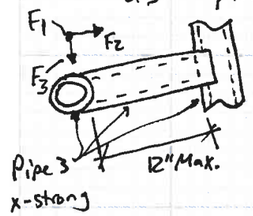
$S_w = \frac{d^2}{3} = \frac{9"^2}{3} = 27\ in^2$ (5" → 8.33)

$J_w = \frac{b^3 + 3bd^2}{6} = \frac{9"^3 + 3 \cdot 9" \cdot 3"^2}{6} = 162\ in^3$ (5 → 148)

- Section props are much greater than MC ~~to~~ MC props therefore welds are adequate by observation.

- Max deflection $\approx \frac{1}{2}"$ @ top $\frac{30' \cdot 12"}{1/2"} = \frac{L}{720}$ OK

- Design "telescopic" connections. Connections are modeled as pinned. Try 12" max. eccentricity.



Joint 72: $F_1 = 1.2^k$ $F_2 = 0.53^k$ $F_3 = -6.609^k$ ← worst case

Direct shear: $V_u = \sqrt{F_1^2 + F_2^2 + F_3^2} = 6.74^k$

Moment: $M_u = V_u \cdot e = 6.74^k \cdot 12" = 80.6^{k\text{-}in}$

Pipe 3 x-strong: $t = 0.28"$ $d_o = 3.50"$

Max. weld size = 3/16"

Weld length = $3.5" \cdot 2 + 2 \cdot 3.50" = 18.0"$

$f_v = \frac{V_u}{A_w} = \frac{6.74^k}{18"} = 0.374\ k/in$

bending $S_{wy} = 5.50" \cdot 3.5" + \frac{3.5^2}{3} = 23.3\ in^2$ ← worst case

$S_{wx} = 3.5" \cdot 5.5" + \frac{5.5^2}{3} = 29.3\ in^2$

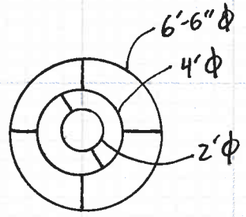
$f_b = \frac{M_u}{S_{wy}} = \frac{80.6^{k\text{-}in}}{23.3\ in^2} = 3.46\ k/in$ $f_r = \sqrt{f_v^2 + f_b^2} = 3.48\ k/in$

Check weld: $\phi R_n = 0.75 \cdot 0.6 \cdot 0.707 \cdot 3/16" \cdot 70\ ksi = 4.18\ k/in > f_r$ OK

Check base metal: $\phi R_n = 1.0 \cdot 0.6 \cdot 0.28" \cdot 35\ ksi = 5.88\ k/in$
$= 0.75 \cdot 0.6 \cdot 0.28" \cdot 60\ ksi = 7.56\ k/in > f_r$ OK

★ Use 3/16" fillet weld all around w/ Pipe 3 x-strong.

- Design mullions for glass @ top ring.



Dead Load

½" glass	–	8 psf
framing	–	4 psf
misc	–	2 psf
		14 psf

Live Load

Snow – 25 psf

Wind – ASCE 7-05 Use 6.5.13.3 – Comp. + Cladding on Open Buildings

$p = q_h G C_N$ $q_h = 19.4$ psf $G = 0.85$

C_N : Fig. 6-19A, Zone 3, $\theta = 7.5°$ $C_N = 3.2, -4.2$

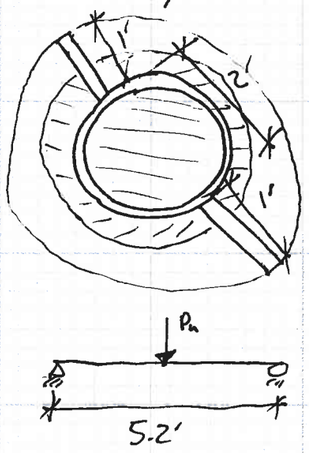
$p = 19.4 \text{psf} \cdot 0.85 \cdot \begin{matrix} 3.2 \\ -4.2 \end{matrix}$

$p = 52.8, -69.3$ psf

Load Combos

1. $1.2D + 1.6S + 0.8W = 1.2 \cdot 14 + 1.6 \cdot 25 + 0.8 \cdot 52.8 = 99$ psf
2. $1.2D + 1.6W + 0.5S = 1.2 \cdot 14 + 1.6 \cdot 52.8 + 0.5 \cdot 25 = 114$ psf
3. $0.9D + 1.6W = 0.9 \cdot 14 + 1.6(-69.3) = -98$ psf

- Design 2'ϕ Mullion.



