ROBERT-JAMES & ASSOCIATES, Inc.
12255 West 187th Street
Mokena, Illinois 60448
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PRCA20241630
Flag Pole's revision

File : EderFlag1602a.mcd

Site : Washington State Fair Gold Gate Renovation
110 9th Avenue South West
Puyallup, Washington 98372

Model : ECA40 IH 40'-0" two piece flag pole for a 8' x 12' flag with a caisson footing.
Drawing No. 2501194 rev. A

Design wind load based on the Washington State Building Code (2021 IBC) using Exposure C and 115 mph wind speed.

Design Wind Speed : (mph.) $V := 115.0$ Based on Risk Category II

Velocity Pressure Coefficient at a Height of Less Than 40', Exposure C : $Kz := 1.04$ Based on Table 26.10-1

Topographic Factor : $Kzt := 1.00$ Based on Table 26.8-1

Wind Directionality Factor : $Kd := 0.85$ Based on Table 26.6-1

Velocity Pressure : (PSF) $qz := 0.00256 \cdot Kz \cdot Kzt \cdot Kd \cdot V^2$ $qz = 29.929$ Based on Equation 26.10-1

For Figure 29.5.1

Overall Height : (ft.) $h := 40.0$ Average Diameter of Pole : (ft.) $D := 0.55$

$\frac{h}{D} = 72.727$ $D \cdot \sqrt{qz} = 3.009$

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Force Coefficient : $Cf := 0.9$ Based on Figure 29.5.1 - Rough

Gust Effect Factor : $G := 0.85$ Based on 26.11.4 for Other Structures

ASD Conversion Factor : $LCF := 0.60$

Design Pressure : (PSF) $F := qz \cdot Cf \cdot G \cdot LCF$ $F = 13.737$

Reference : 2020 Aluminum Design Manual, The Aluminum Association

Pipe : 6063-T6 Temper and Alloy Fy = 35.0 ksi. ; Fv = 11.33 ksi. ; Fb = 24.00 ksi. (Per 6.8.2 for non-welded members.)

Reference : American Concrete Institute, Code 318-19

Rebar : ASTM A-615 Grade 60 Fy = 60.0 ksi.

Concrete : 3,000 psi. compressive strength at 28 days.

Wind Load on Flag :

Size of Flag : (ft.) Height : $HtFlg := 8$ Width : $WdthFlg := 12$

Flag Load : $WLFlag := (0.0014 \cdot V^2) \cdot \sqrt{(HtFlg \cdot WdthFlg)}$ $WLFlag = 181.409$ lbs.

Design Loads at Grade :

Height of Pole : (ft.) $HtPole := 40$

Flag : $Flag := \left(\frac{WLFlag}{2}\right) \cdot (HtPole) + \left(\frac{WLFlag}{2}\right) \cdot (HtPole - WdthFlg)$ $Flag = 6167.913$ ft.lbs.

Tapered Section of Pole : $TprdP := \left(29.08 \cdot \left(\frac{3.5 + 8.0}{2 \cdot 12}\right) \cdot F\right) \cdot \left(\left(\frac{29.08}{2}\right) + 10.92\right)$ $TprdP = 4873.489$ ft.lbs.

Straight Section of Pole : $StrtP := \left(10.92 \cdot \left(\frac{5.0}{12}\right) \cdot F\right) \cdot \left(\frac{10.92}{2}\right)$ $StrtP = 341.275$ ft.lbs.

Moment : (ft.lbs.) $MtGrd := Flag + TprdP + StrtP$ $MtGrd = 11382.677$

Shear : (lbs.) $ShrGrd := (WLFlag) + \left(29.08 \cdot \left(\frac{3.5 + 8.0}{2 \cdot 12}\right) \cdot F\right) + \left(10.92 \cdot \left(\frac{8.0}{12}\right) \cdot F\right)$ $ShrGrd = 472.834$

Design of Pole Structure at Grade :

Section Modulus of Pole : (in.3) 8" Dia. x 0.156" wall - $OD := 8.0$ $WT := 0.156$

$$PoleSM := \frac{\pi \cdot \left(OD^4 - (OD - 2 \cdot WT)^4\right)}{32 \cdot OD} \qquad PoleSM = 7.395$$

