**Coast Welcome Figure at Isthmus Park**
**Pre-submission Narrative**

## A. Project Specifics

The Olympia Parks, Arts and Recreation Department (OPARD) is planning to install a public art piece, known as the *Coast Welcome Figure,* and associated landscaping at the Isthmus Park located at 531 4th Ave W. The project will be constructed on the NW corner of the park near the Olympia Yashiro Friendship Bridge ($4^{th}$ Avenue). This is a joint project that has been requested by the City Council and Squaxin Island Tribal Council, and is a key connection between Percival Landing and what will become the Deschutes Estuary. The attached concept design (Exhibit A) is a draft proposal with the flexibility to be revised as appropriate to avoid a Shoreline Substantial Development permit or trigger the need for any stormwater permitting. We look forward to working with the city to find a path that delivers a meaningful space while minimizing the permit requirements.

The project is to be installed in an area that is currently majority asphalt parking. See Exhibit A for a site plan for the proposed design and Exhibit C for the existing conditions. The installation and design features of our proposal include:

- Sawcutting and removal of existing asphalt paving and removal of gravel subbase.
- Decompaction and placement of planting soil. We will be building up and planting soil will be placed on top of existing soil that is exposed with the removal of asphalt and subbase. There will be no excavation beyond this.
- Potential installation of irrigation. We will also consider installation of plantings in the fall to optimize plant establishment without a permanent irrigation system.
- Installation of a carved Coast Welcome Figure sculpture by artist Andrea Wilbur-Sigo.
- Installation of a concrete plinth and foundation that support the sculpture (see Exhibit B for structural design from a similar sculpture).
- Planting of native perennials, shrubs, and trees.
- Placement of large woody debris on existing soils (no excavation).
- Installation of crushed oyster shells or crushed rock surfacing.
- Installation of sand-set pavers to provide an accessible route to the sculpture.
- Placement of wood log rounds to serve as informal seating.
- Re-striping of adjacent parking stalls and installation of wheel stops on existing asphalt pavement.

We have some specific permitting questions and items for coordination or confirmation:

- There is a large stormwater vault to the north. What access is required for maintaining the vault? Knowing this can help us identify ways to adjust our design to allow for this access.
- The design calls for no excavation other than what is required to place the sculpture foundation (within the existing pavement limits). We are building up soil and placing pavers on top of the existing subbase. Will this allow us to stay below the threshold for obtaining a grading permit?

- Does the foundation for the Welcome Figure or other project elements trigger a shoreline substantial development permit? Knowing what elements specifically trigger this requirement will help us identify ways to adjust our design to minimize impacts and permitting.
- We are showing new plantings around the existing stormwater vault, which would require removal of the turf that is there. Would removing turf and replacing with native plantings and doing the work by hand help us not trigger a grading permit? Due to the planting around the vault falling outside of the existing pavement area and within shoreline jurisdiction, would that work trigger a critical areas permit or review?
- We understand that structures are limited in the shoreline jurisdiction. As designed, we see that the sculpture and its base/foundation are a structure. Are there other elements that would be considered structures?

**B. Site conditions-existing**

In 2013, OPARD purchased the former County Health and Thurston County Housing Authority properties totaling 2.3 acres. The derelict buildings were demolished in 2015. In 2018, interim improvements were made to the park. The park is now home to Oly on Ice, Olympia's seasonal ice-skating rink from mid November through mid January. The park also hosts a seasonal pump track for riding bikes, scooters and skateboards spring through fall.

The portion of the site that is being proposed to house this new landscape and Coast Welcome Figure sculpture is now paved in asphalt bounded by three wheel stops at the western edge. See Exhibit C for existing conditions.

**C. Proposed vehicle access and parking**

The existing vehicle access to the park is from 4$^{th}$ Avenue and 5$^{th}$ Avenue and will not be changed. We are proposing 2-3 standard parking stalls and one accessible stall for onsite dedicated parking for park use.

**D. Proposed utilities to serve project**

If possible, in a minimal permitting scenario, we would like to see if it is feasible to add irrigation, however the design is flexible and we can move forward without that. The site has storm, electrical, water, and sewer utilities adjacent to the site. See Exhibit C derived from city GIS.

**E. Any other relevant project information**

The proposed improvements fall beneath the stormwater management thresholds of 2,000 square feet of new plus replaced hard surface area and 7,000 square feet of land disturbing activities. Per section I-3.3 of the City's 2022 Drainage Design and Erosion Control Manual, only Core Requirement #2: Construction Stormwater Pollution Prevention Plan (C-SWPPP) applies to this project. A C-SWPPP will not be prepared, but the project team will consider all of the C-SWPPP Elements and propose controls for the elements that pertain to the project site.