- Design as simply supported beam.
- Assume ~~10%~~ 50% eccentricity.

$l = 1' + 1' + \frac{\pi \cdot 2'}{2} = 5.14'$

$P_u = 114 \text{ psf} \cdot \pi/4 \cdot (2')^2 = ~~358~~ 806 \#$

$T_{or} = P_u \cdot e = ~~358~~ 806 \# \cdot 2'(~~0.1~~ 0.5) = ~~71.6~~ 806 \#\text{-ft}$

$M_u = \frac{P_u l}{4} = \frac{~~358~~ 806 \# \cdot 5.2'}{4} = ~~465~~ 1048 \#\text{-ft}$

$V_u = \frac{P_u}{2} = ~~179~~ 403 \#$

- Try HSS 2x2x¼ – $Z_x = 0.964 in^3$ $I = 0.747 in^4$ $A_g = 1.51 in^2$
  - compact in flexure. $J = 1.31 in^4$ $C_c = 1.41 in^3$ $h/t = 5.58$

Flex. $\phi M_n = \phi F_y Z = 0.9 \cdot 46 ksi \cdot 0.964 in^3 = 39.9 k\text{-in} = 3326 \#\text{-ft} > ~~465~~ 1048 \#\text{-ft}$ ok

Shear $\phi V_n = \phi 0.6 F_y A_w C_v = 0.9 \cdot 0.6 \cdot 46 ksi \cdot 1 in^2 \cdot 1 = 24.8^k > ~~179~~ 403 \#$ ok

Torsion $\phi T_n = \phi F_{cr} C$ $2.45\sqrt{E/F_y} = 61.5 > 5.6 \therefore F_{cr} = 0.6 F_y$

$= 0.9 \cdot 0.6 \cdot 46 ksi \cdot 1.41 in^3$

$= 35.0^{k\text{-in}} = 2919 \#\text{-ft} > ~~72~~ 806 \#\text{-ft}$ ok

Interaction $\frac{M_r}{M_c} + \left(\frac{V_r}{V_c} + \frac{T_r}{T_c}\right)^2 = \frac{~~465~~ 1048}{3326} + \left(\frac{~~179~~ 403}{24,800} + \frac{~~72~~ 806}{2919}\right)^2 = ~~0.14~~ 0.40 < 1.0$ ok

- Check deflection: $\Delta_{TL} = \frac{Pl^3}{48EI} = \frac{276 \# \cdot 5.2^3}{48 \cdot 29E6 \cdot 0.747 in^4} = 0.064"$ ok

- Design connection. weld. 8" total.

$f_v = \frac{V}{A_w} = \frac{~~403~~ 403 \#}{8"} = 50 \#/in$ $J_w = \frac{(2d)^3}{6} = \frac{(2 \cdot 2")^3}{6} = 10.7 in^3$

$f_t = \frac{T \cdot c}{J_w} = \frac{~~806~~ 806 \#\text{-ft} \cdot \frac{12"}{1'} \cdot 1"}{10.7 in^3} = 904 \#/in$ $f_r = 50 + 904 = 954 \#/in$

$\phi F_r = 0.75 \cdot 0.6 \cdot 0.707 \cdot 70{,}000 psi \cdot 3/16" = 4{,}176 \#/in > f_r$ ok

* Use 3/16" weld all around.

RE: Helios Pavilion specs
From: Rich - PSC (rich@pugetsoundcoatings.com)
Sent: Mon 6/15/09 3:35 PM
To: James M Harrison (jamesmharrison@hotmail.com)

Attachments: 9 attachments | Download all attachments (1047.2 KB)
52 InterZ...pdf (37.5 KB), 345 Epoxy...pdf (94.3 KB), 870 Semi ...pdf (68.8 KB), 345 MSDS ...pdf (190.7 KB), 345 MSDS ...pdf (186.3 KB), 52 Interz...pdf (189.4 KB), 52 Interz...pdf (31.5 KB), 870 Inter...pdf (63.0 KB), 870 Inter...pdf (185.8 KB)
James,

Here are the technical data sheets and MSDS's for the three products we applied to the sculpture. The 52 is the zinc primer, the 345 is the epoxy intermediate coat, and the 870 is the finish coat. Originally through Commercial Welding I forwarded Tnemec brand paints. Tnemec had difficulty matching the finish color, so I switched it to International brand which is a performance equivalent.