Bending Stress : (psi.) $f_b := \frac{MtGrd \cdot 12}{PoleSM}$ $f_b = 18472.118$

Area of Pole : (in.2) 8" Dia. x 0.156" wall - $PoleArea := \frac{\left\langle \pi \cdot \left\langle OD^2 - (OD - (2 \cdot WT))^2 \right\rangle \right\rangle}{4}$

$PoleArea = 3.844$

Shear Stress : (psi.) $f_v := \frac{ShrGrd}{PoleArea}$ $f_v = 122.998$

Unity Check - Pole : $UCPole := \frac{f_b}{24000} + \frac{f_v}{11330}$ $UCPole = 0.781$ < 1.00 OK

Design of Caisson Footing :

Overturning Moment : (ft.lbs.)	$Ma := MtGrd$	$Ma = 11382.677$
Shear : (lbs.)	$Va := ShrGrd$	$Va = 472.834$
Applied Lateral Force : (lbs.)	$P := Va$	$P = 472.834$
Allowable Lateral Soil Pressure : (lbs./ft.2 per ft.)		$LP := 225$
Diameter of Round Footing : (ft.)		$b1 := 4.0$
Distance in Feet From Ground Surface to Point of Application of "P"	$h := \frac{Ma}{Va}$	$h = 24.073$
Depth of Footing Below Grade : (ft.)		$d1 := 4.5$

Allowable Lateral Soil Bearing Pressure Pursuant to the 2021 International Building Code Section 1807.3.2.1 and Table 1806.2.

$$S1 := d1 \cdot \frac{(LP \cdot 1.33)}{3} \qquad S1 = 448.875$$

$$A := 2.34 \cdot \frac{P}{(S1 \cdot 1) \cdot b1} \qquad A = 0.616$$

$$d2 := \left(\frac{A}{2}\right) \cdot \left(1 + \left(\sqrt{1 + 4.36 \cdot \frac{h}{A}}\right)\right) \qquad d2 = 4.341 \quad \leq \quad d1 = 4.5 \qquad \text{OK}$$

Check Tensile Stress in Footing :

Overturning Moment About Heel Point : (ft.lbs.) Treat as a cantilever at bottom.

$$Mh := Ma + (Va \cdot d1) \qquad Mh = 13510.431$$

Compressive Strength of Concrete : (psi.)

$$fc := 3000$$

Yield Strength of Rebar : (psi.)

$$fy := 60000$$

Section Modulus of Footing : (in.3)

$$Sw := \frac{\pi \cdot (b1 \cdot 12)^3}{32} \qquad Sw = 10857.344$$

Tensile Stress in Concrete : (psi.)

$$ft := \left(\frac{1.6 \cdot (Mh \cdot 12)}{Sw}\right) \qquad ft = 23.892$$

Allowable Concrete Stress : (psi.)

$$\phi Ft := 0.60 \cdot \left(3 \cdot \sqrt{fc}\right) \qquad \phi Ft = 98.59 \quad > \quad ft = 23.892$$

REBAR NOT REQUIRED FOR STRESS

Quantity of Concrete : (yds.3)

$$CY := \left(\frac{\pi \cdot b1^2 \cdot d1}{4 \cdot 27}\right) - \left(\frac{\pi \cdot 0.92^2 \cdot 4.0}{4 \cdot 27}\right) \qquad CY = 1.996$$

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File : EderFlag1602b.mcd

Site : Washington State Fair Gold Gate Renovation
110 9th Avenue South West
Puyallup, Washington 98372

Model : ECA30 IH 30'-0" one piece flag pole for a 5' x 8' flag with a caisson footing.
Drawing No. 2501195 rev. A

Design wind load is based on the Washington State Building Code (2021 IBC) using Exposure C and 115 mph wind speed.

Design Wind Speed : (mph.) $V := 115.0$ Based on Risk Category II

Velocity Pressure Coefficient at a Height of Less Than 30', Exposure C : $Kz := 0.98$ Based on Table 26.10-1

Topographic Factor : $Kzt := 1.00$ Based on Table 26.8-1

Wind Directionality Factor : $Kd := 0.85$ Based on Table 26.6-1

Velocity Pressure : (PSF) $qz := 0.00256 \cdot Kz \cdot Kzt \cdot Kd \cdot V^2$ $qz = 28.202$ Based on Equation 26.10-1