Attachments:

1. Vicinity Map
2. Exhibit A: Concept Design
3. Exhibit B: Example structural base & foundation design
4. Exhibit C: Existing site conditions plan

**EXHIBIT A**

# Where the Deschutes Estuary Begins

## Welcome Figure at the Yashiro Friendship Bridge, Olympia


Welcome Figure | *Andrea Wilbur-Sigo*

Landscape | *Olympia Parks, Arts, and Recreation*

**EXHIBIT B**

# ODD lot

**Project:**
**Martin Residence Figure**

**Client:**
**Andrea Sigo**


Sculpture Structural design
10/4/2023

ODD Lot Design LLC
4110 Dayton Ave N
Seattle, WA
98103
United States of America
tel: (206) 300-7261

| ODD lot | Job Title: Martin Residence sculpture | Job # 73 |
|---|---|---|
| | Reference: General | |
| | Made By: CB Date: 10/4/2023 | Sheet # 1/15 |

**Welcome figures - general info**

These calculations document the structural design for the proposed welcome figure sculptures by Andrea Sigo located in Olympia WA

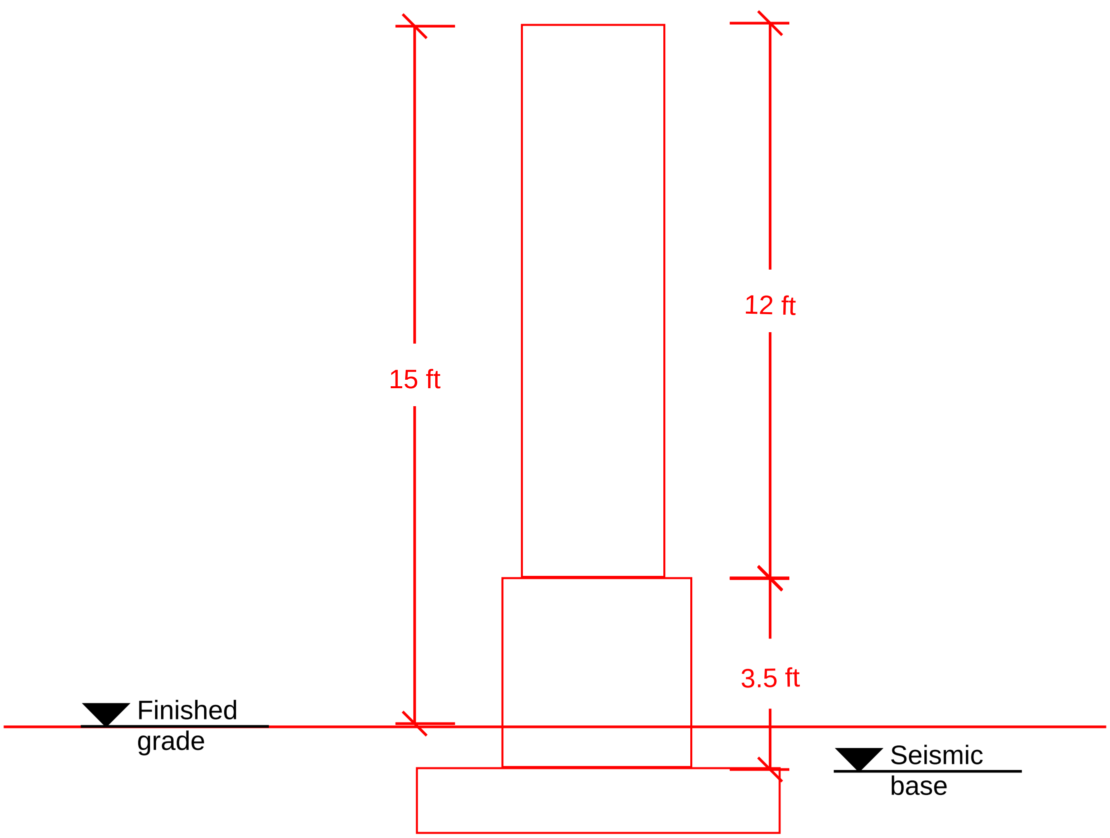
518 Howard Ave NE, Olympia 98506

The figure is 12' tall and 32" dia and estimated to weigh 2000 lb

The sculpture rests on a concrete plinth 36" dia that extends up to a maximum of 3'-0" above grade that in turn rests on a square foundation 18" below grade.