I suggest you call Brett Bechtel, the local International representative, for maintenance, graffiti removal and touch-up information. His number is 206-762-6119.

Thank You,
Rich

Rich Tieman
rich@pugetsoundcoatings.com
(206) 767-3800 Work
(206) 767-5817 Fax
(206) 423-6432 Cell

PAINT SPECIFICATIONS

International
Protective Coatings

Interzinc 52

Epoxy Zinc-Rich

Surface Preparation

All surfaces to be coated should be clean, dry and free from contamination. Prior to paint application all surfaces should be assessed and treated in accordance with ISO 8504:1992.

Oil or grease should be removed in accordance with SSPC-SP1 solvent cleaning.

Abrasive Blast Cleaning

Abrasive blast clean to Sa2½ (ISO 8501-1:1988) or SSPC-SP6. If oxidation has occurred between blasting and application of Interzinc 52, the surface should be reblasted to the specified visual standard.

Surface defects revealed by the blast cleaning process, should be ground, filled, or treated in the appropriate manner.

A surface profile of 40-75 microns (1.6-3.0 mils) is recommended.

Shop Primed Steelwork

Interzinc 52 is suitable for application to steelwork freshly coated with zinc silicate shop primers.

If the zinc shop primer shows extensive or widely scattered breakdown, or excessive zinc corrosion products, overall sweep blasting will be necessary. Other types of shop primer are not suitable for overcoating and will require complete removal by abrasive blast cleaning.

Weld seams and damaged areas should be blast cleaned to Sa2½ (ISO 8501-1:1988) or SSPC-SP6.

Application

Mixing

Material is supplied in two containers as a unit. Always mix a complete unit in the proportions supplied. Once the unit has been mixed it must be used within the working pot life specified.

(1) Agitate Base (Part A) with a power agitator.
(2) Combine entire contents of Curing Agent (Part B) with Base (Part A) and mix thoroughly with power agitator.

Mix Ratio	4 parts : 1 part by volume			
Working Pot Life	5°C (41°F) 24 hours	15°C (59°F) 12 hours	25°C (77°F) 5 hours	40°C (104°F) 2 hours
Airless Spray	Recommended	- Tip range 0.43-0.53 mm (17-21 thou) - Total output fluid pressure at spray tip not less than 176 kg/cm² (2,500 p.s.i.)		
Air Spray (Pressure Pot)	Recommended	Gun Air Cap Fluid Tip	DeVilbiss MBC or JGA 704 or 765 E	
Brush	Small areas only	Typically 50-75 microns (2-3 mils) can be achieved		
Roller	Not Recommended			
Thinner	International GTA220 (or GTA415)	Do not thin more than allowed by local environmental legislation.		
Cleaner	International GTA822 (or GTA415)			

Work Stoppages

Do not allow material to remain in hoses, gun or spray equipment. Thoroughly flush all equipment with International GTA822. Once units of paint have been mixed they should not be resealed and it is advised that after prolonged stoppages work recommences with freshly mixed units.

Clean Up

Clean all equipment immediately after use with International GTA822. It is good working practice to periodically flush out spray equipment during the course of the working day. Frequency of cleaning will depend upon amount sprayed, temperature and elapsed time, including any delays.

All surplus materials and empty containers should be disposed of in accordance with appropriate regional regulations/legislation.

Product Characteristics

In order to ensure good anti-corrosive performance, it is important to achieve a minimum dry film thickness of Interzinc 52 of 40 microns (1.5 mils). To achieve a uniform, coalesced, closed film at this dry film thickness, it will be necessary to thin Interzinc 52 with 10% with International thinners. The film thickness of Interzinc 52 applied must be compatible with the blast profile achieved during surface preparation. Low film thickness should not be applied over coarse blast profiles.

Care should be exercised to avoid the application of dry film thicknesses in excess of 150 microns (6 mils).

Care should be exercised during application to avoid over-application which may result in cohesive film failure with subsequent high builds, and to avoid dry spray which can lead to pinholing of subsequent coats.