For Figure 29.5.1

Overall Height : (ft.) $h := 30.0$ Average Diameter of Pole : (ft.) $D := 0.44$

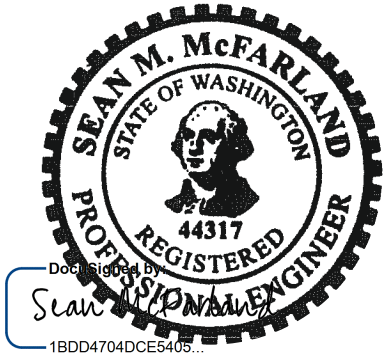
$\frac{h}{D} = 68.182$ $D \cdot \sqrt{qz} = 2.337$

Force Coefficient : $Cf := 1.2$ Based on Figure 29.5.1

Gust Effect Factor : $G := 0.85$ Based on 26.11.4 for Other Structures

ASD Conversion Factor : $LCF := 0.60$

Design Pressure : (PSF) $F := qz \cdot Cf \cdot G \cdot LCF$ $F = 17.26$



Reference : 2020 Aluminum Design Manual, The Aluminum Association

Pipe : 6063-T6 Temper and Alloy Fy = 35.0 ksi. ; Fv = 11.33 ksi. ; Fb = 24.00 ksi. (Per 6.8.2 for non-welded members.)

Reference : American Concrete Institute, Code 318-19

Rebar : ASTM A-615 Grade 60 Fy = 60.0 ksi.

Concrete : 3,000 psi. compressive strength at 28 days.

Wind Load on Flag :

Size of Flag : (ft.) Height : $HtFlg := 5$ Width : $WdthFlg := 8$

Flag Load : $WLFlag := \left(0.0014 \cdot V^2\right) \cdot \sqrt{\left(HtFlg \cdot WdthFlg\right)}$ $WLFlag = 117.099$ lbs.

Design Loads at Grade :

Height of Pole : (ft.) $HtPole := 30$

Flag : $Flag := \left(\frac{WLFlag}{2}\right) \cdot (HtPole) + \left(\frac{WLFlag}{2}\right) \cdot (HtPole - WdthFlg)$ $Flag = 3044.578$ ft.lbs.

Tapered Section of Pole : $TprdP := \left(17.25 \cdot \left(\frac{3.5 + 6.0}{2 \cdot 12}\right) \cdot F\right) \cdot \left(\left(\frac{17.25}{2}\right) + 12.75\right)$ $TprdP = 2519.067$ ft.lbs.

Straight Section of Pole : $StrtP := \left(12.75 \cdot \left(\frac{6.0}{12}\right) \cdot F\right) \cdot \left(\frac{12.75}{2}\right)$ $StrtP = 701.443$ ft.lbs.

Moment : (ft.lbs.) $MtGrd := Flag + TprdP + StrtP$ $MtGrd = 6265.087$

Shear : (lbs.) $ShrGrd := (WLFlag) + \left(17.25 \cdot \left(\frac{3.5 + 6.0}{2 \cdot 12}\right) \cdot F\right) + \left(12.75 \cdot \left(\frac{6.0}{12}\right) \cdot F\right)$ $ShrGrd = 344.981$

Design of Pole Structure at Grade :

Section Modulus of Pole : (in.3) 6" Dia. x 0.156" wall - $OD := 6.0$ $WT := 0.156$

$$PoleSM := \frac{\pi \cdot \left(OD^4 - (OD - 2 \cdot WT)^4\right)}{32 \cdot OD} \qquad PoleSM = 4.079$$

Bending Stress : (psi.) $f_b := \frac{MtGrd \cdot 12}{PoleSM}$ $f_b = 18433.388$

Area of Pole : (in.2) 6" Dia. x 0.156" wall - $PoleArea := \frac{\left(\pi \cdot \left(OD^2 - (OD - (2 \cdot WT))^2\right)\right)}{4}$

$PoleArea = 2.864$

Shear Stress : (psi.) $f_v := \frac{ShrGrd}{PoleArea}$ $f_v = 120.451$

Unity Check - Pole : $UCPole := \frac{f_b}{24000} + \frac{f_v}{11330}$ $UCPole = 0.779$ < 1.00 OK

Design of Caisson Footing :

Overturning Moment : (ft.lbs.)	$Ma := MtGrd$	$Ma = 6265.087$
Shear : (lbs.)	$Va := ShrGrd$	$Va = 344.981$
Applied Lateral Force : (lbs.)	$P := Va$	$P = 344.981$
Allowable Lateral Soil Pressure : (lbs./ft.2 per ft.)		$LP := 225$
Diameter of Round Footing : (ft.)		$b1 := 2.5$
Distance in Feet From Ground Surface to Point of Application of "P"	$h := \frac{Ma}{Va}$	$h = 18.161$
Depth of Footing Below Grade : (ft.)		$d1 := 3.5$

