Wine history Project Pavilion
Primitivo edition

A Senior Project
presented to
the Faculty of the Architectural Engineering Department
California Polytechnic State University – San Luis Obispo

In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Science in Architectural Engineering

By

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SPECIAL THANKS TO:

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Construction Management Students: *Maerill Ceballos for coordinating with me to ensure our design can be built. Also, for helping coordination within the team go smoothly and helping everyone in team whenever she can.*

LPA, Irvine CA: *For funding our class and providing office hours for our team to use.*

Wine History Project: *for giving us the opportunity to design your future pavilion and scheduling meetings with our class, so that we may create the ideal design for you.*

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INTRODUCTION

Background: The Wine History Project of San Luis Obispo County is a local organization that documents, preserves, and aims to educate the public about San Luis Obispo County's distinctive wine and food history. Currently, they are looking to invest in a Pavilion that will aid them in both attracting and informing the public about the story of wine in the county.

Team: Our team was compromised of three Architectural students (ARCH), one Architectural Engineer student (ARCE), and one Construction Management student (CM). Our goal was to work together using an IPD design approach in order to create the best Pavilion Design for our client, the Wine History Project.

IPD Approach: Integrated Project Delivery (IPD) is a project delivery approach that integrates all involved parties in the Project to come together from the very beginning to realize the optimal solution for the project. The idea is that every discipline/party is contributing their insight in order to maximize efficiency in the building, reduce waste, lower costs, and come to a solution that everyone can agree to. In our case, our CM student and I where able to have a big influence in the schematic design phase of the pavilion as we worked with ARCH students. We were able to create a design that was structurally sound, constructible, and aesthetically pleasing within a short span of 12 weeks.

Constraints: Our ambitious and creative clients wanted a pavilion with the following requirements: a 400sf requirement, provides security, modular, lightweight framing, easy constructibility, is temporary, can be assembled by college students, all pieces fit in a U-Haul, no cranes during construction, can not dig into the ground, integrated shelving, materials are all local, and design is aesthetically pleasing

Client Interaction: Every 3 weeks at least one meeting, face-to-face was held in order guide our project towards the clients optimal pavilion design.

PROJECT DESCRIPTION

The pavilion is located on Saucelito Canyon Winery's site. This project seeks to attract and enlighten guests as they experience both the pavilion and the Wine History showcase. The space provided intends to enhance the guest's overall experience during their stay at the Saucelito Canyon Winery. This is achieved through first attracting guests to the pavilion through visual appeal of the pavilion and secondly, enlightening the guests about the history of winery through a laid out program provided by the Wine History Project.

This Pavilion will be built on a relatively flat grade. Being near the roadside, the building will attract fellow travelers to its space. Furthermore, the pavilion will be as open as it can be to the guests and nature. Meaning that there is no flooring and there is lots of wind circulation to allow for a more natural experience while inside the pavilion.

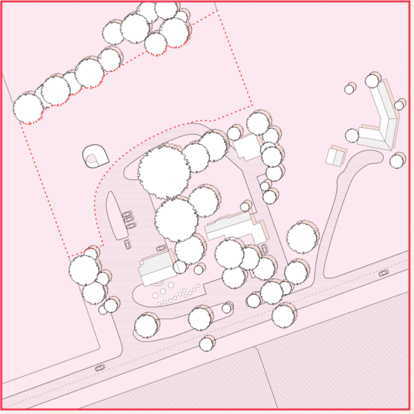
The pavilion stands with a ceiling height of 9' and a grand entrance of 24' wide. This pavilion is wide open to guests and allows for a circular path throughout the space. The total square footage of the pavilion is estimated to be 600 square feet.

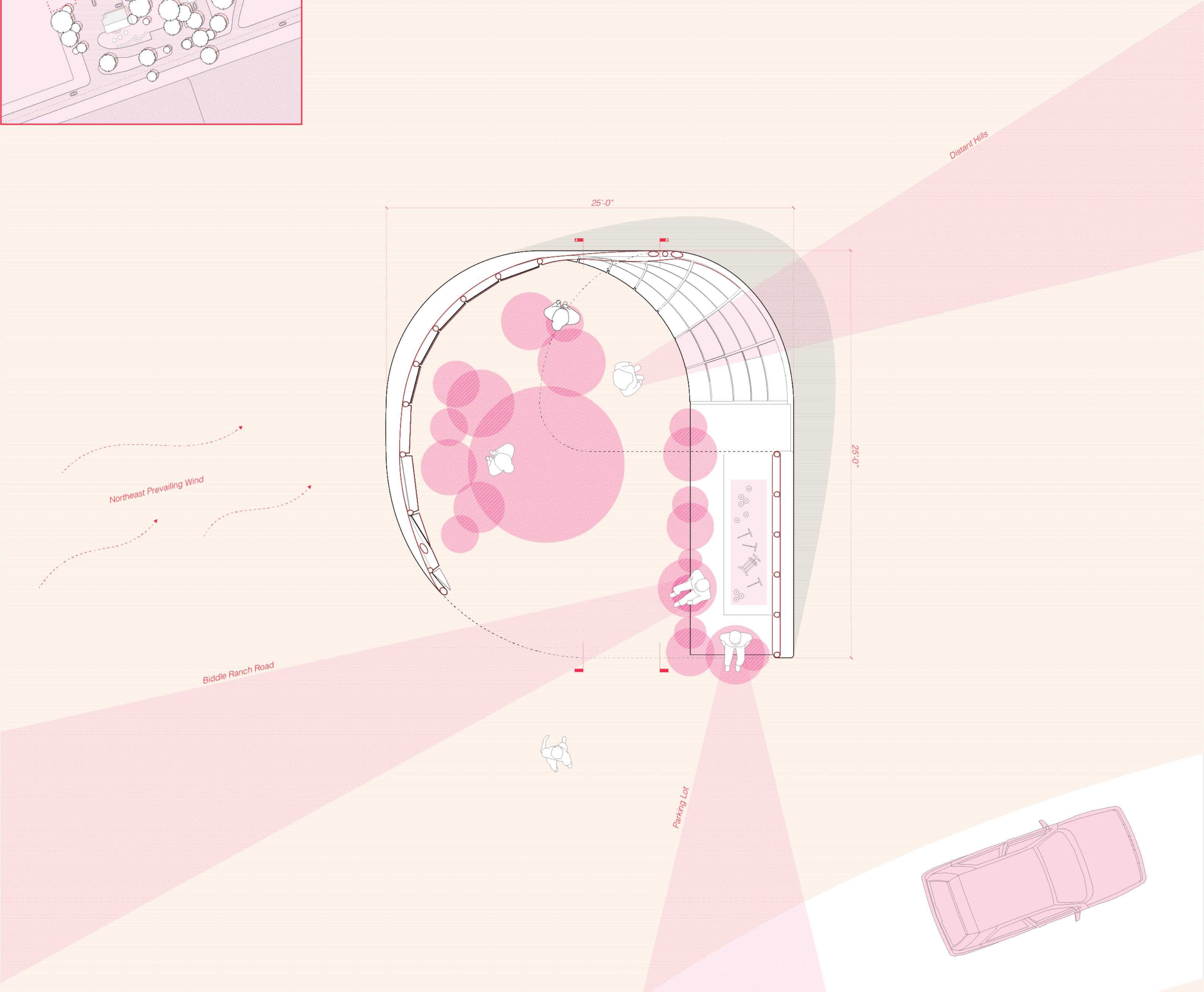
Paneling is composed of a white fabric wrapping around the aluminum framing. Interior paneling is made up of plywood attached to the aluminum framing as well.

Design Assumptions for the lateral load resisting system

1) Grid shell composed of aluminum framing is the main lateral resisting system in both directions.

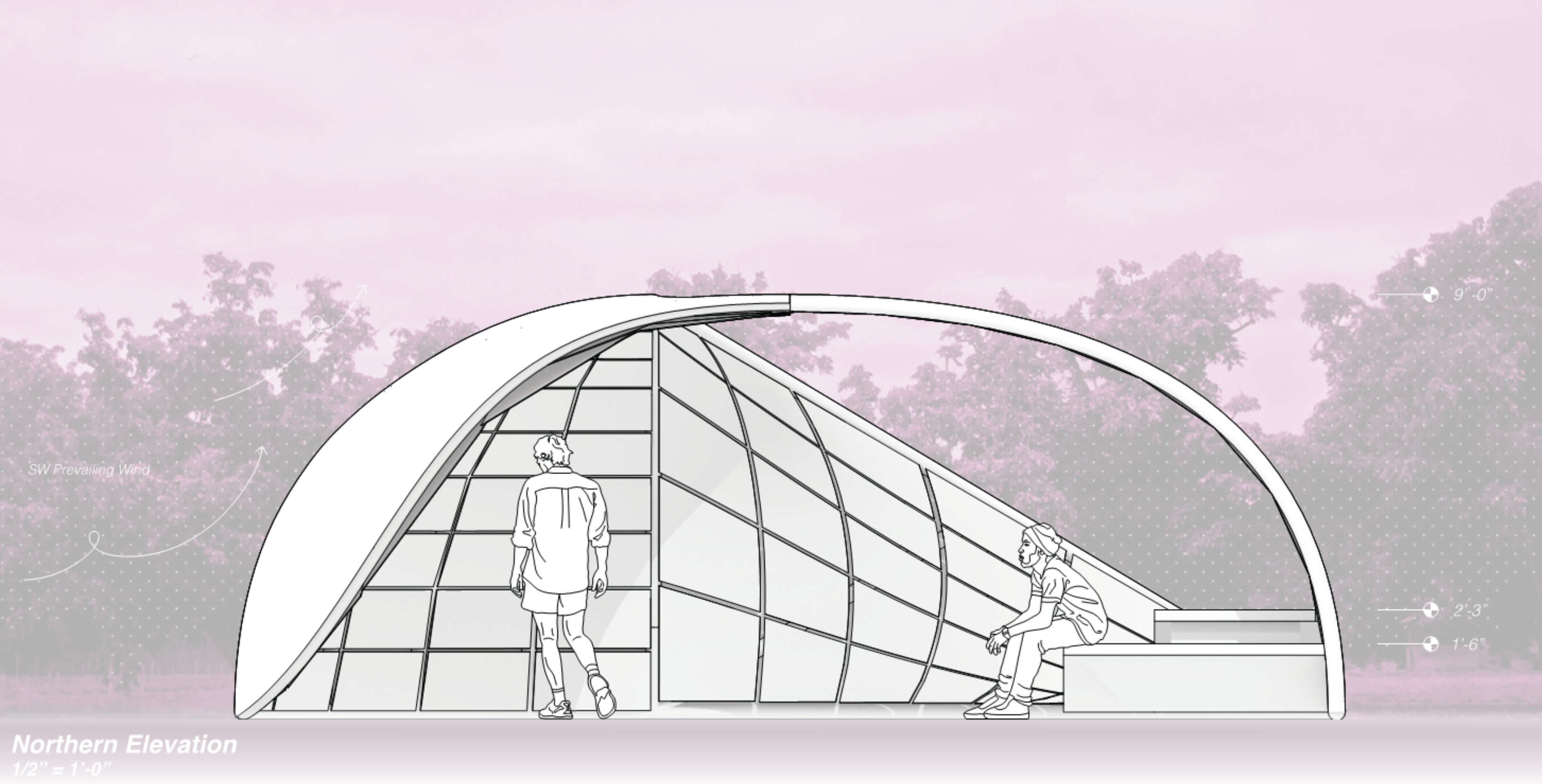
SITE ANALYSIS





CREDIT: TOBY PETERS-BLECK

NORTH ELEVATION



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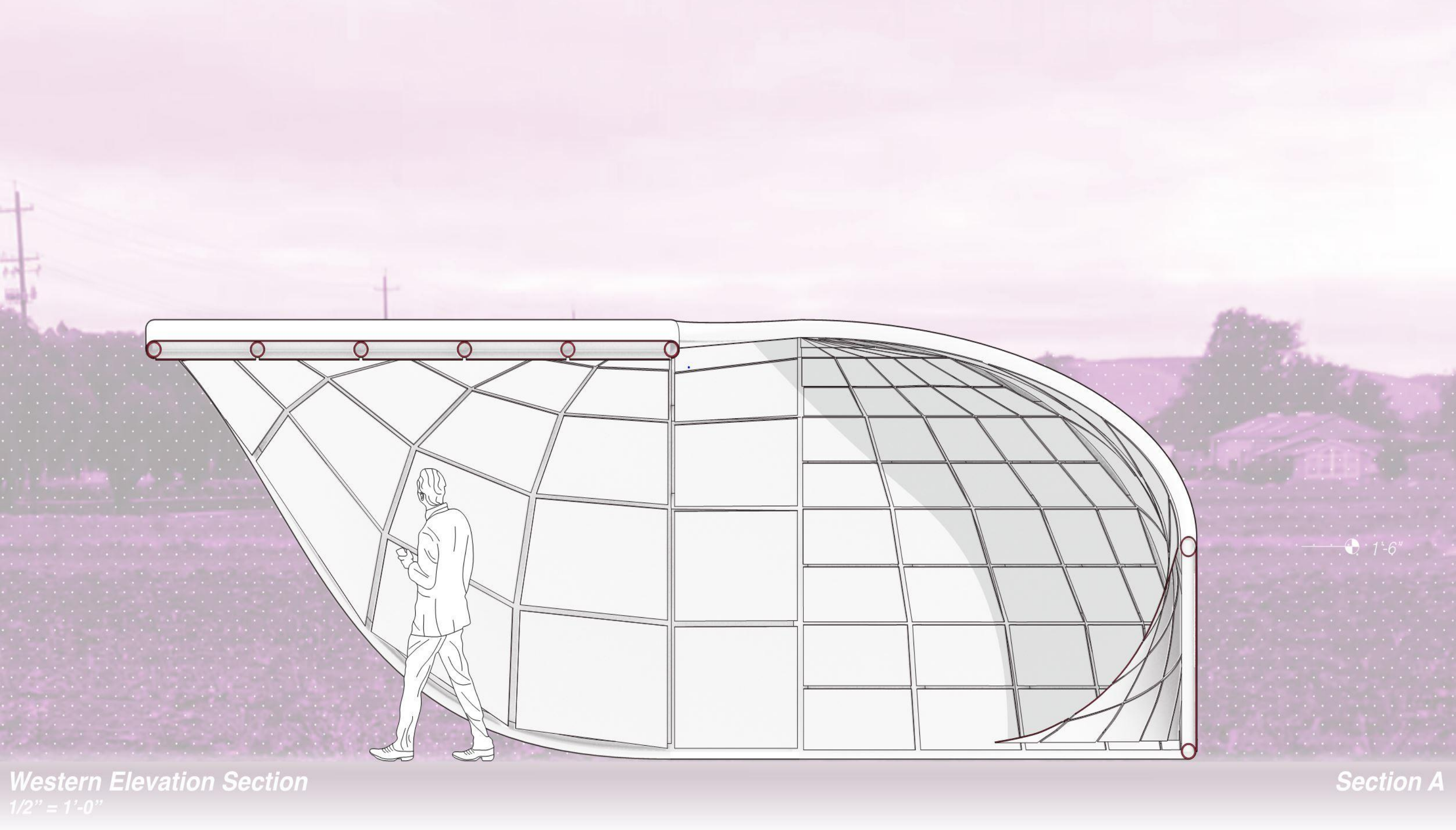
CREDIT: KY NGUYEN HUYNH

WESTERN ELEVATION SECTION



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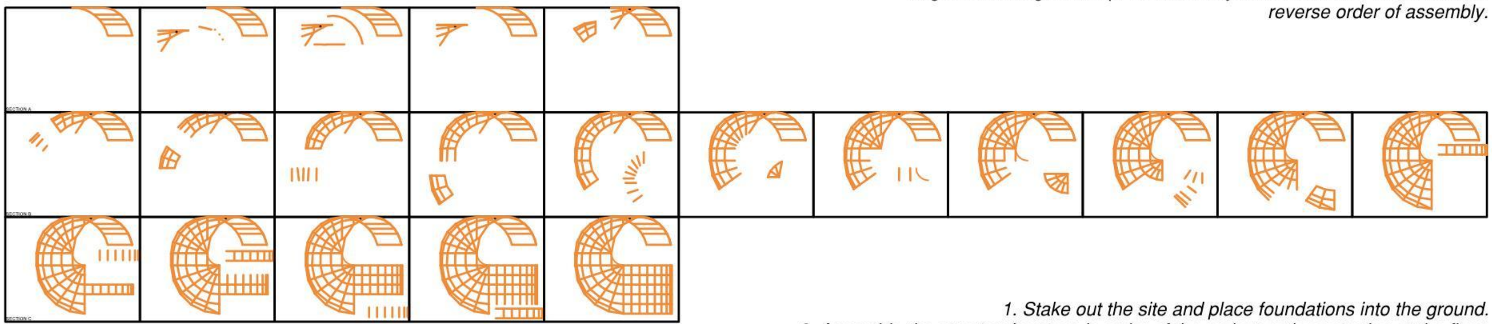
PRIMITIVO

assembly & disassembly

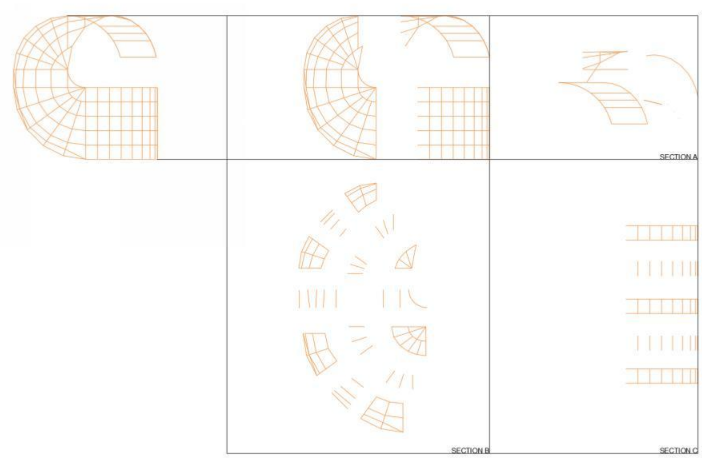
Once all individual sections of the structure arrive on site, assembly can begin from the ground-up. Disassembly of the structure will be done in reverse order of assembly.