Over-application of Interzinc 52 will extend both the minimum overcoating periods and handling times, and may be detrimental to long term overcoating properties.

When Interzinc 52 is allowed to weather before topcoating ensure all zinc salts are removed prior to paint application and only topcoat with recommended materials.

Surface temperature must always be a minimum of 3°C (5°F) above dew point.

Interzinc 52 is not normally recommended for underwater use. Please consult International Protective Coatings for further details in this situation.

Interzinc 52 is suitable for the localised repair of damaged inorganic zinc primer - consult International Protective Coatings for specific advice.

Low Temperature Curing▲

An alternative curing agent is available for applications at temperatures less than 5°C (41°F). When using this alternative curing agent it should be noted that the VOC will increase to 360 g/l (3 lb/gal).

Interzinc 52 is capable of curing at temperatures below 0°C (32°F). However, this product should not be applied at temperatures below 0°C (32°F) where there is a possibility of ice formation on the substrate.

Temperature	Touch Dry	Hard Dry	Minimum overcoating interval with recommended topcoats *Minimum*	*Maximum*
-5°C (23°F)	6 hours	32 hours	36 hours	Extended*
0°C (32°F)	3 hours	16 hours	18 hours	Extended*
5°C (41°F)	2 hours	6 hours	6 hours	Extended*

Touch dry times shown above are actual drying times due to chemical cure, rather than physical set due to solidification of the coating film at temperatures below 0°C (32°F).

* See International Protective Coatings Definitions & Abbreviations.

This product has the following specification approvals:

Steel Structures Painting Council - SSPC Paint 20

Systems Compatibility

Interzinc 52 is designed for application to correctly prepared steel. It is possible to apply over approved prefabrication primers. Details of these can be obtained from International Protective Coatings.

Recommended topcoats are:

Intercryl 530	Intergard 401
Intercure 200	Intergard 475HS
Intercure 200HS	Intergard 740
Intercure 420	Interseal 670HS
Interfine 629HS	Interthane 870
Interfine 979	Interthane 990
Intergard 251	Interzone 505
Intergard 269	Interzone 954
Intergard 345	Interzone 1000

For other suitable topcoats, consult International Protective Coatings.

Interzinc 52
Epoxy Zinc-Rich

Additional Information

Further information regarding industry standards, terms and abbreviations used in this data sheet can be found in the following sections of the International Protective Coatings data manual:

- Definitions & Abbreviations
- Surface Preparation
- Paint Application
- Theoretical & Practical Coverage

Individual copies of these information sections are available upon request.

Safety Precautions

This product is intended for use only by professional applicators in industrial situations in accordance with the advice given on this sheet, the Material Safety Data Sheet and the container(s), and should not be used without reference to the Material Safety Data Sheet (MSDS) which International Protective Coatings has provided to its customers.

All work involving the application and use of this product should be performed in compliance with all relevant national, Health, Safety & Environmental standards and regulations.

In the event welding or flame cutting is performed on metal coated with this product, dust and fumes will be emitted which will require the use of appropriate personal protective equipment and adequate local exhaust ventilation.

If in doubt regarding the suitability of use of this product, consult International Protective Coatings for further advice.

Pack Size	10 litre unit	Interzinc 52 Base Interzinc 52 Curing Agent	8 litres in a 10 litre container 2 litres in a 2.5 litre container
	3 gallon unit	Interzinc 52 Base Interzinc 52 Curing Agent	2.4 gallons in a 3.5 gallon container 0.6 gallons in a 1 gallon container
	For availability of other pack sizes contact International Protective Coatings		
Shipping Weight	U.N. Shipping No.	1263	
	10 litre unit	25.4 kg (56.0 lb) Base (Part A) 2.1 kg (4.6 lb) Curing Agent (Part B)	
	3 gallon unit	28.7 kg (63.4 lb) Base (Part A) 2.4 kg (5.4 lb) Curing Agent (Part B)	
Storage	Shelf Life	12 months minimum at 25°C (77°F). Subject to re-inspection thereafter. Store in dry, shaded conditions away from sources of heat and ignition.	