Allowable Lateral Soil Bearing Pressure Pursuant to the 2021 International Building Code Section 1807.3.2.1 and Table 1806.2 with 100% increase for allowable 1/2" deflection at grade.

$$S1 := d1 \cdot \frac{(LP \cdot 1.33)}{3} \qquad S1 = 349.125$$

$$A := 2.34 \cdot \frac{P}{(S1 \cdot 2) \cdot b1} \qquad A = 0.462$$

$$d2 := \left(\frac{A}{2}\right) \cdot \left(1 + \left(\sqrt{1 + 4.36 \cdot \frac{h}{A}}\right)\right) \qquad d2 = 3.266 \quad \leq \quad d1 = 3.5 \qquad \text{OK}$$

Check Tensile Stress in Footing :

Overturning Moment About Heel Point : (ft.lbs.) Treat as a cantilever at bottom. $Mh := Ma + (Va \cdot d1)$ $Mh = 7472.519$

Compressive Strength of Concrete : (psi.) $fc := 3000$

Yield Strength of Rebar : (psi.) $fy := 60000$

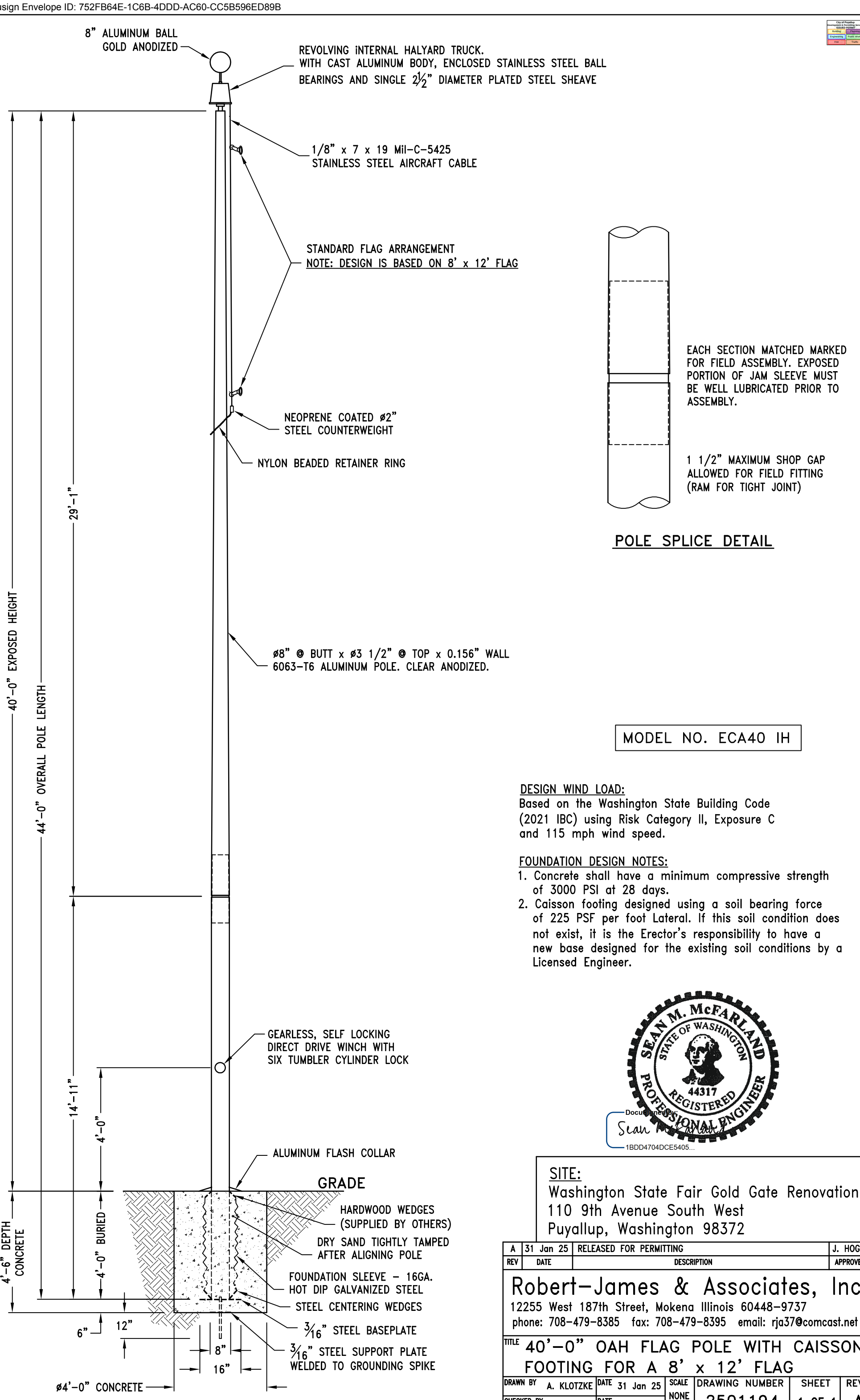
Section Modulus of Footing : (in.3) $Sw := \frac{\pi \cdot (b1 \cdot 12)^3}{32}$ $Sw = 2650.719$