1. Stake out the site and place foundations into the ground.
2. Assemble the structural system in order of the major sections starting at the floor.
3. Unfold each section of fabric and enclose the exterior.
4. Attach the wood panels into the interior.
5. Place the seating and table assembly into the space and add any final touches.
6. Place artifacts and attach posters to the pavilion and enjoy the exhibit.

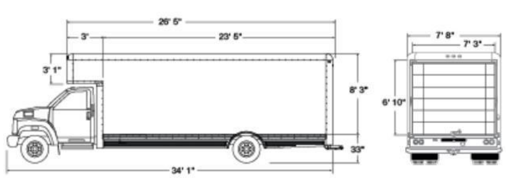
PRIMITIVO

transportation guideline



Sizes that fit within the dimensions of a 26' U-Haul truck:
Largest size of an individual section: 23 ft. long, 7 ft. wide, and 6 ft. tall

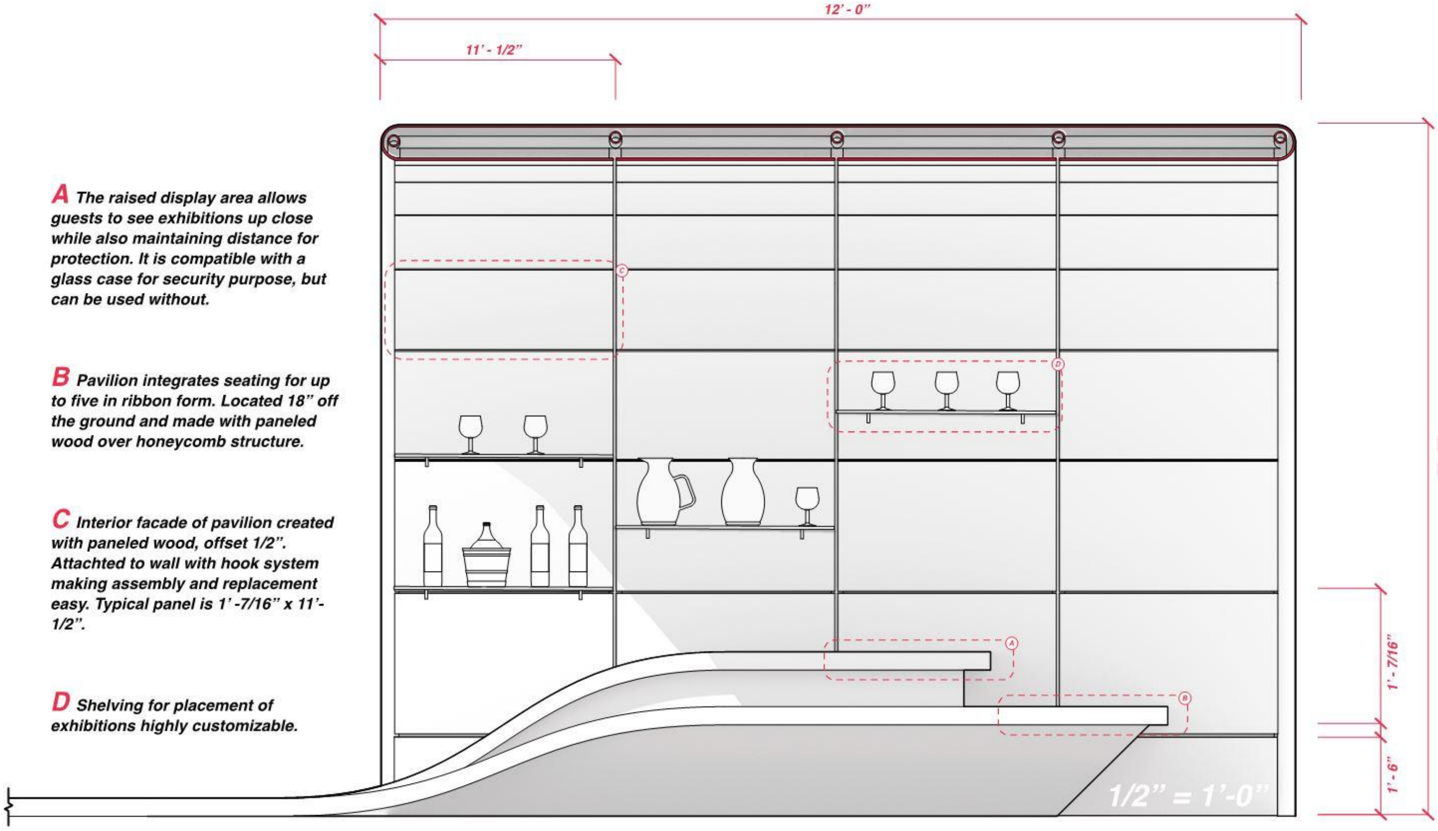
Weight of each section that four movers can carry:
Max weight per person: 50 lbs.
Average weight of structural tubing: 3 lbs/ft
Total weight of one section carried by four people: 200 lbs.
Max total length of structural tubing per section: 66 ft.



We divided the whole structure into a few major sections comprised of even smaller segments, making sure that each piece carefully fits inside a 26' U-Haul truck. We also considered a maximum weight of 50 lbs. for a single person to carry. If we assume that there are at least four movers, each segment is limited to a maximum of 200 lbs.

CREDIT: MAERILL CEBALLOS

INTERIOR PANELING



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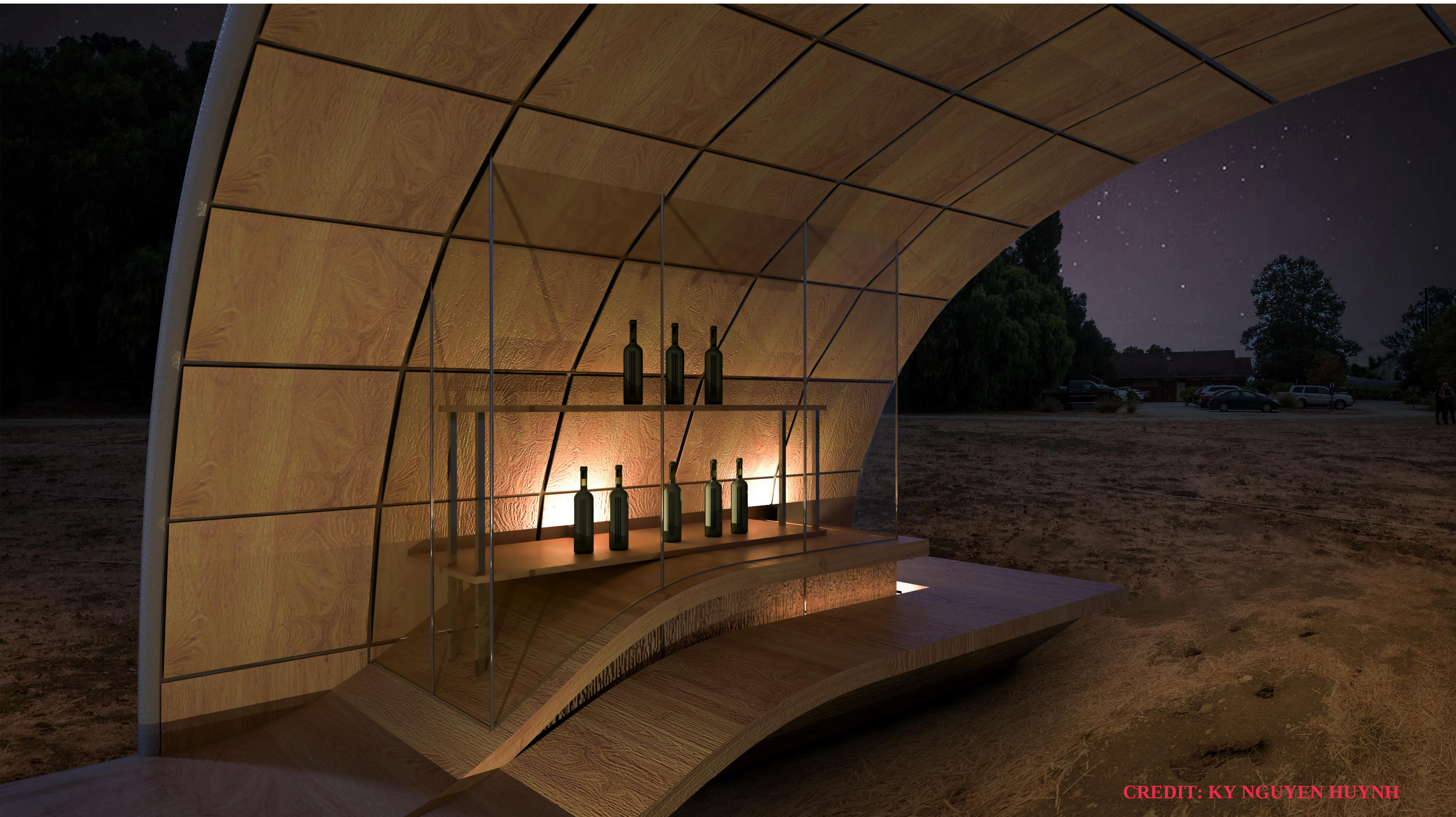

CREDIT: KY NGUYEN HUYNH

STRUCTURAL CALCULATIONS

PRIMITIVO PAVILION DESIGN

SAN LUIS OBISPO, CALIFORNIA

Prepared by:

Erick Vazquez

December 13, 2019

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DESIGN CRITERIA

1) Applicable Codes:
   a. International Building Code 2018
   b. California Building Code 2016
   c. American Society of Civil Engineers 7-16
   d. Aluminum Design Manual 2010
2) Design Loads:
   a. Dead Loads – Actual in-place weights of all materials shown on the drawings and specifications
   b. Live Loads – uniform as follows:
      i) Roof: 10 psf
   c. Wind Loads: Based on CBC section 1609 with exposure C condition with a basic wind speed of 92mph. Design Process based on ASCE 7-16 Section 26 and 27
      i) qz = 0.00256Kz*Kzt*Kd*Ke*V2
   d. Seismic Load: based on CBC Section 1613 and ASCE 7-16 Section 12.8
      i)To be determined at a later date
3) Foundation Design
   a. No geotechnical report provided. The recommended design soil values are as follows by CBC TABLE 1806.2. Since class of soil is unknown, will go with worst case soil.

Vertical Foundation Pressure	Lateral Bearing pressure
1,500 psf	400 psf - 100 psf

MATERIAL & MODELING CRITERIA

Material Criteria

1) Aluminum

    a. For Frames: Using 6061 T6 Aluminum Round Tubing

    b. For Connections: Aluminum plates, Auger Anchors, Aluminum Bolts, 6061 T6 Custom Tube Sleeves

    c. For foundations: Aluminum 6061 T6 Base Plates

3) FOUNDATIONS

    a. 8"X8"X12" CMU BLOCKS

    b. PE46-Hex (American Earth Anchors - Auger Anchor)

    c. Non Shrink Grout

SAP2000 Modeling Criteria

The actual structure is composed of curved aluminum members, but in the sap model the members are all modeled as straight continuous frame members. This is allowable to do because there are multiple members that are generating the curve of the structure. Most eccentricities between the straight member and actual member fall between 0 3/8” – 1 1/2” distance of eccentricity. These are relatively small distances, which causes the overall model to be reasonably accurate. Only a few members exceed that eccentricity with a distance of around 2”. To account for this eccentricity difference, SCI PUBLICATION P281 by Charles King & David Brown suggests applying a moment created by the axial force of that member times the eccentricity, to the ends of that member. This will provide a more accurate model.

Every connection is a fixed connection between the members while the supports are all pinned connections.

All loads are applied to the joint by multiplying the tributary area of that joint by the given design load(dead, live & wind). Wind load has an applied windward pressure, leeward pressure, and uplift pressure.

Furthermore, the model is running both LRFD design code checks and ASD force analysis for foundation design.

Design Loads

Client: WINE HISTORY PROJECT

Project: PRIMITIVO – DEAD LOAD TAKEOFF

Sheet: D1 of D1

Job No:

Date: 11/22/19

Engineer: EAV

TABULATION OF PANELING DEAD LOAD

MATERIAL	WEIGHT	REFERENCE
(1) SEAMAN 8421 POLYSTER FABRIC W/ ACRYLIC COATING	22.0oz/sy	(1)
(2) 11/32" SANDED PLYWOOD	0.938PSF	(2)
(3) 2 3/4" OD x 1/8" thk 6061-T6 ALUMINUM ROUND TUBING	1.2012 lb/ft	(3)
(4) 1/8" VINYL COATED STAINLESS STEEL CABLE REEL	0.042lb/ft	(4)

REFRENCES

(1) SLO Sail & Canvas

(2) HOME DEPOT

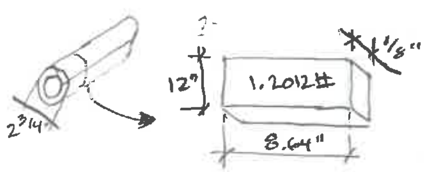
(3) Speedy Metals

(4) E-Rigging

SAP MODEL DEAD LOAD

- TO ACCOUNT FOR THE DEAD LOAD, A SELF WEIGHT MULTIPLYER OF 2.5 WAS USED BETWEEN THE ALUMINUM ROUND TUBING & EVERY OTHER ITEM IN THE STRUCTURE.
  - FIRST, ONLY MATERIALS THAT PLAY A BIG ROLE INTO THE WEIGHT OF THE BUILDING ARE, ALUMINUM ROUND TUBING, PINNED CONNECTIONS, & THE INTERIOR PLYWOOD.
    - COMPARING ALUMINUM ROUND TUBING TO PLYWOOD BEING USED

ALUMINUM

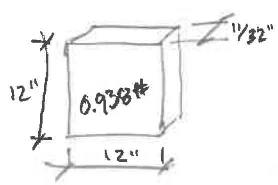


DENSITY

$\frac{1.2012\ \#}{12"(8.64")(1/8)"}$

= 0.0927 Pci

PLYWOOD

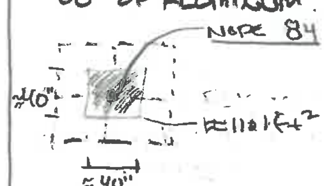


DENSITY

$\frac{0.938\ \#}{12"(12")(11/32")}$

= 0.0189 Pci

LOOKING AT THE WORST CASE TA OF THE MODEL THERE IS A CASE WHERE THERE IS 11ft² OF PLYWOOD & 80" OF ALUMINUM.