Disclaimer

International Protective Coatings

Worldwide Availability

World Centre	Asia Region	Australasia Region	Europe Region	Middle East Region	North America Region	South America Region
P.O Box 20980 Oriel House 16 Connaught Place London, W2 2ZB England	3 Neythal Road Jurong Town Singapore 628570	115 Hyde Road Yeronga Brisbane Queensland Australia	P.O Box 20980 Oriel House 16 Connaught Place London, W2 2ZB England	PO Box 37 Dammam 31411 Saudi Arabia	6001 Antoine Drive Houston Texas 77091	Av Paiva 999, Neves, Sao Gonçalo, Rio de Janeiro Brazil
Tel: (44) 20 7479 6000 Fax: (44) 20 7479 6500	Tel: (65) 663 3066 Fax: (65) 266 5287	Tel: (61) 7 3892 8888 Fax: (61) 7 3892 4287 H&S (61) 1800 807 001	Tel: (44) 20 7479 6000 Fax: (44) 20 7479 6500	Tel: (966) 3 812 1044 Fax: (966) 3 812 1169	Tel: (1) 713 682 1711 Fax: (1) 713 684 1514	Tel: (55) 21 624 7100 Fax: (55) 21 624 7123

Local Office:
Tel: 0191 469 6111 Fax: 0191 495 0676

City of Burien Arts Commission
Department of Parks, Recreation, and Cultural Services

Conservation Record

City of Burien Public Art Collection

To be completed by Artist when artwork is completed.

Date 15 Sept 2009

Artist James M Harrison

Title of Work Helios Pavilion

Date Work Completed June 13, 2009
Dimensions of Work (H x W X D) 30 feet tall x 16 feet diameter
(Attach additional sheet if necessary)

MEDIUM AND TECHNIQUE
(Supply brand names of materials used when possible)

1. Principal materials used in fabrication (describe in detail). (i.e., specific metal, brand name, source, or manufacturer, etc.):

- 3" O.D. Schedule 80 rolled mild steel pipe for majority of structure
- Laminated Art Glass
- Cast Acrylic Resin
- Copper Plaque
- 3 part paint system (refer to specs in owner's manual)

If applicable, describe any electrical components used, their operation and supplier:

- The sculpture is remotely lit, with one in ground light and two lights on a pole adjacent to sculpture. There is no internal wiring.

2. Other materials used (i.e., screws, nails, glue, armatures, etc.)

- The glass is held in place with Norseal V980 Closed Cell PVC Foam Tape
(see cut sheet in owner's manual)

3. Preliminary work methods (e.g. drawings, smaller models, etc.):

- Drawings, physical models at various scales, and computer aided drafting
- Design was finalized in Rhino 3d

4. Equipment used in construction:

- Sculpture was fabricated by Commercial Welding and Fabrication
711 S Myrtle St, Seattle, WA 98108
Contact: Don Thompson 206 767 4211

- Sculpture fabricated on site using one Boom Forklift, one Cherry Picker, and a three man crew
- Sculpture components had primer coat and intermediate coat applied in shop, and final coat applied in field.
- Artist installed the glass after armature and painting were finished, using a man lift.

5. Final work methods, describe in detail (e.g., cast, welded, carved, modeled, thrown, assembled, etc.)

- Field Welded of all components

If the work has been cast, specify how many have been and/or will be produced:

5. Describe how final surface/patina achieved:
   - Final finish is paint

6. Protective coating:
   - A graffiti coating was applied by Burien Parks to the lower 10 feet of the sculpture

Method of application:

7. Where was work completed? (e.g., name of studio, foundry, etc.):
   - Design was created at the artist's studio in exotic Portland, Oregon.
   - Sculpture was largely fabricated in the field on site.

Date work completed: June 13, 2009

How long was work in process? One year.

INSTALLATION

1. Were there any special installation considerations (e.g. viewing height, measured distance from relative objects, etc.)?
Piece was field aligned with the compass points and with Mt. Rainier.

2. If work is comprised of more than one piece requiring special assembly, supply documentation on how to install correctly (provide photography or sketch): Refer to Owner's Manual

EXTERNAL FACTORS

Describe existing environmental factors which may affect the condition of the artwork and any precautionary measures which should be taken. (e.g., direct sunlight, extremes of annual rain or snowfall, temperature, air moisture or dryness, acidity of rainfall, flooding, wind, vibrations, air pollutants, vehicular and/or pedestrian traffic; animal interaction with artwork--potential for nesting, droppings, etc.; human interaction with artwork—touching, sitting, climbing, vandalism)

- Sculpture is designed to require little to no maintenance aside from simple routine cleaning (and removal of graffiti and/or stickers as necessary). There are no special cleaning instructions beyond routine common sense
- The paint finish will fade somewhat over time due to UV exposure. The color of paint was chosen in part to minimize the effect of this on the overall appearance. If the sculpture needs repainting at some future date it is the artist's wish that this be done to match the existing color, and that it be done in a timely enough fashion to keep sculpture looking fresh and not faded, neglected, or forgotten.