Tensile Stress in Concrete : (psi.) $ft := \left(\frac{1.6 \cdot (Mh \cdot 12)}{Sw}\right)$ $ft = 54.126$

Allowable Concrete Stress : (psi.) $\phi Ft := 0.60 \cdot (3 \cdot \sqrt{fc})$ $\phi Ft = 98.59 \quad > \quad ft = 54.126$

REBAR NOT REQUIRED FOR STRESS

Quantity of Concrete : (yds.3) $CY := \left(\frac{\pi \cdot b1^2 \cdot d1}{4 \cdot 27}\right) - \left(\frac{\pi \cdot 0.92^2 \cdot 3.0}{4 \cdot 27}\right)$ $CY = 0.562$



EACH SECTION MATCHED MARKED FOR FIELD ASSEMBLY. EXPOSED PORTION OF JAM SLEEVE MUST BE WELL LUBRICATED PRIOR TO ASSEMBLY.

1 1/2" MAXIMUM SHOP GAP ALLOWED FOR FIELD FITTING (RAM FOR TIGHT JOINT)

POLE SPLICE DETAIL

MODEL NO. ECA40 IH

DESIGN WIND LOAD:
Based on the Washington State Building Code (2021 IBC) using Risk Category II, Exposure C and 115 mph wind speed.

FOUNDATION DESIGN NOTES:
1. Concrete shall have a minimum compressive strength of 3000 PSI at 28 days.
2. Caisson footing designed using a soil bearing force of 225 PSF per foot Lateral. If this soil condition does not exist, it is the Erector's responsibility to have a new base designed for the existing soil conditions by a Licensed Engineer.