PLYWOOD VS ALUMINUM
≈ 10.3 : 8
≈ 1.3 : 1

W/ PINNED CONNECTIONS A SELF WEIGHT MULTIPLIER OF 2.5 WOULD BE SUFFICIENT TO ACCOUNT FOR DEAD LOADS

– WEIGHT OF PLYWOOD

$= 0.0189\ Pci \times (11.1ft^2 \times \frac{144 in^2}{1ft^2})(\times 11/32)$

$= 10.3\ \#$

– WEIGHT OF ALUMINUM

$= 0.0927\ Pci \times (80in)(8.64")(1/8")$

$= 8\ \#$

Frame Analysis

Client: WINE HISTORY PROJECT

Project: PRIMITIVO - KEY PLAN

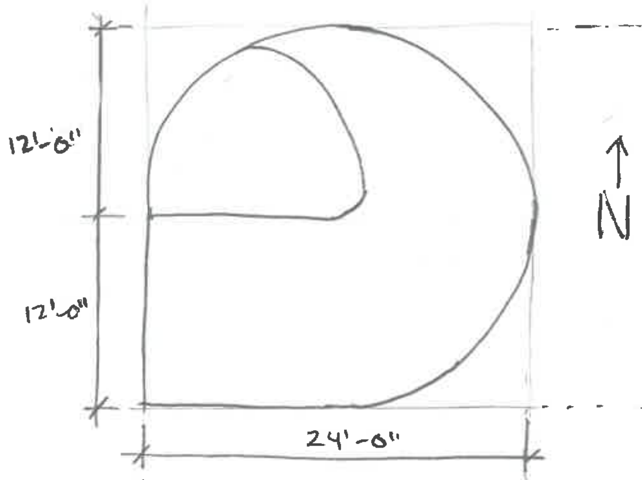
Sheet: F1 of F8

Job No:

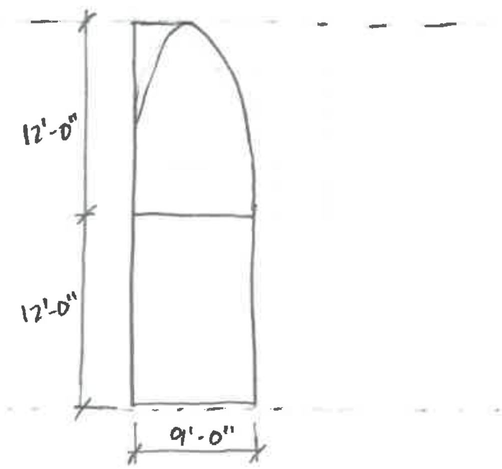
Date: 11/11/19

Engineer: EAV

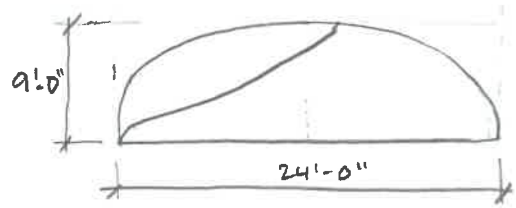
PLAN VIEW



ELEVATION VIEW



ELEVATION VIEW



3D VIEW

Client: WINE HISTORY PROJECT

Project: PRIMITIVO — FRAME PROPERTIES & TENSILE STRENGTH

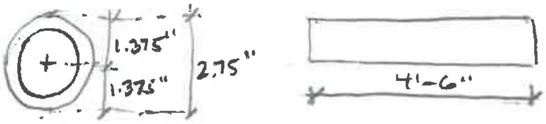
Sheet: F2 of F8

Job No:

Date: 11/24/19

Engineer: EAV

FINDING CAPACITIES ASSOCIATED W/ $2\frac{3}{4}$" OD x $\frac{1}{8}$" thk ALUMINUM ROUND TUBING, 6061-T6



(LONGEST FRAME MEMBER)

MATERIAL PROPERTIES

- $E = 10{,}100\text{ksi}$
- $F_{ty} = 35\text{ksi}$
- $F_{tu} = 38\text{ksi}$
- $A_g = 1.03\text{in}^2$
- $F_{cy} = 35\text{ksi}$
- $F_{su} = 24\text{ksi}$
- $I_x, I_y = 0.89\text{in}^4$
- $r_x, r_y = 0.93\text{in}$
- $S_x, S_y = 0.647\text{in}^3$

TENSILE STRENGTH (ADM 2010 D.2)

- YIELDING

$P_n = F_{ty} A_g$ (D.2-1)

$= 35\text{ksi}(1.03\text{in}^2)$

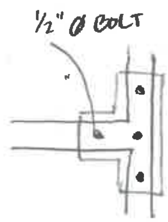
$= 36\text{kips}$

$\phi P_n = 0.9(36\text{kips})$

$= 32.4\text{kips}$

- RUPTURE

FOR UNWELDED MEMBERS



$P_n = F_{tu} A_e / k_t$ (D.2-3)

$P_n = 38\text{ksi}(1.03\text{in}^2 - .125"(.5")(2))$

$= 34.39\text{kips}$

$\phi P_n = 0.75(34.34.4\text{k})$

$= 25.8\text{kips}$

COMPRESSION STRENGTH (ADM E)

E.2 EFFECTIVE LENGTH (C.3 → K=1.0)

E.3 MEMBER BUCKLING

– $P_n = F_c A_g$ (E.3-1)

$C_c \rightarrow S_2 \rightarrow KL/r = S_2 \rightarrow F_c$

$C_c = S_2$ (E.3-4)

$C_c = 0.41\, B_c/D_c$ (TABLE B4.2)

– THIS IS FOR COMPRESSION IN COLUMNS & BEAM FLANGES, ALL FRAME ELEMENTS ACT AS BEAMS & COLUMNS, SINCE ALL MEMBERS ARE EXPOSED TO COMBINED BENDING & AXIAL FORCES

$$B_c = F_{cy}\left(1+\left(\frac{F_{cy}}{2250(1)}\right)^{1/2}\right) = 35ksi\left(1+\left(\frac{35ksi}{2250(1ksi)}\right)^{1/2}\right)$$

$$= 39.37ksi$$

$$D_c = \frac{B_c}{10}\left(\frac{B_c}{E}\right)^{1/2} = \frac{39.37ksi}{10}\left(\frac{39.37ksi}{10{,}100ksi}\right)^{1/2}$$

$$= 0.246ksi$$

$$C_c = 0.41\left(\frac{39.37ksi}{0.246ksi}\right) = 65.67$$

$$\frac{KL}{r} = \frac{(1.0)(4'-6")}{0.93} = 58.06$$

SINCE 58.06 < 65.67

$$F_c = 0.85(B_c - D_c(KL/r)) \le F_{cy}$$

$$= 0.85(39.37ksi - 0.246ksi(58.06)) < 35ksi$$

$$= 21.32ksi < 35ksi \checkmark$$

– $P_n = F_c A_g$

$= 21.32ksi(1.03in^2)$

$= 21.96k$

$\Phi P_n = 0.9(21.96k)$

$= 19.77k$

ΦP_n

– SINCE THIS IS A ROUND TUBE, FLEXURAL BUCKLING & LOCAL BUCKLING WILL NOT GOVERN.

SUMMARY: COMPRESSIVE STRENGTH
$\Phi P_n = 19.77k$

Client: WINE HISTORY PROJECT

Project: PRIMITIVO – FLEXURAL CAPACITY OF MEMBERS

Sheet: F4 of F8

Job No:

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Engineer: EAV

FLEXURAL STRENGTH (ADM F)

$M_n = 1.17 F_{cy} S$ (TENSILE YIELDING & COMPRESSIVE YIELDING) (F.6.1)

$= 1.17(35ksi)(0.647in^3)$

$= 26.5 k\,in$

$\phi M_n = 0.9(26.5ksi) \longrightarrow 23.86ksi$

$M_n = 1.24 F_{tu} S / k_t$ (TENSILE RUPTURE) (F.6.1)

$= 1.24(38ksi)(0.647in^3)/1.1$

$= 27.72\ kin$

$\phi M_n = 0.75(27.72kin) = 20.79 kin$

ϕM_n

$M_n = F_b S$ (LOCAL BUCKLING) (F.6.2)

$$F_b = \frac{\pi^2 E}{16\left(\frac{R_b}{t}\right)\left(1 + \frac{\sqrt{R_b/t}}{35}\right)^2} =$$

$$= \frac{\pi^2 (10,100ksi)}{16\left(\frac{1.375''}{.125''}\right)\left(1 + \frac{(1.375/.125)^{1/2}}{35}\right)^2}$$

$= 472.57ksi$

$M_n = 472.57ksi(0.647in^3)$

$= 305.75ksi$

$\phi M_n = 0.9(305.75ksi)$

$= 275ksi$

SUMMARY: FLEXURAL STRENGTH

$\phi M_n = 20.79kin$

Client: WINE HISTORY PROJECT

Project: PRIMITIVO – SHEAR CAPACITY OF MEMBERS

Sheet: F5 of F8

Job No:

Date: 11/24/19

Engineer: EAV

SHEAR STRENGTH (ADM G)

$V_n = F_s A_g / 2$ NOMINAL SHEAR STRENGTH (G.3-1)

$F_{sy} = 0.6 F_{ty}$ (TABLE A.3.1)

$= 0.6(35ksi)$

$= 21ksi$

$F_s = F_{sy}$ ∴ $V_n = 21ksi(1.03in^2)/2$

$= 20.4kips$ (YIELDING)

$\Phi V_n = 0.9(20.4kips)$

$= 18.35kips$

ΦV_n

CONCLUSION: SHEAR CAPACITY

$\Phi V_n = 18.35kips$

Client: WINE HISTORY PROJECT

Project: PRIMITIVO — STRESSES IN CURVED ELEMENTS

Job No:

Date: 11/24/19

Engineer: EAV

STRESSES IN CURVED ELEMENTS (ADM H3.2)

(EQUATION H3-3)

$$f_c/\phi F_c + f_b/\phi F_b + [f_s/\phi F_s]^2 \le 1.0 \xrightarrow{\text{SIMILARLY}} \frac{P_d}{\phi P_n} + \frac{M_d}{\phi M_n} + \left(\frac{V_d}{\phi V_n}\right)^2 \le 1.0$$

FROM PREVIOUS PAGES

$\phi P_n = 19.77K$

$\phi M_n = 20.79 Kin$

$\phi V_n = 18.35 Kips$

FROM SAP2000 MODEL

WORST AXIAL FORCE $P_d = 3.685K$ — (FRAME 276 LOAD COMBO LRFD EQN 4)

WORST SHEAR FORCE $V_d = 0.525K$ — (FRAME 145 LOAD COMBO LRFD EQN 4)

WORST MOMENT FORCE $M_d = 6.657Kin$ — (FRAME 12 LOAD COMBO LRFD EQN 3)

PLUGGING INTO EQN (H3-3)

$$\frac{P_d}{\phi P_n} + \frac{M_d}{\phi M_n} + \left(\frac{V_d}{\phi V_n}\right)^2 \le 1.0$$

$$\frac{3.685K}{19.77K} + \frac{6.657Kin}{20.79Kin} + \left(\frac{0.525K}{18.35K}\right)^2 \le 1.0$$

$$0.186 + 0.320 + 0.0008 \le 1.0$$

$$0.507 \le 1.0$$

ALL MEMBERS OKAY ✓

SUMMARY: 2 3/4" OD x 1/8" thk ALUMINUM 6061-T6 ROUND TUBING IS SAFE TO USE FOR ALL MEMBERS IN STRUCTURE

FRAME DESIGN CONTINUED

- FRAME 340, 62, 342 FROM SAP2000, ARE THE ONLY MEMBERS THAT EXCEED 4'6" DISTANCE, SO THE COMPRESSIVE STRENGTH WILL HAVE TO BE REVISITED.

$\phi M_n = 20.79 kin$ (STAYS THE SAME) P.g ____

$\phi V_n = 18.35K$ (STAYS THE SAME) P.g ____

FOR FRAME MEMBER, COMPRESSIVE STRENGTH IS AS FOLLOWS (ADM E)

$P_n = F_c A_g$ (E.3-1)

$C_c = 65.67 = S_2$ P.g ____

$\frac{KL}{r} = \frac{(1.0)(6.5')}{0.93} = 83.87$ FRAME (340) $\frac{KL}{r} > C_c$

$\frac{KL}{r} = \frac{1.0(5.5')}{0.93} = 70.96$ FRAME (62) $\frac{KL}{r} > C_c$ ∴ $F_c = \frac{0.85\pi^2 E}{(\frac{KL}{r})^2}$

$\frac{KL}{r} = \frac{1.0(5.6')}{0.93} = 64.52$ FRAME (342) $\frac{KL}{r} < C_c$ & $F_c = 0.85(B_c - D_c\frac{KL}{r}) < F_{cy}$

$B_c = 39.37ksi$ P.g ____

$D_c = 0.246$ P.g ____

FRAME 342

$F_c = 0.85(39.37ksi - 0.246(64.52))$
$= 19.97ksi < 35ksi = F_{cy}$ ✓

$\phi P_n = F_c A_g$
$= 0.9(19.97ksi)(1.03in^2)$
$\phi P_n = 18.5kips$

FROM SAP2000 MODEL, (DEMAND FORCES)
P = 0.725K (LRFD EQ 3)
V = 0.035K (LRFD EQ 3)
M = 1.854Kin (LRFD EQ 3)

ADM EQN H3-3

$$\frac{P_d}{\phi P_n} + \frac{M_d}{\phi M_n} + \left(\frac{V_d}{\phi V_n}\right)^2 < 1.0 \longrightarrow \frac{0.725K}{18.5K} + \frac{1.854kin}{20.79kin} + \left(\frac{0.035K}{18.35K}\right)^2$$

$= 0.128 < 1.0$ ✓ FRAME 342 IS OK

FRAME DESIGN CONTINUED

FRAME 62

$$F_c = \frac{0.85\pi^2 E}{\left(\frac{KL}{r}\right)^2} = \frac{0.85\pi^2(10{,}100\text{ksi})}{(70.96)^2}$$

$$= 16.83\text{ksi}$$

$$\phi P_n = F_c A_g$$
$$= 16.83\text{ksi}\,(1.03\text{in}^2)(0.9)$$
$$= 15.60\text{kips}$$

FROM SAP2000 MODEL (DEMAND FORCES)

$P = 2.018\text{k}$ (LRFD EQ 3)
$V = 0.044\text{k}$ (LRFD EQ 3)
$M = 3.078\text{kin}$ (LRFD EQ 3)

ADM EQN H3-3

$$\frac{P_d}{\phi P_n} + \frac{M_d}{\phi M_n} + \left(\frac{V_d}{\phi V_n}\right)^2 \le 1.0 \longrightarrow \frac{2.018\text{k}}{15.6\text{k}} + \frac{3.078\text{kin}}{20.79\text{kin}} + \left(\frac{0.044\text{k}}{18.35\text{k}}\right)^2$$

$$= 0.277 \le 1.0$$ FRAME 62 OK ✓

FRAME 340

$$F_c = \frac{0.85\pi^2 E}{\left(\frac{KL}{r}\right)^2} = \frac{0.85\pi^2(10{,}100\text{ksi})}{(83.87)^2}$$

$$= 12.05\text{ksi}$$

$$\phi P_n = F_c A_g$$
$$= 0.9(12.05\text{ksi})(1.03\text{in}^2)$$
$$= 11.166\text{kips}$$

FROM SAP2000 MODEL (DEMAND FORCES)

$P = 0.959\text{kip}$ (LRFD EQN 3)
$V = 0.072\text{kip}$ (LRFD EQN 3)
$M = 4.85\text{kin}$ (LRFD EQN 3)

ADM EQN H3-3

$$\frac{P_d}{\phi P_n} + \frac{M_d}{\phi M_n} + \left(\frac{V_d}{\phi V_n}\right)^2 \le 1.0 \longrightarrow \frac{0.959\text{kip}}{11.166\text{kip}} + \frac{4.85\text{kin}}{20.79\text{kin}} + \left(\frac{0.072\text{kip}}{18.35\text{k}}\right)^2$$

$$= 0.319 \le 1.0$$ FRAME 340 OK ✓

SUMMARY: FRAMES 340, 62, & 342 PASS COMBINED STRESS CHECKS.