DESIRED APPEARANCE

1. Describe in specific terms and, if necessary, with drawings or photographs, the physical qualities for which the agency should strive in order to maintain the artist's intent. (e.g. matte rather than glossy luster, color of patina). What may be acceptable alteration in form, surface, texture, coloration as related to natural aging of materials?

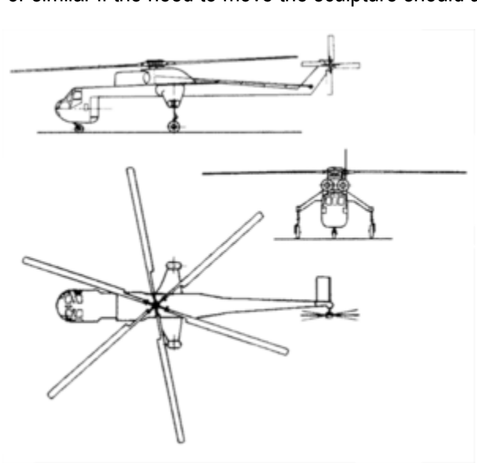
- See above. Some fading of the paint is unavoidable and therefore acceptable. However, the artist desires that the piece be kept clean and free of graffiti, and that sculpture be repainted prior to looking faded, neglected, or forgotten.

2. If the work is site-specific, describe in detail the particular relationship of the work to its site, including any significant physical aspects of the site which, if altered, would significantly alter the intended meaning and/or appearance of the work:

- The sculpture and the meaning of the sculpture are carefully integrated into the site.
  The sculpture is oriented to the compass points, and to the line 37 degrees off of North that draws a line from Mt. Rainier to the old Bering Land Bridge.
  Refer to Owner's Manual for further detail.

PACKING AND SHIPPING INSTRUCTIONS
(include diagram)

Good luck with this one. I would suggest a Sikorsky S-64 Sky Crane, a CH-47 Chinook, or similar if the need to move the sculpture should arise:



MAINTENANCE/CONSERVATION INSTRUCTIONS
Provide detailed instructions regarding the methods and frequency of maintenance for the artwork (with observations regarding permanency/durability of materials and techniques):

- Mid cleaning solution and water should be all that's needed to keep sculpture clean.
  Sculpture is made from durable materials that have a track record of low maintenance needs outdoors
  The paint has a 'sacrificial' graffiti coating applied on the lower 10 feet to make the removal of paint graffiti and stickers easier.
- The glass should be cleaned like any normal window glass, i.e. as needed to keep bird poop in check.
- The resin can be wiped down with a cleaning solution and a rag, as needed

1. Routine maintenance (e.g., removal of dust, dirt; maintenance of protective surfaces; tightening, adjusting, oiling, etc.:

   - Sculpture should be checked in the dry months for any rust spots that may have developed during the rainy season. If there are spots that need retouching, the paint should only be applied either by or under the instruction of Puget Sound Coatings, the original painters for the project. Their contact info is included in the Owner's Manual, along with the painting specs.

2. Cyclical maintenance (less frequent and more extensive preventive measures, e.g., disassembly and inspection; reapplication of protective sealers; repainting; etc) :

- If sculpture needs repainting at some future date, Artist recommends the work be carried out by Puget Sound Coatings, the original painters for the project. The artist assumes no cost liability for repainting of the sculpture (after the initial 1 year warranty on all work held by the artist)
- If glass were to need replacing for any reason, please contact the artist.

CONCEPTUAL INFORMATION
1. Provide conceptual information on the work, including subject, source of inspiration:

The sculpture was inspired by Gaussian star Charts, Basket weaving, and a desire to put color against a gray Northwest sky. It also marks the line that runs from the old Bering land bridge, through Burien to Mt. Rainier. Please refer to the Owner's manual for greater detail.

Artist Signature_____ Date_____

Agency Signature_____ Date_____