SEAN M. McFARLAND
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REGISTERED
PROFESSIONAL ENGINEER

Docusigned by:
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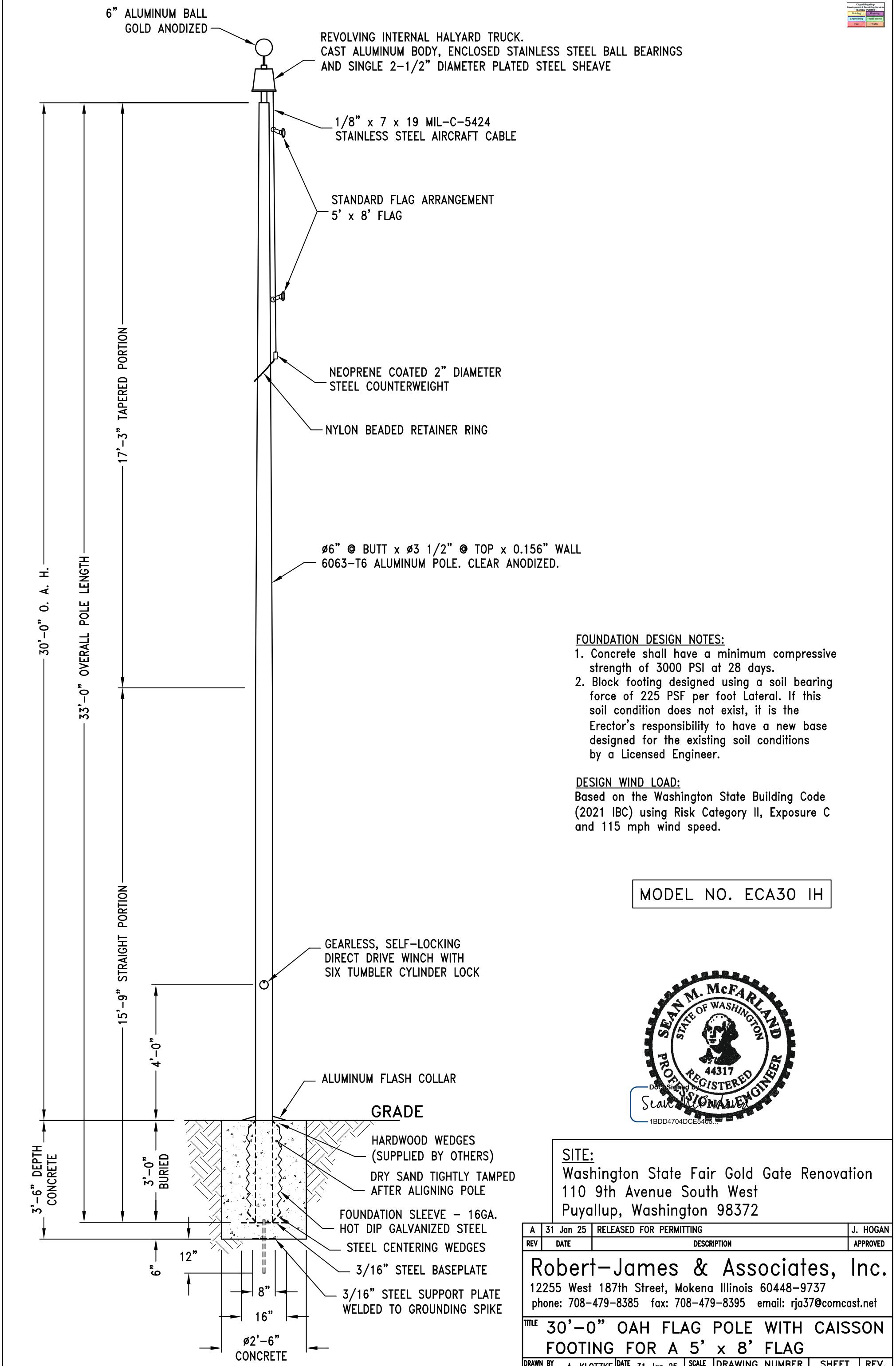
SITE:
Washington State Fair Gold Gate Renovation
110 9th Avenue South West
Puyallup, Washington 98372

REV	DATE	DESCRIPTION	APPROVED
A	31 Jan 25	RELEASED FOR PERMITTING	J. HOGAN

Robert-James & Associates, Inc.
12255 West 187th Street, Mokena Illinois 60448-9737
phone: 708-479-8385 fax: 708-479-8395 email: rja37@comcast.net

TITLE 40'-0" OAH FLAG POLE WITH CAISSON FOOTING FOR A 8' x 12' FLAG

DRAWN BY	DATE	SCALE	DRAWING NUMBER	SHEET	REV.
A. KLOTZKE	31 Jan 25	NONE	2501194	1 OF 1	A
CHECKED BY J. HOGAN	DATE 31 Jan 25				



FOUNDATION DESIGN NOTES:

1. Concrete shall have a minimum compressive strength of 3000 PSI at 28 days.
2. Block footing designed using a soil bearing force of 225 PSF per foot Lateral. If this soil condition does not exist, it is the Erector's responsibility to have a new base designed for the existing soil conditions by a Licensed Engineer.

DESIGN WIND LOAD:

Based on the Washington State Building Code (2021 IBC) using Risk Category II, Exposure C and 115 mph wind speed.

MODEL NO. ECA30 IH

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SITE:
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REV	DATE	DESCRIPTION	APPROVED
A	31 Jan 25	RELEASED FOR PERMITTING	J. HOGAN

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12255 West 187th Street, Mokena Illinois 60448-9737
phone: 708-479-8385 fax: 708-479-8395 email: rja37@comcast.net

TITLE: 30'-0" OAH FLAG POLE WITH CAISSON FOOTING FOR A 5' x 8' FLAG

DRAWN BY	DATE	SCALE	DRAWING NUMBER	SHEET	REV.
A. KLOTZKE	31 Jan 25	NONE	2501195	1 OF 1	A
CHECKED BY J. HOGAN	DATE 31 Jan 25				