Wind Analysis

Client: WINE HISTORY PROJECT
Project: PRIMITIVO — WIND PRESSURES

Sheet: W1 of W3
Job No:
Date: 11/21/19
Engineer: EAV

ASCE 7-16 CH. 26 GENERAL REQUIREMENTS

BASIC WIND SPEED V = 92 mph (7-16, Fig 26.5-1B)

WIND DIRECTIONALITY FACTOR, K_d = 0.95 (7-16, TABLE 26.6-1)

- FOR ROUND OR OCTAGONAL STRUCTURES W/ NONAXISYMMETRIC STRUCTURAL SYSTEM

EXPOSURE C [7-16 26.7.3]

- SURFACE ROUGHNESS C

TOPOGRAPHIC FACTOR, K_{zt} = 1.0 (7-16, 26.8)

- NO ESCARPMENT OR 2D RIDGE

GROUND ELEVATION FACTOR K_e = 1.0 (7-16, TABLE 26.9-1)

VELOCITY PRESSURE q_z = 17.5 PSF (7-16, 26.10)

$q_z = 0.00256(0.85)(1.0)(0.95)(1.0)(92\text{ mph})^2$
$= 17.5$ PSF

W/ H < 15' K_z = 0.85 (7-16, TABLE 26.10-1)

GUST EFFECT FACTOR = 0.85 (7-16, 26.11)

- LOW RISE BUILDINGS ARE PERMITTED TO BE CONSIDERED RIGID

ENCLOSURE CLASSIFICATION [7-16, 26.2]

- PARTIALLY ENCLOSED

INTERNAL PRESSURE COEFFICIENT, GC_{pi} = +0.55 / −0.55 (7-16, TABLE 26.13-1)

ASCE 7-16 CH. 27 DIRECTIONAL PROCEDURE

STEP (1-5) SHOWN ABOVE

STEP (6) → [C_p], USING (ASCE 7-16, FIG 27.3-3) → ARCHED ROOF

- RISE TO SPAN RATIO: 9' / 24' = 0.375 = r

ROOF SPRINGING FROM GROUND LEVEL	WINDWARD QUARTER	CENTER HALF	LEEWARD QUARTER
	1.4r	−0.7−r	0.5
C_p	0.525	−1.075	0.5
p	−1.8 PSF 17.4 PSF	−25.6 PSF	−2.2 PSF 17.1 PSF

STEP (7) USE (ASCE 7-16 EQN 27.3-1) →

$p = qGC_p - q_i(GC_{pi})$

$q_z = q_h = q = q_i$

Serviceability Check

Client: WINE HISTORY PROJECT

Project: PRIMITIVO - SERVICEABILITY DEFLECTIONS

Sheet: W2 of W3

Job No:

Date: 11/21/19

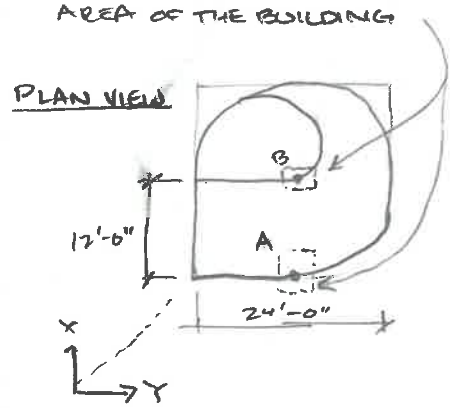
Engineer: EAV

DEFLECTION LIMITATIONS (VERTICAL)

[IBC 2018 TABLE 1604.3]

FOR ROOF MEMBERS	LIVE	DEAD + LIVE
SUPPORTING NONPLASTER CEILING	$\ell/240$	$\ell/180$

WORST DEFLECTIONS OCCUR IN THIS AREA OF THE BUILDING



∴ Pt's A & B. I WILL USE ℓ OF 24'-0" FOR DEFLECTION LIMITATION

- LIVE

$$\frac{24'(12''/1')}{240} = 1.2''$$

- DEAD + LIVE

$$\frac{24'(12''/1')}{180} = 1.6''$$

FROM SAP2000 MODEL, WORST DEFLECTIONS

D+L	−1.67"	$\frac{1.67}{1.6} = 1.04$	✓ OK
L	−0.96"	$\frac{0.96}{1.2} = 0.8$	✓

- THE D+L IS WITHIN 4% OF RECOMMENDED IBC DEFLECTION LIMIT. I WOULD SAY THIS IS OK ✓.

VERTICAL DEFLECTIONS ARE OKAY ✓

NOTE: AS STATED IN WEST & FISHER'S ARTICLE, "Serviceability Limit States Under Wind Load", PUBLISHED IN 2003, "NONE OF THE THREE NATIONAL BUILDING CODES IN THE UNITED STATES SPECIFY A LIMIT TO LATERAL FRAME DEFLECTION UNDER WIND LOAD."

THIS IS IMPORTANT BECAUSE THIS LIMIT IS LEFT TO ENGINEERING JUDGEMENT. CURRENTLY WEST & FISHER RECOMMEND A LIMIT FROM **H/100 to H/600**, WHERE H/100 APPLIES TO **METAL PANELS**, THE REASON FOR THIS MAY BE DUE TO THE METAL PANELS BEING MORE ~~BRITTLE~~ & FLEXIBLE AS COMPARED TO OTHER MATERIALS. THIS PROJECT USES **FABRIC** WHICH IS VERY FLEXIBLE & THAT IS WHY MY LIMITED ENGINEERING JUDGEMENT SAYS TO USE H/100 ~ H/60. THIS LIMIT WAS MADE TO PROTECT YOUR EXTERIOR CLADDING, WHICH IN MY CASE IS FABRIC.

W/ A HEIGHT OF H=9', I CONCLUDE DRIFT LIMITATIONS ARE LIMITED TO A RANGE FROM 1.8" ~ 1.08" & LOWER.

FROM SAP2000 MODEL, WORST LATERAL DEFLECTIONS ARE

NODE 30 1.24" (LRFD EQN 4)
NODE 133 0.73" (LRFD EQN 4)

1.24 IS WITHIN 1.8" < 1.24" ≤ 1.08" ✓

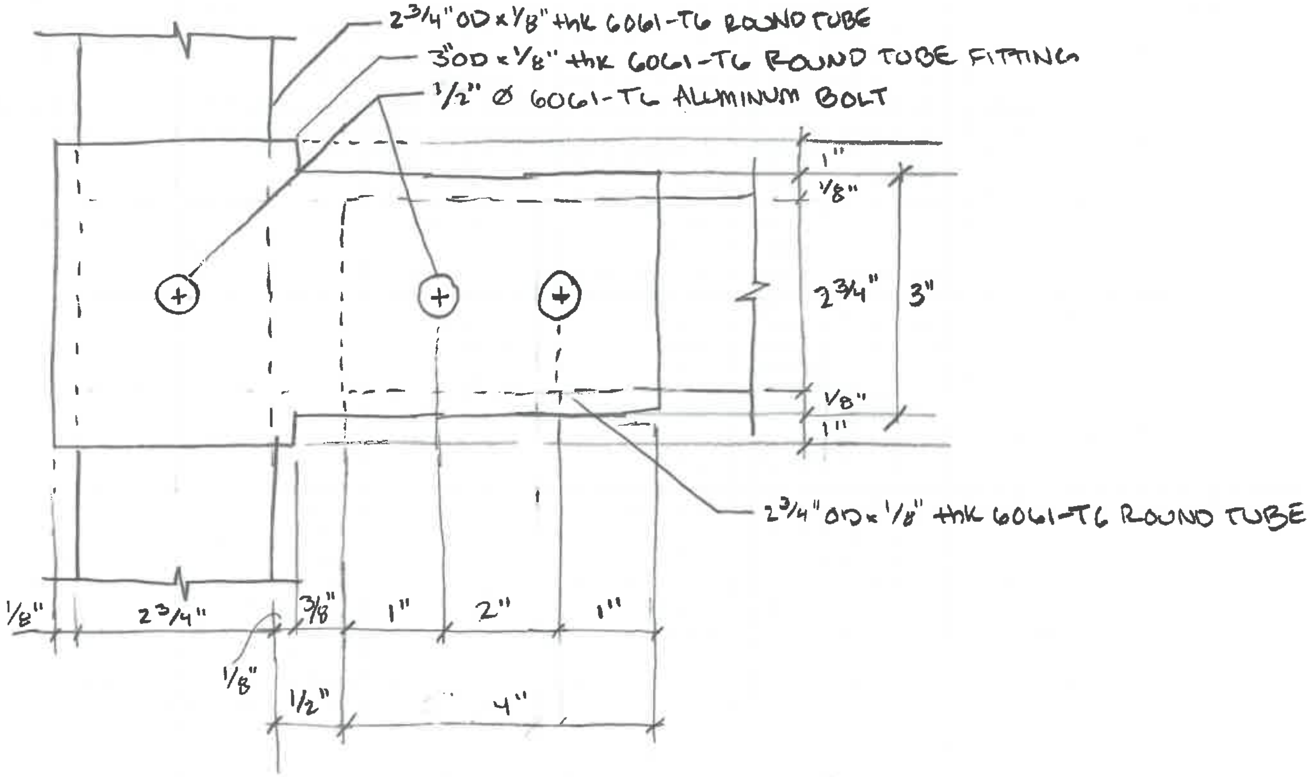
WIND DRIFT SERVICEABILITY CHECK PASSES

Connection Design

Slotted Connection

Client: WINE HISTORY PROJECT | Sheet: C1 of C13
Project: PRIMITIVO-CONNECTION DESIGN
SLOTTED CONNECTION | Job No:
Date: 11/26/19
Engineer: EAV

CASE (1) (ALUMINUM ROUND TUBE FITTINGS)



MATERIAL PROPERTIES

6061-T6 ⟶ E = 10,100 ksi

F_{tu} = 38 ksi

F_{su} = 24 ksi

CAPACITY SUMMARY

(ADM J3.5)	BOLT TENSION	6.47K
(ADM J3.6)	SHEAR RUPTURE	8.112K
(ADM J3.7)	BOLT BEARING	7.125K
(AISC 360-10 J4-5)	BLOCK SHEAR	8.34K
ENGINEERING JUDGEMENT	MOMENT CAPACITY	6.50 Kin

Client: WINE HISTORY PROJECT

Project: PRIMITIVO-CONNECTION DESIGN

SLOTTED CONNECTION

Job No:

Date: 11/26/19

Engineer: EAV

BOLT TENSION (ADM J3.5)

$$R_n = \frac{\pi\left(D - \frac{1.191}{n}\right)^2}{4} F_{tu} = \frac{\pi\left(1/2'' - 1.191/13\right)^2}{4} \; 38\,ksi$$

$= 0.13\ in^2 (38\,ksi)(2\ \text{BOLTS})$

$= 9.95\,K$

D = 1/2" ⌀ OF BOLT

n = 13 Threads Per Inch

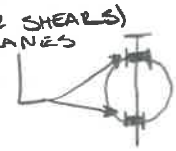
$\phi R_n = 0.65(9.95\,K)$

$= 6.47\,K$

SHEAR RUPTURE (ADM J3.6)

$$R_n = \frac{\pi\left(D - 1.191/n\right)^2}{4} F_{su} = 0.13\ in^2 (24\,ksi)(2\ \text{BOLTS})(2\ \text{SHEARS PLANES})$$

$= 12.48\,K$



CROSS SECTION

$\phi R_n = 0.65(12.48\,K)$

$= 8.112\,K$

BOLT BEARING (ADM J3.7)

$R_n = d_e t F_{tu} \le 2 D t F_{tu}$

d_e = 1" EDGE DISTANCE

t = 1/4" thk OF CONNECTED PART

$R_n = 1''(1/4'')(38\,ksi) \le 2(5/8'')(1/4'')(38\,ksi)$

$9.5\,K \le 11.875\,K$

$\phi R_n = 0.75(9.5\,K)$

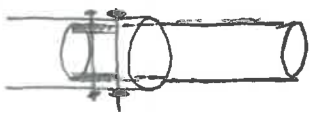
$= 7.125\,K$

BLOCK SHEAR (AISC 360-10, J4-5)

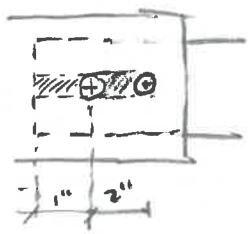
* NOTE: ADM DOES NOT ADDRESS BLOCK SHEAR EQN, BUT AISC 360-10 PROVIDES A WAY TO CHECK IT. STEEL CODE IS OKAY TO USE HERE BECAUSE THE ALUMINUM BEHAVES SIMILARLY.

$R_n = 0.60 F_u A_{nv} + U_{bs} F_u A_{nt} \leq 0.60 F_y A_{gv} + U_{bs} F_u A_{nt}$

- BLOCK SHEAR FAILURE 1



SO



FAILURE FROM INNER ALUMINUM ROUND TUBE

$A_{gv} = 2(3")(1/8") = 0.75 in^2$

$A_{nv} = A_{gv} - 2 cuts (1/8 thk)(1.5 Ø)(1/2") = 0.5625 in^2$

$A_{nt} = 0$ (REALLY SMALL SO I USED 0.

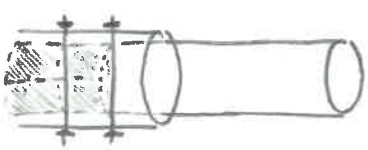
$R_n = 0.60(38)(0.5625) + 1.0(38)(0) \leq 0.60(35)(0.75) + 1.0(38)(0)$

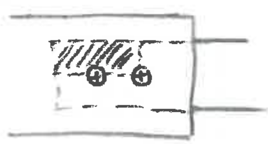
$12.825k \leq 15.75k$

$\phi R_n = 0.65(12.825)$

$= 8.34k$

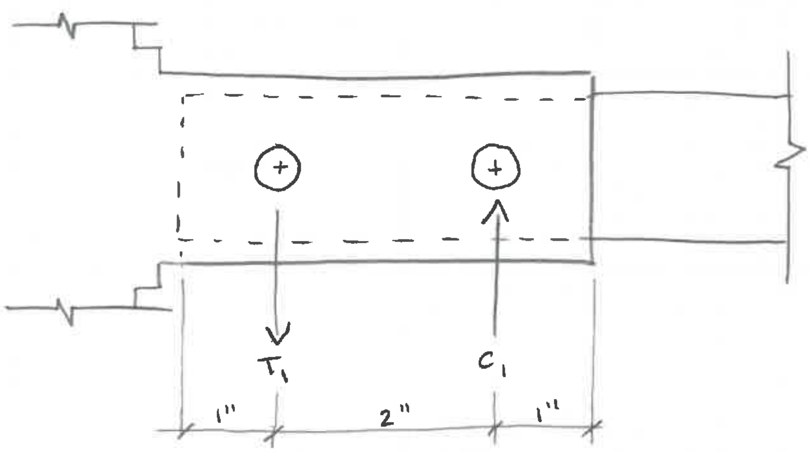
- BLOCK SHEAR FAILURE 2





BLOCK SHEAR 2 WILL NOT GOVERN SINCE IT WILL RESULT IN A GREATER CAPACITY THAN BLOCK SHEAR 1 FAILURE

MOMENT CAPACITY



USING THE BOLT TENSION CAPACITY

$\phi R_n = 6.47k$ (FOR 2 BOLTS)

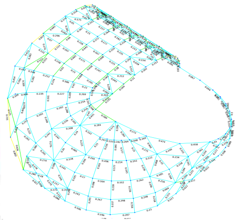
$= 3.235k$ (FOR 1 BOLT)

MOMENT CAPACITY

$\phi M_{CAP} = T_1 (M_{ARM})$

$= 3.235k(2")$

$= 6.47 k\text{in}$



Client: WINE HISTORY PROJECT

Project: PRIMITIVO - CONNECTION DESIGN

SLOTTED CONNECTION

Sheet: C5 of C13

Job No:

Date: 11/26/19

Engineer: EAV

SUMMARY REPORT FOR ALUMINUM ROUND TUBE FITTING W/ 1/2" Ø BOLTS

BOLT TENSION	$\phi R_n = 6.47$ K
SHEAR RUPTURE	$\phi R_n = 8.11$ K
BOLT BEARING	$\phi R_n = 7.13$ K
BLOCK SHEAR	$\phi R_n = 8.34$ K
MOMENT CAPACITY	$\phi M_n = 6.47$ Kin

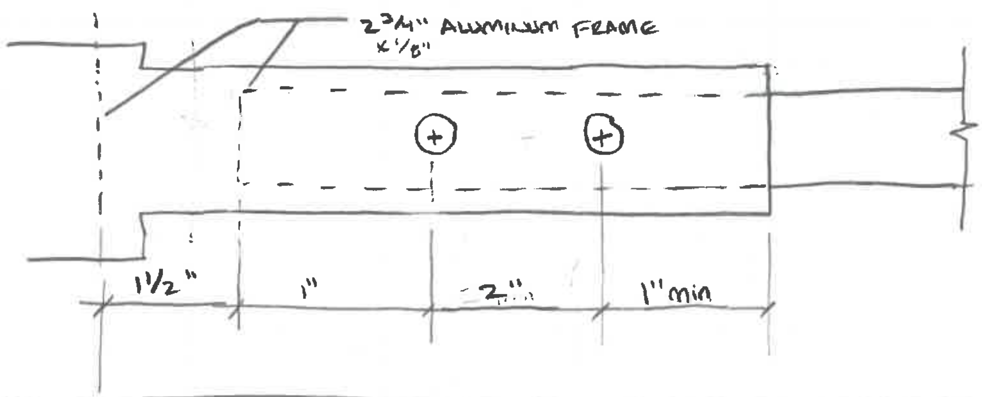
SAP2000 ELEMENT JOINT FORCES → MAX VALUES

	VALUE	JOINT	LOAD COMBO
MAX AXIAL	3.608K	85	LRFD EQ4
MAX SHEAR	0.525K	70,75	LRFD EQ4
MAX MOMENT	6.657Kin	13	LRFD EQ3

FITTING $\phi R_n = 6.47K$ d/c 3.61K/6.47K — 0.56 < 1 ✓

$\phi M_n = 6.47K_{in}$ d/c 6.657Kin/6.47Kin — 1.03 ≈ 1 within 5% ok ✓

CONCLUSION: 3" OD × 1/8" CUSTOM FITTING SLOT CONNECTION W/ 1/2" Ø BOLTS WORKS FOR ANY FRAME CONNECTION.



Client: WINE HISTORY PROJECT

Project: PRIMITIVO-CONNECTION DESIGN

SLOTTED CONNECTION

Sheet: C6 of C13

Job No:

Date: 11/26/19

Engineer: EAV

NOTE: EVERY CONNECTION WILL BE CUSTOM MADE. EVERY FRAME WILL SLIDE INTO A SLOT WITH TWO 1/2" Ø BOLT HOLES SPACED APART 2" WITH 1" MIN EDGE DISTANCE. THE PREVIOUS PAGE SHOWS HOW THAT DETAIL WILL LOOK.

EXAMPLES OF JOINT CONNECTS.

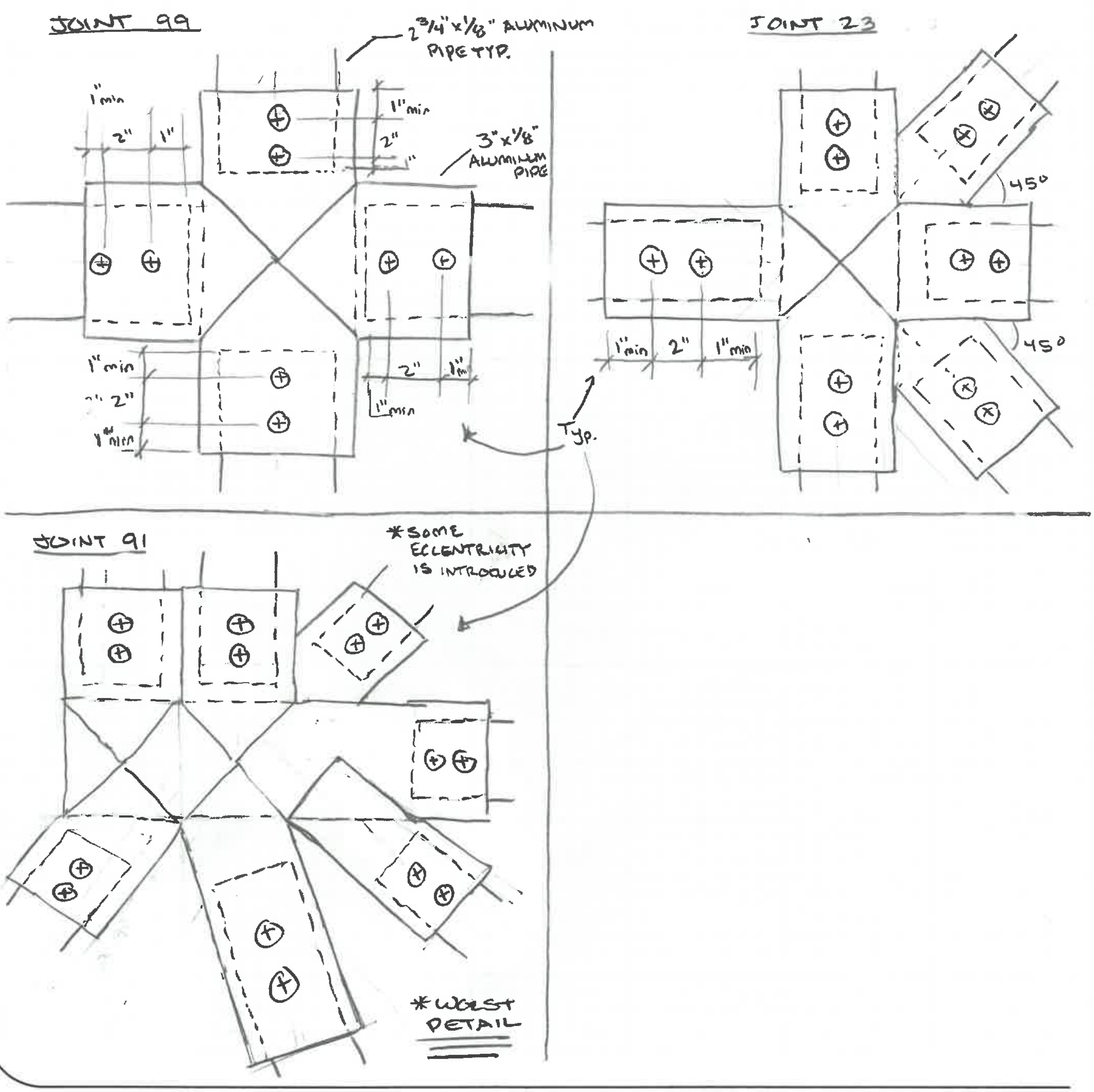


Plate Design

Client: WINE HISTORY PROJECT

Project: PRIMITIVO - PLATE DESIGN

Sheet: C7 of C13

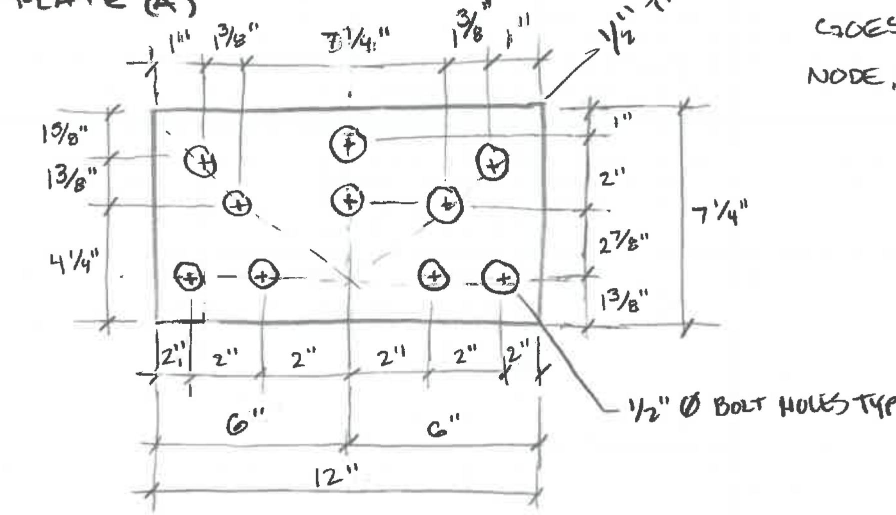
Job No:

Date: 12/10/19

Engineer: EAV

TYPES OF PLATES (NOT TO SCALE)

PLATE (A)



GOES ON EVERY FOUNDATION NODE, EXCEPT ON NODE 64.

PLATE (B)

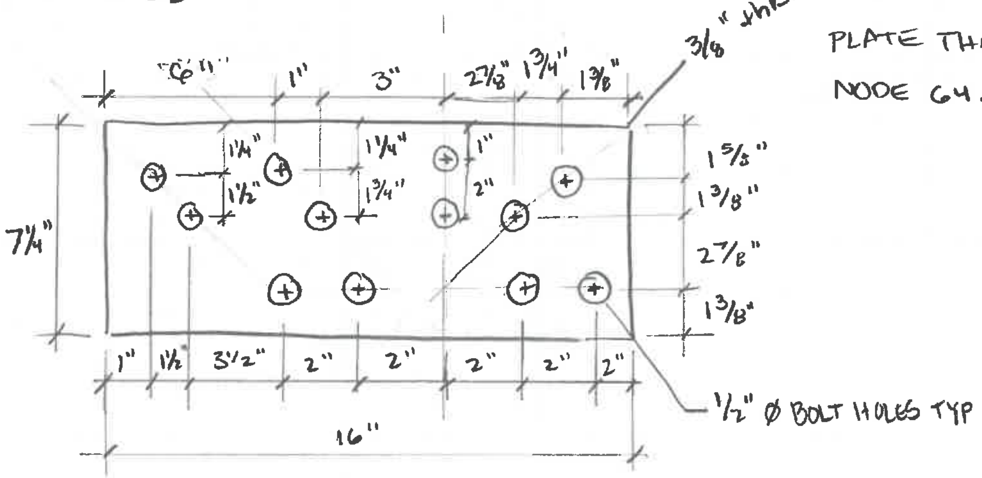
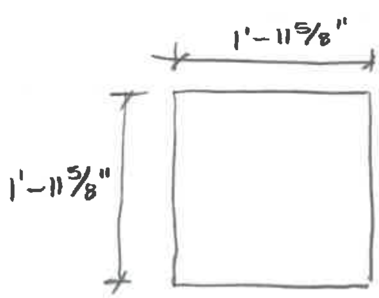


PLATE THAT GOES ON NODE 64.

PLATE (C)



BASE PLATE ON TOP OF EVERY FOUNDATION SYSTEM

Client: WINE HISTORY PROJECT

Project: PRIMITIVO – PLATE DESIGN

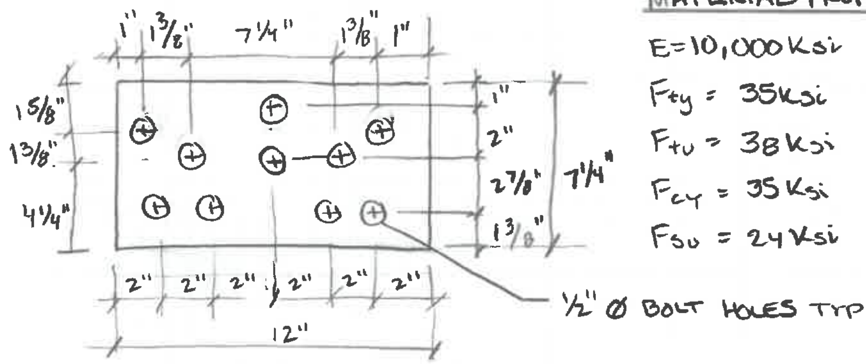
Sheet: C8 of C13

Job No:

Date: 12/10/19

Engineer: EAV

PLATE DESIGN CASE (A)



MATERIAL PROPERTIES

E = 10,000 ksi

F_{ty} = 35ksi F_{tyw} = 11ksi

F_{tu} = 38ksi F_{tuw} = 24ksi

F_{cy} = 35ksi F_{cyw} = 11ksi

F_{su} = 24ksi F_{suw} = 15ksi

* WHOLE BOTTOM PART OF PLATE IS WELDED TO ANOTHER PLATE

– TRYING 1/2" PLATE

– TENSILE YIELDING (ADM D.2a)

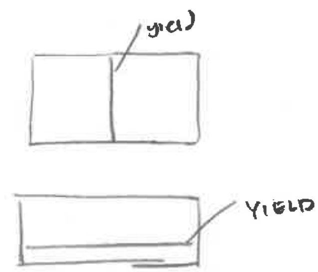
$\Phi P_n = F_{ty}(A_g - A_{wz}) + F_{tyw} A_{wz}$

VERTICALLY

$\Phi P_n = [35ksi[7 1/4"(1/2") - 1"(1/2")] + 11(1"(1/2"))]\, 0.9$
$= 103.4k$

HORIZONTALLY

$\Phi P_n = [11ksi(12"(1/2"))](0.9)$
$= 59.4k$



– TENSILE RUPTURE (ADM D.2b)

$\Phi P_n = F_{tu}(A_e - A_{wz})/k_t + F_{tuw} A_{wz}$

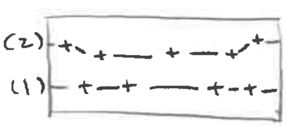
HORIZONTALLY

TWO RUPTURE PLANES

RUPTURE 1 $A_e = 12(1/2) - 4(1/2 + 1/16)(1/2) = 4.875"$

RUPTURE 2 $A_e = 12(1/2) - 3(1/2 + 1/16)(1/2) + \frac{2(1.375)^2(1/2)}{4(1.375)} = 4.94"$

RUPTURE 1 GOVERNS



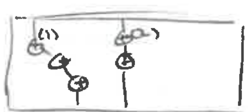
$\Phi P_n = 0.75(24ksi(4.875"))$ (WELD AFFECTED)
$= 87.75k$

VERTICALLY

TWO RUPTURE PLANES

RUPTURE 2 $A_e = 7 1/4(1/2) - (1/2 + 1/16)(2)(1/2) = 3.0625"$

RUPTURE 1 $A_e = 7 1/4(1/2) - 3(1/2)(1/2 + 1/16) + \frac{1.375^2(1/2)}{4(1.375)} + \frac{(3/8)^2(1/2)}{4(2.875)} = 2.96"$



$\Phi P_n = [38(2.96 - 1(1/2)) + 24(1)(1/2)]\, 0.75$
$= 79.11k$

COMPRESSION STRENGTH (ADM E)

$\phi P_n = \phi [P_{no}(1 - A_{wz}/A_g) + P_{nw}(A_{wz}/A_g)]$ (ADM E.6-1)

STEPS (1) FIND $B_p \rightarrow D_p \rightarrow C_p$

(2) $kL/r \rightarrow F_c$

(3) $P_{no}, P_{nw} \rightarrow \phi P_n$

C_{po} (NOT WELD AFFECTED)

$B_{po} = F_{cy}\left(1 + \left(\frac{F_{cy}}{1500(1)}\right)^{1/3}\right)$ TABLE B4.2

$= 35(1 + (35/1500)^{1/3})$

$= 45$

$D_{po} = B_p/10\,(B_p/E)^{1/2}$

$= \frac{45}{10}\left(\frac{45}{10{,}100}\right)^{1/2}$

$= 0.3$

$C_{po} = 0.41 B_p / D_p$

$= 0.41(45)/0.3$

$= 61.42 = S_2$

C_{pw} (WELD AFFECTED)

$B_{pw} = F_{cy}\left(1 + \left(\frac{F_{cyw}}{440(1)}\right)^{1/3}\right)$

$= 35\text{ksi}\,(1 + (35/440)^{1/3})$

$= 49.94$

$D_{pw} = \frac{B_p}{20}\left(\frac{6B_p}{E}\right)^{1/2}$

$= \frac{49.9}{20}\left(\frac{6(49.9)}{10{,}100}\right)^{1/2}$

$= 0.41$

$C_{pw} = \frac{2B_p}{3D_p} = \frac{2(49.94)}{3(0.41)}$

$= 50.15 = S_2$

HORIZONTAL

$\frac{KL}{r} = \frac{(1.0)(12")}{0.144} = 83.33 > S_2 = C_{po}\ \&\ C_{pw}$

$F_c = \frac{0.85\pi^2 E}{\left(\frac{KL}{r}\right)^2} = \frac{0.85\pi^2(10{,}100)}{(0.144)^2}$

$= 12.2\text{kips}$

$\phi P_n = 0.9[12.2\text{k}(12"(1/2"))]$

$= 65.9\text{kips}$

VERTICAL

$\frac{KL}{r} = \frac{(1.0)(7\,1/4")}{0.144} = 50.35$

$P_{no} = F_c A_g = 0.85(B_p - D_p(KL/r))\,A_g$

$= 0.85(45 - 0.3(50.35))(7.25(.5))$

$= 92.11\text{kips}$

$P_{nw} = \frac{0.85\pi^2 E}{\left(\frac{KL}{r}\right)^2} A_g$

$= \frac{0.85\pi^2(10{,}100)}{50.35^2}(7.25(.5))$

$= 121.16\text{kips}$

$\phi P_n = \left[92.11\left(1 - \frac{1(.5)}{7.25(.5)}\right) + 121.16\left(\frac{.5}{7.25(.5)}\right)\right]0.9$

$= 86.5\text{ kips}$

FLEXURAL CAPACITY (ADMF)

TENSION (FLEXURE)

$F_b = 1.30[F_{ty}(1 - A_{wzt}/A_{gt}) + F_{tyw} A_{wzt}/A_{gt}]$

HORIZONTAL

$F_b = 1.30[11(1)]$

$= 14.3\text{ksi}$

$\phi M_{nx} = F_b S_x = 0.9(14.3\text{ksi})(0.5)$ $\phi M_{ny} = 0.9(14.3\text{ksi})(12)$

$\phi M_{nx} = 6.44\text{kin}$ $= 154.4\text{kin}$

VERTICAL

$F_b = 1.30[35(1 - .5/7.25(.5)) + 11(.5/7.25(.5))]$

$= 41.2\text{ksi}$

$\phi M_{nx} = F_b S_x = 0.9(41.2\text{ksi})(0.3)$

$= 11.2\text{kin}$

$\phi M_{ny} = 0.9(41.2\text{ksi})(4.38)$

$= 162.4\text{kin}$

RUPTURE (FLEXURE)

$F_b = 1.42[F_{tu}(1 - A_{wzt}/A_{gt})/k_t + (F_{tuw} A_{wzt}/A_{gt})]$

HORIZONTAL

$F_b = 1.42(24\text{ksi})(1)$

$= 34\text{ksi}$

$\phi M_{nx} = F_b S_x = 0.75(34\text{ksi})(0.5) = 12.75\text{kin}$

$\phi M_{ny} = F_b S_y = 0.75(34\text{ksi})(12) = 306\text{kin}$

VERTICAL

$F_b = 1.42(38(1 - .5/7.25(.5))/k_t + 24(.5/7.25(.5)))$

$= 51.2\text{ksi}$

$\phi M_{nx} = F_b s_x = 0.75(51.2)(0.3) = 11.52\text{kin}$

$\phi M_{ny} = F_b s_y = 0.75(51.2)(4.38) = 168.2\text{kin}$

SHEAR CAPACITY ($\phi F_s A_g$)

HORIZONTAL $\phi V_n = 0.9(15\text{ksi})(12''(1/2)) = 81\text{kips}$

VERTICAL $\phi V_n = 0.9[15(.5/7.25(.5)) + 24(1 - .5/7.25(.5))] = 74.25\text{kips}$

Client: WINE HISTORY PROJECT

Project: PRIMITIVO PLATE DESIGN

Sheet: C11 of C13

Job No:

Date: 11/26/19

Engineer: EAU

SUMMARY OF PLATE CASE (A)

HORIZONTAL DIRECTION

TENSILE YIELDING	$\phi P_n = 59.4K$
TENSILE RUPTURE	$\phi P_n = 87.5K$
COMPRESSIVE STRENGTH	$\phi P_n = 69.9K$
FLEXURAL TENSION YIELDING	$\phi M_n = 6.44 \text{Kin}$
FLEXURAL TENSILE RUPTURE	$\phi M_n = 12.75 \text{Kin}$
SHEAR CAPACITY	$\phi V_n = 81 \text{Kips}$

VERTICAL DIRECTION

TENSILE YIELDING	$\phi P_n = 103.4K$
TENSILE RUPTURE	$\phi P_n = 79.1K$
COMPRESSIVE STRENGTH	$\phi P_n = 86.5K$
FLEXURAL TENSION YIELDING	$\phi M_n = 11.2 \text{Kin}$
FLEXURAL TENSILE RUPTURE	$\phi M_n = 11.52 \text{Kin}$
SHEAR CAPACITY	$\phi V_n = 74.3 \text{Kips}$

* THESE CAPACITIES CAN BE USED WHEN ANALYZING EACH SUPPORT CONNECTION. EXCEPT NODE 64. NODE 64 HAS ANOTHER PLATE DESIGN

Client: WINE HISTORY PROJECT

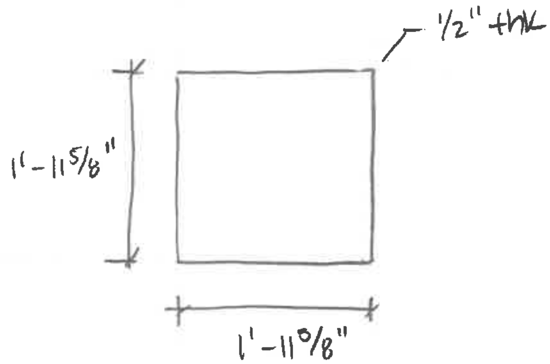
Project: PRIMITIVO - PLATE DESIGN

Job No:

Date: 12/13/19

Engineer: EAV

PLATE DESIGN CASE (C)



(BASE PLATE DESIGN)

MATERIAL PROPERTIES

$E = 10{,}100\,ksi$	$r_x =$	$A =$
$F_{tyw} = 11\,ksi$	$r_y =$	$I_x = 0.246\,in^4$
$F_{tuw} = 24\,ksi$	$S_x = 0.98\,in^3$	$I_y =$
$F_{cyw} = 11\,ksi$	$S_y =$	
$F_{suw} = 15\,ksi$		

(WHOLE PLATE IS WELD AFFECTED BECAUSE OF LONGITUDINAL WELD.

(TRYING 1/2" THK)

SHEAR CAPACITY

$\phi V_n = 0.75(24\,ksi)(23.625'')(1/2'')$

$= 212.625\,K$

FLEXURAL CAPACITY BY TENSION

$F_b = 1.30\,[F_{tyw}]$

$= 1.3(11\,ksi) = 14.3\,ksi$

$\phi M_n = F_b S_x$

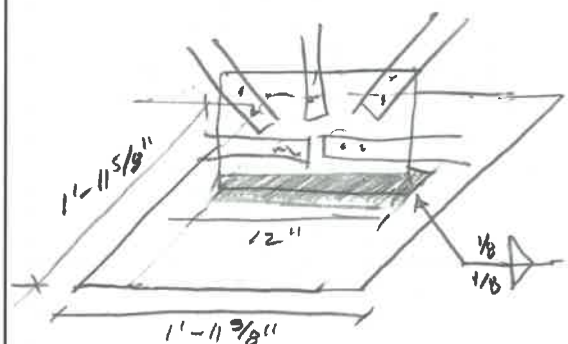
$= 0.9(14.3\,ksi)(0.98\,in^3)$

$= 12.67\,K\,in$

MODEL WAS DESIGNED WITH PINNED SUPPORTS SO 0 MOMENT SHALL BE RESISTED BY BASE PLATE. FURTHERMORE, 212.625K FOR SHEAR RESISTS MAX LATERAL FORCE OF 2.741 KIPS BASE PLATE IS OKAY TO USE FOR 1/2" THICKNESS

Weld Connection

FILLET WELD DESIGN



WELD PROPERTIES

USING FILLER 5356

$F_{suw} = 17ksi$

$F_{tuw} = 35ksi$

BASE METAL 6061 T6

$F_{suw} = 15ksi$

$F_{tuw} = 24ksi$

DETERMINING EFFECTIVE THROAT LENGTH & S_w

$\phi R_n = 0.75 F_{sw} L_{we}$ (ADM J.2.2.1)

WHERE F_{sw} = (a) F_{suw}(EFFECTIVE THROAT) $= 17(S_w\sqrt{2}/2) = 12 S_w$

(b) $F_{suw}(S_w) = 15(S_w) = 15 S_w$

(c) $F_{tuw}(S_w) = 24(S_w) = 24 S_w$

FROM SAP2000 MODEL MAX SUPPORT FORCES ARE AS FOLLOWS

MAX AXIAL	2.039k	FRAME	116	LRFD EQ 4
MAX SHEAR	2.741k	FRAME	138	LRFD EQ 4

$\therefore \phi R_n > 2.741k \leq 0.75 F_{sw} L_{we}$

$\leq 0.75(12 S_w)(12")(2 \text{ SIDES})$

$\leq 216k\, S_w$

$0.013" \leq S_w$

$\therefore$ 1/8" WELD WOULD WORK

USING 1/8" = S_w FOR FILLET WELD

$\phi R_n = 0.75(12(0.125)(12")(2 \text{ SIDES})$

$= 27$ kips

$\frac{2.74k}{27 kips} = 0.1 < 1$ ✓

USE FILLET WELD 1/8" LEG FOR 12" WELD EFFECTIVE LENGTH CENTERED AT BOTTOM OF PLATE ON EACH SIDE

Foundation Design

Client: WINE HISTORY PROJECT

Project: PRIMITIVO – FOUNDATION DESIGN

Sheet: FN1 of FN4

Job No:

Date: 11/25/19

Engineer: EAU

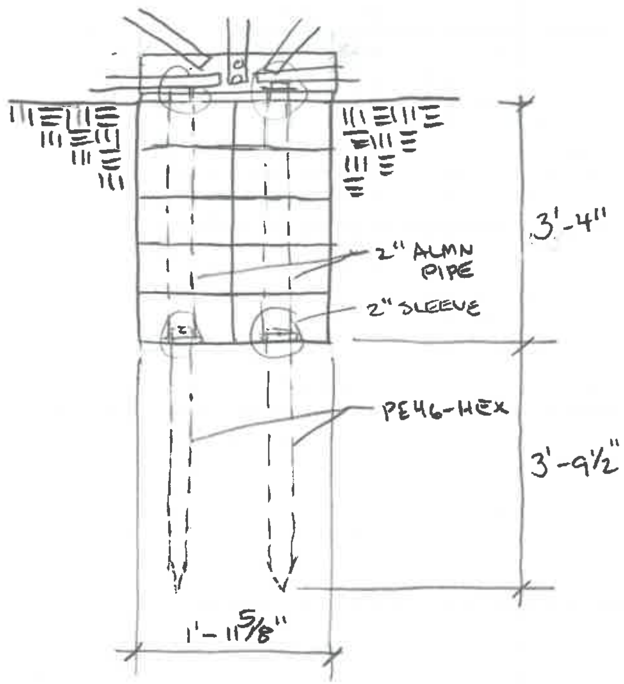
* NOTE: FOUNDATION PROVIDED BELOW IS COSTLY AND NOT A PERFERRED FOUNDATION SYSTEM. OTHER FOUNDATION SYSTEMS THAT WOULD WORK WOULD HAVE BEEN

(1) USE A CONTINOUS RING FOOTING CONNECTING ALL OF THE SUPPORTS TOGETHER.

(2) USE BATTER PILE FOUNDATION SYSTEM.

(3) IF AMERICAN EARTH ANCHORS PROVIDE LATERAL RESISTANCE FOR THEIR AUGER ANCHORS, AUGER ANCHORS CONNECTED TO A BASE PLATE MAY PROVIDE AN ADEQUATE FOUNDATION.

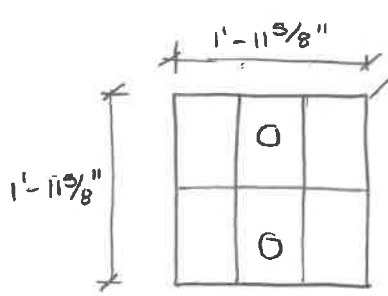
FOUNDATION SYSTEM



MATERIALS

30	8"x8"x12" CMU BLOCKS
1	1" ALUMINUM BASE PLATE
2	PE46-HEX
2	2" ALUMINUM PIPES
4	AMERICAN EARTH ANCHOR 2" SLEEVES.
4	½" ALUMINUM ANCHOR BOLTS
-	NON SHRINK GROUT TO FILL CMU BLOCKS.

* THIS FOUNDATION SYSTEM WORKS FOR EVERY SUPPORT EXCEPT NODES 64 & 116. FOR THOSE YOU JUST NEED TO ADD 1 MORE LAYER OF CMU BLOCKS, SO 36 CMU BLOCKS IN TOTAL.



TOP OF CMU

PLATE ON TOP OF CMU

Client: WINE HISTORY PROJECT

Project: PRIMITIVO - FOUNDATION DESIGN

Sheet: FN2 of FN4

Job No:

Date: 11/25/19

Engineer: EAV

ALLOWABLE BEARING PRESSURE CHECK

FROM CBC TABLE 1806.2

VERTICAL FOUNDATION PRESSURE	LATERAL BEARING PRESSURE
1,500 PSF	100PSF - 400PSF

* OUR TEACHER, DENNIS BASHAW (STRUCTURAL ENGINEER), RECOMMENDED TO USE A LATERAL BEARING PRESSURE OF 300PSF FROM HIS EXPERIENCE. FURTHERMORE, HE RECOMMENDED THAT THE FIRST 12" OF TOP SOIL ARE NOT USABLE.

BEARING CAPACITY

$$= 1500\,PSF\left[(23.625'')^2 - 2\pi(1'')^2\right](1ft^2/144in^2)/1000\#/k$$

↑ CMU AREA ↑ AREA OF 2" PIPE

$= 5.75k$

FROM SAP2000 MODEL, HIGHEST COMPRESSIVE LOAD IS AT SUPPORT NODE 64 WITH A LOAD OF 2.79K. SUPPORT NODE CAPACITIES ON APPENDIX A3

$$\frac{C}{D}\quad \frac{5.75k}{2.79k} = 2.06 > 2 = S.F.\ \text{FOR ASD}$$

UPLIFT CHECK

PE46-HEX AUGER ANCHORS WILL TAKE THE UPLIFT FORCE

CAPACITY PER ANCHOR = 2000# OF UPLIFT ⟶ SEE APPENDIX A4

WITH A S.F OF 2, CAPACITY = 1000#, & WITH 2 ANCHORS

TOTAL UPLIFT CAPACITY = 2000#

$$\overset{C}{2000\#} > \overset{D}{1.767k} \quad \checkmark$$

1.767 IS HIGHEST COMPRESSIVE LOAD AT SUPPORT NODE 138. RESULTS DISPLAYED ON APPENDIX A3

Client: WINE HISTORY PROJECT

Project: PRIMITIVO- FOUNDATION DESIGN

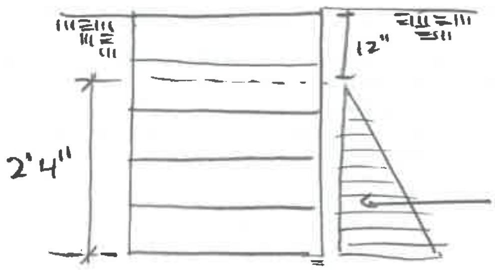
Sheet: FN3 of FN4

Job No:

Date: 11/25/19

Engineer: EAV

SLIDING CHECK (JUST RELYING ON THE CMU BLOCKS



300PSF/FT ← $P_P = \frac{3(h)^2(b)}{2}(1.33)$

P_P = LATERAL BEARING RESISTANCE

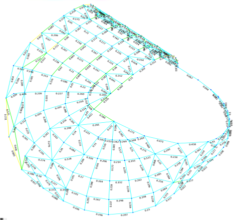
$P_P = \frac{300PSF/FT(28 \times 1''/12'')^2}{2}(23.625(1'/12''))\ (1.33)$

↑ b ↑ WIND

P_P = 2.14 Kips

HIGHEST LATERAL SUPPORT REACTION, BESIDES THE ONES ON NODE 64 & 116 IS 0.733 Kips. SEE APPENDIX PAGE A3

$\frac{2.14\text{Kips}}{0.733} = 2.9 > 1.5$ ✓ ASD & CBC REQUIRE A SF OF 1.5 SO WE ARE ✓

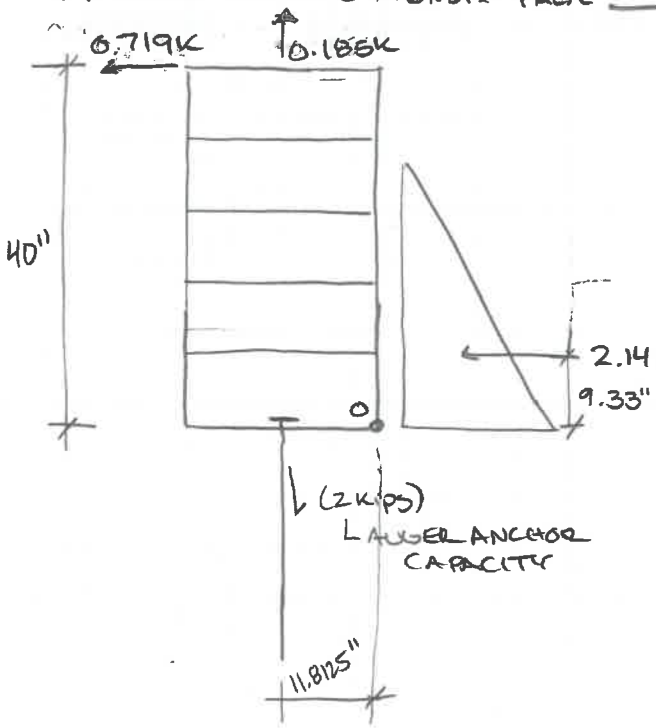


Client: WINE HISTORY PROJECT
Project: PRIMITIVO - FOUNDATION DESIGN

Sheet: FN4 of FN4
Job No:
Date: 11/25/19
Engineer: EAU

OVERTURNING CHECK

WORST OVERTURNING RESULTANT IS 2.214Kft (IGNORING OT MOMENTS ON NODES 64 & 116) BY NODE 124. SEE APENDIX PAGE A6



$M_{RESISTING}$ ABOUT O $= 2.14K(9.33/12) + 2(11.8/12)$
$= 3.63Kft$

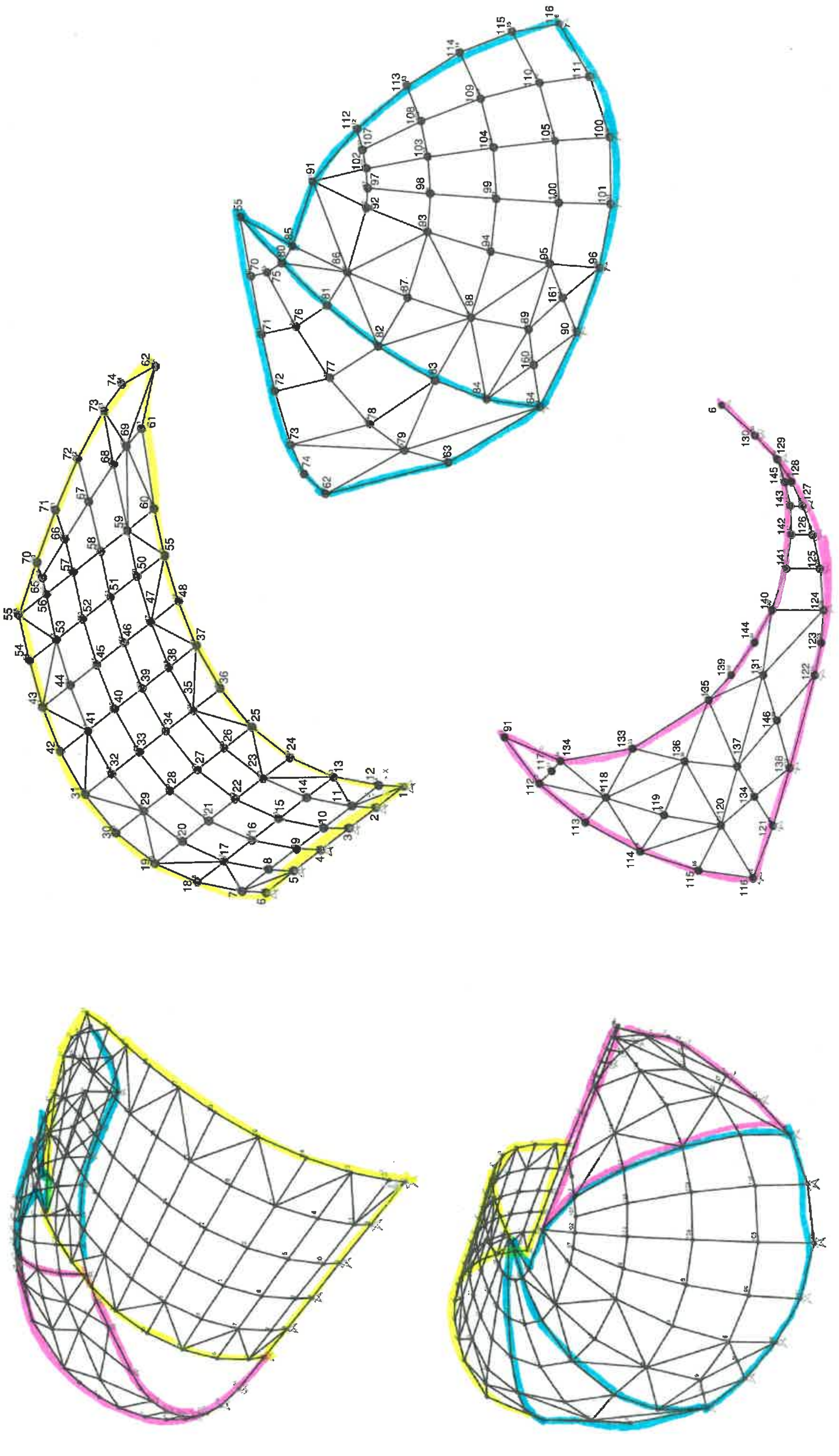
$M_{OVERTURNING}$ ABOUT O $= 0.719(40/12) - .185(11.8/12)$
$= 2.21Kft$

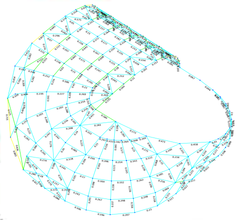
$$\frac{M_{RESIST}}{M_{OVERTURNING}} = \frac{3.63Kft}{2.21Kft} = 1.64 > 1.5 = SF \text{ FOR OVERTURNING}$$

FOUNDATION IS SAFE FOR OVERTURNING

Appendices

NODE LOCATIONS





Client: WINE HISTORY PROJECT

Project: PRIMITIVO - APPENDIX

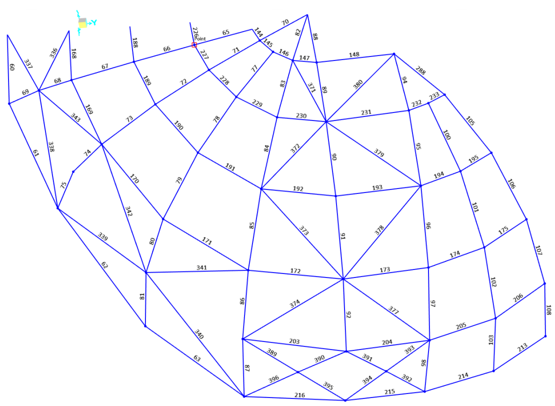
FRAME MEMBERS

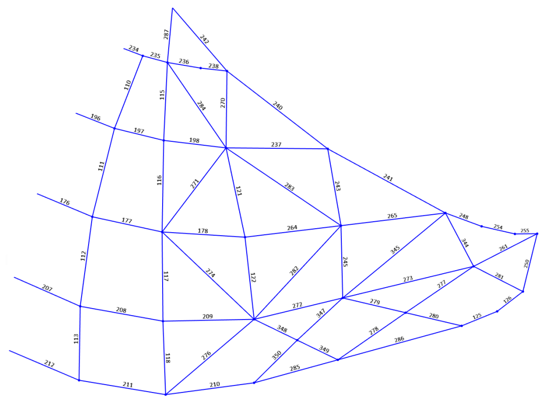
Sheet: A2 of A7

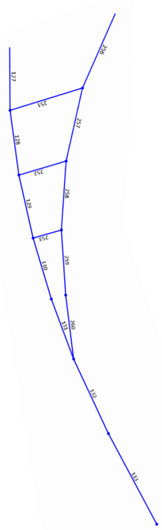
Job No:

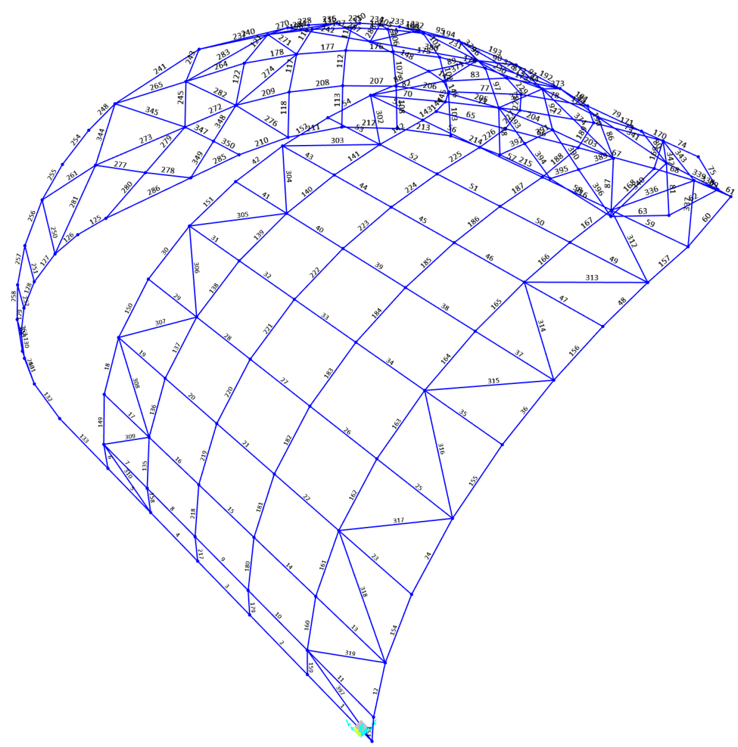
Date: 12/13/19

Engineer: EAU



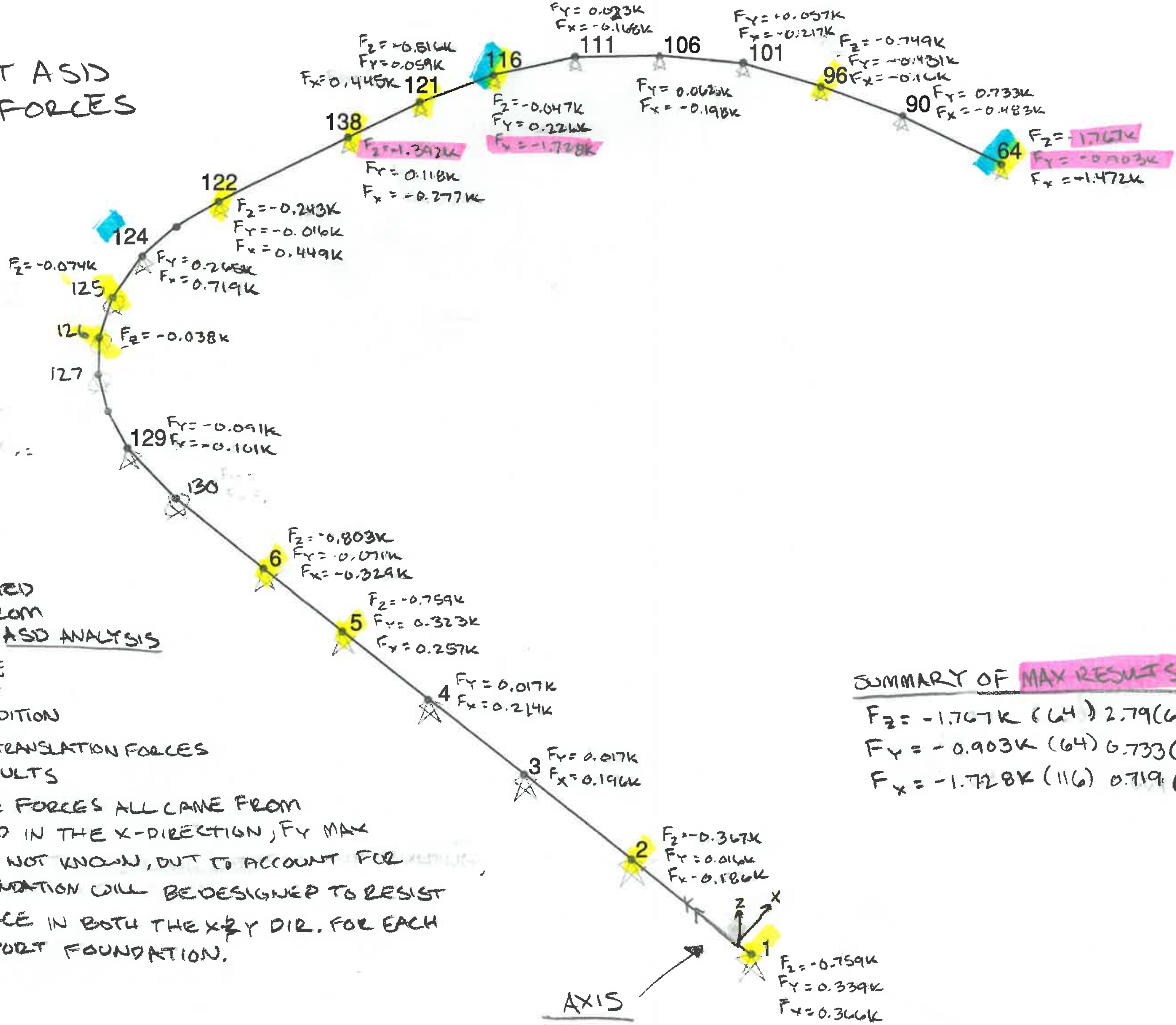






NODE LOCATIONS

SUPPORT ASD DESIGN FORCES



* VALUES DISPLAYED ARE TAKEN FROM SAP2000 MODEL ASD ANALYSIS

COLOR SCHEME

- (yellow) UPLIFT CONDITION
- (blue) WORST F_X TRANSLATION FORCES
- (pink) MAX RESULTS

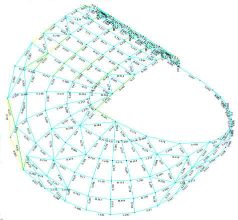
* SINCE THESE FORCES ALL CAME FROM WIND APPLIED IN THE X-DIRECTION, F_Y MAX VALUES ARE NOT KNOWN, BUT TO ACCOUNT FOR THIS, THE FOUNDATION WILL BE DESIGNED TO RESIST MAX F_X FORCE IN BOTH THE X & Y DIR. FOR EACH PINNED, SUPPORT FOUNDATION.

SUMMARY OF MAX RESULTS

$F_Z = -1.767K$ (64) 2.79(64)

$F_Y = -0.903K$ (64) 0.733(90)

$F_X = -1.728K$ (116) 0.719 (124)



Client: WINE HISTORY PROJECT
Project: PRIMITIVO - APPENDIX

Sheet: A4 of A7
Job No:
Date: 12/13/19
Engineer: EAV

American Earth Anchors

The best screw you will have in the dirt ™

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QUICK REFERENCE

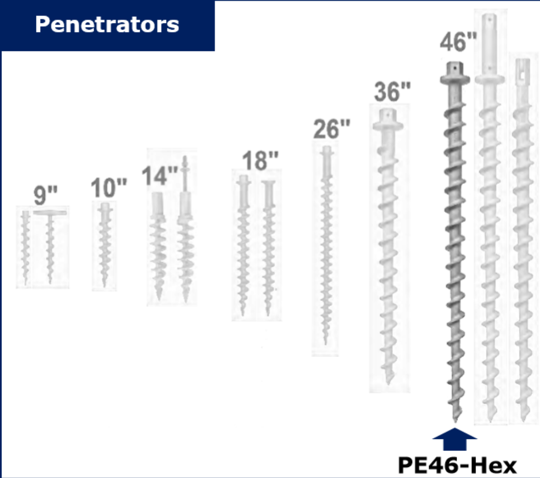
PE46-Hex | Specifications

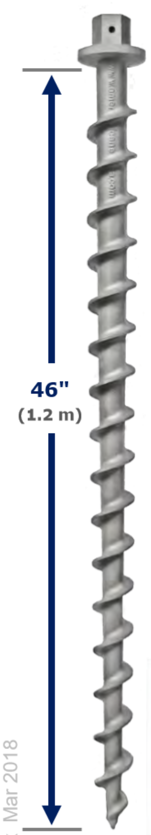
46" Penetrator ™
with hex head

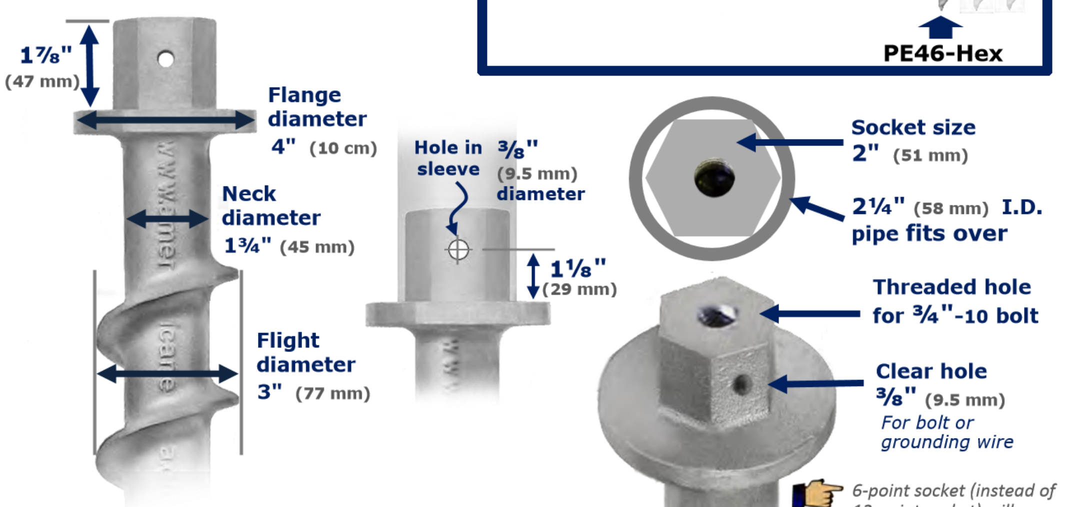
- Aircraft-quality cast aluminum 356 alloy
- Heat-treated to T6 specification
- Install with 2" or 51 mm socket
- Removable

10.5 lb (4.8 kg)

Penetrators







LOAD CAPACITY

Pullout strength with flight fully embedded

Soil Class 1	Soil Class 2	Soil Class 3	Soil Class 4	Soil Class 4
Hardpan Asphalt	Sandy gravel Very dense sand	Silty/clayey sand Silty gravel	Loose/med dense sands Loose sands Firm clays	Loose fine un-compacted sand
14,000 lb 62.3 kN	**9,500 lb** 42.3 kN	**3,300 lb** 14.7 kN	**2,000 lb** 8.90 kN	**750 lb** 3.34 kN

Soil classification per ASTM D-2487/2488

American Earth Anchors
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americanearthanchors.com

Contact us for CUSTOM WORK
Size, length, shape, material, prototypes, cable assemblies

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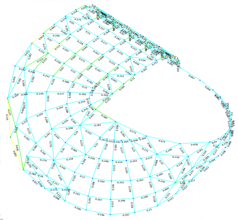


Client: WINE HISTORY PROJECT

Project: PRIMITIVO - APPENDIX

Sheet: A5 of A7

Job No:

Date: 12/13/19

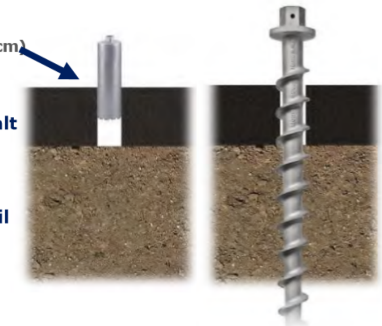
Engineer: EAU

QUICK REFERENCE

PE46-Hex | Installation

Through asphalt

Drill PILOT HOLE
through asphalt



Installation methods

Impact wrench

Watch the video:
Click here
or visit
aeavideo.com

Power take-off

Watch the video: Click here
or visit aeavideo.com
(Video shows PE46-Guy)

Attachment accessories

We will make custom brackets or sleeves to your specification

TIE-OFF CABLE
PE-TC46

Can be doubled over to make large loop around structural member

U-BRACKETS

For 4"x 4" post
(10 cm x 10 cm)

For 2" pipe
(5 cm)

SLEEVES

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Client: WINE HISTORY PROJECT

Project: PRIMITIVO - APPENDIX

SUPPORT REACTIONS WITH

OVERTURNING CALCULATIONS

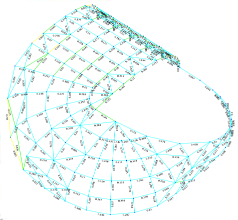
Job No:

Date: 12/13/19

Engineer: EAV

THE FOLLOWING EXCEL SHEETS PROVIDES ALL SUPPORT REACTIONS EXCEPT NODES 116 AND 64. RESULTS ARE EXPORTED DIRECTLY FROM SAP2000. THE OVERTURNING CALCULATIONS ARE BASED OFF THE FOUNDATION CALCULATION FOUND ON FN4.

Joint	OutputCase	F1	F2	F3	OT w/F1,F3	OT w/F2,F3
Text	Text	Kip	Kip	Kip	Kipft	Kipft
1	ASD EQ1 (ASCE 7-16 2.4.1)	0.162	0.087	0.484	0.0635625	-0.1864375
1	ASD EQ3 (ASCE 7-16 2.4.1)	0.366	0.19	1.02	0.2159375	-0.3707292
1	ASD EQ5 (ASCE 7-16 2.4.1)	0.161	0.32	0.98	-0.428021	0.1019792
1	ASD EQ6 (ASCE 7-16 2.4.1)	0.314	0.339	1.258	-0.191677	-0.1083438
1	ASD EQ7 (ASCE 7-16 2.4.1)	0.096	0.285	0.786	-0.453719	0.1762813
2	ASD EQ1 (ASCE 7-16 2.4.1)	0.084	-0.00141	0.133	0.1490781	-0.1356119
2	ASD EQ3 (ASCE 7-16 2.4.1)	0.179	0.002398	0.113	0.4854323	-0.103241
2	ASD EQ5 (ASCE 7-16 2.4.1)	-0.152	0.016	-0.314	-0.197573	0.3624271
2	ASD EQ6 (ASCE 7-16 2.4.1)	-0.022	0.014	-0.217	0.140276	0.260276
2	ASD EQ7 (ASCE 7-16 2.4.1)	-0.186	0.016	-0.367	-0.258734	0.414599
3	ASD EQ1 (ASCE 7-16 2.4.1)	0.085	0.001236	0.242	0.0451146	-0.2340988
3	ASD EQ3 (ASCE 7-16 2.4.1)	0.196	0.003984	0.495	0.1660677	-0.4739856
3	ASD EQ5 (ASCE 7-16 2.4.1)	-0.072	0.017	0.238	-0.474281	-0.1776146
3	ASD EQ6 (ASCE 7-16 2.4.1)	0.05	0.015	0.428	-0.254646	-0.3713125
3	ASD EQ7 (ASCE 7-16 2.4.1)	-0.106	0.017	0.141	-0.49213	-0.0821302
4	ASD EQ1 (ASCE 7-16 2.4.1)	0.093	0.001093	0.232	0.081625	-0.2247317
4	ASD EQ3 (ASCE 7-16 2.4.1)	0.214	0.004435	0.468	0.2526458	-0.4459042
4	ASD EQ5 (ASCE 7-16 2.4.1)	-0.046	0.017	0.178	-0.328552	-0.1185521
4	ASD EQ6 (ASCE 7-16 2.4.1)	0.079	0.015	0.369	-0.099901	-0.3132344
4	ASD EQ7 (ASCE 7-16 2.4.1)	-0.084	0.016	0.086	-0.364656	-0.0313229
5	ASD EQ1 (ASCE 7-16 2.4.1)	0.118	0.066	0.41	-0.01026	-0.1835938
5	ASD EQ3 (ASCE 7-16 2.4.1)	0.257	0.156	0.769	0.0996823	-0.2369844
5	ASD EQ5 (ASCE 7-16 2.4.1)	0.055	0.318	1.039	-0.839432	0.0372344
5	ASD EQ6 (ASCE 7-16 2.4.1)	0.176	0.323	1.151	-0.546349	-0.056349
5	ASD EQ7 (ASCE 7-16 2.4.1)	0.008259	0.292	0.875	-0.833798	0.1120052
6	ASD EQ1 (ASCE 7-16 2.4.1)	0.08	-0.015	0.108	0.1603542	-0.1563125
6	ASD EQ3 (ASCE 7-16 2.4.1)	0.17	-0.027	0.12	0.4485417	-0.208125
6	ASD EQ5 (ASCE 7-16 2.4.1)	-0.298	0.066	-0.759	-0.246193	0.9671406
6	ASD EQ6 (ASCE 7-16 2.4.1)	-0.136	0.036	-0.534	0.0723229	0.6456563
6	ASD EQ7 (ASCE 7-16 2.4.1)	-0.329	0.071	-0.803	-0.306214	1.0271198
90	ASD EQ1 (ASCE 7-16 2.4.1)	0.004143	0.36	0.462	-0.440971	0.7452188
90	ASD EQ3 (ASCE 7-16 2.4.1)	-0.00308	0.733	1.059	-1.052726	1.4008802
90	ASD EQ5 (ASCE 7-16 2.4.1)	-0.483	-0.36	2.069	-3.646672	-3.2366719
90	ASD EQ6 (ASCE 7-16 2.4.1)	-0.367	0.099	2.115	-3.305286	-1.7519531
90	ASD EQ7 (ASCE 7-16 2.4.1)	-0.485	-0.505	1.884	-3.471229	-3.5378958
96	ASD EQ1 (ASCE 7-16 2.4.1)	0.037	0.062	-0.329	0.4471927	0.530526
96	ASD EQ3 (ASCE 7-16 2.4.1)	0.075	0.133	-0.749	0.9872969	1.1806302
96	ASD EQ5 (ASCE 7-16 2.4.1)	-0.145	-0.407	0.291	-0.769786	-1.6431198
96	ASD EQ6 (ASCE 7-16 2.4.1)	-0.071	-0.236	-0.179	-0.060464	-0.6104635
96	ASD EQ7 (ASCE 7-16 2.4.1)	-0.16	-0.431	0.423	-0.949724	-1.8530573
101	ASD EQ1 (ASCE 7-16 2.4.1)	-0.00209	0.003059	0.076	-0.081766	-0.0646158
101	ASD EQ3 (ASCE 7-16 2.4.1)	-0.012	0.01	0.164	-0.201438	-0.1281042
101	ASD EQ5 (ASCE 7-16 2.4.1)	-0.217	0.057	0.431	-1.147599	-0.2342656
101	ASD EQ6 (ASCE 7-16 2.4.1)	-0.17	0.049	0.408	-0.968292	-0.2382917
101	ASD EQ7 (ASCE 7-16 2.4.1)	-0.216	0.055	0.401	-1.114734	-0.211401
106	ASD EQ1 (ASCE 7-16 2.4.1)	-0.011	-0.016	0.1	-0.135104	-0.1517708
106	ASD EQ3 (ASCE 7-16 2.4.1)	-0.028	-0.03	0.208	-0.298083	-0.30475
106	ASD EQ5 (ASCE 7-16 2.4.1)	-0.19	0.055	0.394	-1.021177	-0.2045104
106	ASD EQ6 (ASCE 7-16 2.4.1)	-0.158	0.027	0.401	-0.921401	-0.3047344
106	ASD EQ7 (ASCE 7-16 2.4.1)	-0.185	0.062	0.354	-0.965135	-0.1418021
111	ASD EQ1 (ASCE 7-16 2.4.1)	0.004793	-0.024	0.113	-0.095258	-0.1912344
111	ASD EQ3 (ASCE 7-16 2.4.1)	0.006351	-0.044	0.227	-0.202283	-0.3701198
111	ASD EQ5 (ASCE 7-16 2.4.1)	-0.168	0.073	0.244	-0.800188	0.0031458
111	ASD EQ6 (ASCE 7-16 2.4.1)	-0.123	0.034	0.297	-0.702359	-0.179026
111	ASD EQ7 (ASCE 7-16 2.4.1)	-0.169	0.083	0.199	-0.759224	0.080776
121	ASD EQ1 (ASCE 7-16 2.4.1)	-0.248	-0.02	0.289	-1.111151	-0.351151
121	ASD EQ3 (ASCE 7-16 2.4.1)	-0.429	-0.036	0.498	-1.920219	-0.6102188
121	ASD EQ5 (ASCE 7-16 2.4.1)	0.346	0.051	-0.401	1.5480677	0.5647344
121	ASD EQ6 (ASCE 7-16 2.4.1)	0.061	0.021	-0.071	0.273224	0.1398906
121	ASD EQ7 (ASCE 7-16 2.4.1)	0.445	0.059	-0.516	1.9912708	0.7046042
122	ASD EQ1 (ASCE 7-16 2.4.1)	0.26	-0.00899	0.195	0.6747135	-0.2219298
122	ASD EQ3 (ASCE 7-16 2.4.1)	0.449	-0.016	0.315	1.1865885	-0.3634115
122	ASD EQ5 (ASCE 7-16 2.4.1)	-0.298	-0.00518	-0.165	-0.830911	0.1451685
122	ASD EQ6 (ASCE 7-16 2.4.1)	-0.017	-0.011	0.015	-0.071432	-0.0514323
122	ASD EQ7 (ASCE 7-16 2.4.1)	-0.402	-0.00158	-0.243	-1.100797	0.2339398
124	ASD EQ1 (ASCE 7-16 2.4.1)	-0.137	-0.073	0.161	-0.615151	-0.4018177
124	ASD EQ3 (ASCE 7-16 2.4.1)	-0.331	-0.156	0.183	-1.283474	-0.7001406
124	ASD EQ5 (ASCE 7-16 2.4.1)	0.664	0.236	0.249	1.968224	0.5415573
124	ASD EQ6 (ASCE 7-16 2.4.1)	0.318	0.096	0.243	0.8207969	0.0807969
124	ASD EQ7 (ASCE 7-16 2.4.1)	0.719	0.265	0.185	2.2145573	0.701224
125	ASD EQ1 (ASCE 7-16 2.4.1)	0	0	-0.022	0.0216563	0.0216563
125	ASD EQ3 (ASCE 7-16 2.4.1)	0	0	-0.074	0.0728438	0.0728438
125	ASD EQ5 (ASCE 7-16 2.4.1)	0	0	0.166	-0.163406	-0.1634063
125	ASD EQ6 (ASCE 7-16 2.4.1)	0	0	0.08	-0.07875	-0.07875
125	ASD EQ7 (ASCE 7-16 2.4.1)	0	0	0.175	-0.172266	-0.1722656
126	ASD EQ1 (ASCE 7-16 2.4.1)	0	0	-0.00667	0.0065658	0.0065658
126	ASD EQ3 (ASCE 7-16 2.4.1)	0	0	-0.038	0.0374063	0.0374063
126	ASD EQ5 (ASCE 7-16 2.4.1)	0	0	0.108	-0.106313	-0.1063125
126	ASD EQ6 (ASCE 7-16 2.4.1)	0	0	0.055	-0.054141	-0.0541406
126	ASD EQ7 (ASCE 7-16 2.4.1)	0	0	0.11	-0.108281	-0.1082813
127	ASD EQ1 (ASCE 7-16 2.4.1)	0	0	0.014	-0.013781	-0.0137813
127	ASD EQ3 (ASCE 7-16 2.4.1)	0	0	0.000643	-0.000633	-0.000633
127	ASD EQ5 (ASCE 7-16 2.4.1)	0	0	0.118	-0.116156	-0.1161563
127	ASD EQ6 (ASCE 7-16 2.4.1)	0	0	0.082	-0.080719	-0.0807188
127	ASD EQ7 (ASCE 7-16 2.4.1)	0	0	0.113	-0.111234	-0.1112344
129	ASD EQ1 (ASCE 7-16 2.4.1)	0.000759	0.024	0.01	-0.007315	0.0701563
129	ASD EQ3 (ASCE 7-16 2.4.1)	1.72E-05	0.049	-0.00725	0.007192	0.1704681
129	ASD EQ5 (ASCE 7-16 2.4.1)	-0.014	-0.091	0.054	-0.099823	-0.3564896
129	ASD EQ6 (ASCE 7-16 2.4.1)	-0.011	-0.043	0.03	-0.066198	-0.1728646
129	ASD EQ7 (ASCE 7-16 2.4.1)	-0.014	-0.101	0.049	-0.094901	-0.384901
130	ASD EQ1 (ASCE 7-16 2.4.1)	0	0	0.026	-0.025594	-0.0255938
130	ASD EQ3 (ASCE 7-16 2.4.1)	0	0	0.039	-0.038391	-0.0383906
130	ASD EQ5 (ASCE 7-16 2.4.1)	0	0	-0.0065	0.0063975	0.0063975
130	ASD EQ6 (ASCE 7-16 2.4.1)	0	0	0.011	-0.010828	-0.0108281
130	ASD EQ7 (ASCE 7-16 2.4.1)	0	0	-0.017	0.0167344	0.0167344
138	ASD EQ1 (ASCE 7-16 2.4.1)	-0.031	-0.045	0.483	-0.578786	-0.6254531
138	ASD EQ3 (ASCE 7-16 2.4.1)	-0.035	-0.088	0.852	-0.955354	-1.1320208
138	ASD EQ5 (ASCE 7-16 2.4.1)	-0.277	0.1	-1.199	0.2569323	1.513599
138	ASD EQ6 (ASCE 7-16 2.4.1)	-0.219	0.031	-0.501	-0.236828	0.5965052
138	ASD EQ7 (ASCE 7-16 2.4.1)	-0.265	0.118	-1.392	0.4869167	1.7635833
	MAX	0.719	0.733		2.2145573	1.7635833
	MIN	-0.485	-0.505		-3.646672	-3.5378958



Client: WINE HISTORY PROJECT

Project: PRIMITIVO - APPENDIX

SAP2000 - COMBINED BENDING AND AXIAL CHECK FOR ALUMINUM FRAMES

Job No:

Date: 12/13/19

Engineer: EAV