Assume that the plith contributes to the seismic demand
3' dia x 3.5' tall = 24.75 cf = 3.7 k

The sculpture will connect to the base via a frame with epoxy or embeded anchors.



**Welcome Figure sculptures - general design information**

Design of the sculpture structure and its anchorage is per the 2018 Washington State Building Code & ASCE 7-16 by reference

Structure is subject to dead loads arising from its own self weight and seismic loads as well as wind loads and live loads

**Dead Loads**

Dead load consists of the self weight of the wood sculpture and any internal armature or hardware

**Live Loads**

Live loads consist of a 200 lb lateral load applied at 4 ft above the ground and the weight of a person climbing the sculpture.  By inspection, this load does not control the structural design.

**Seismic Loads**

For the purposes of assessing seismic loads, the sculpture is considered a non-building structure per chapter 15 of ASCE 7.

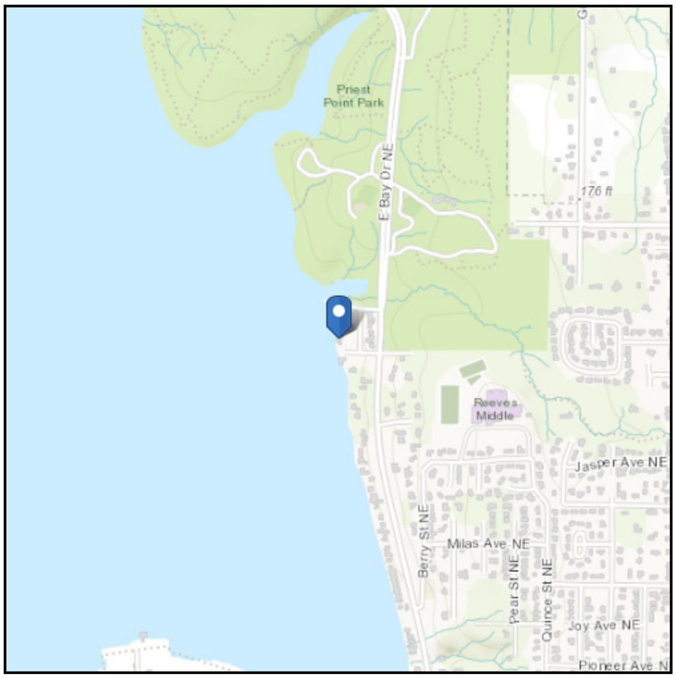
**Wind Loads**

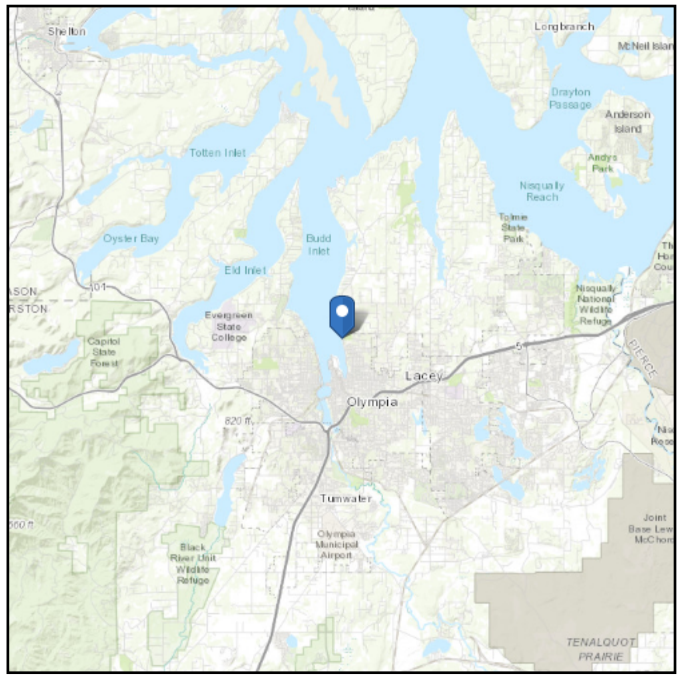
For the purposes of assessing wind loads, the sculpture is considered "Other Structures" per chapter 29 of ASCE 7.

# ASCE 7 Hazards Report

**Address:**
518 Howard Ave NE
Olympia, Washington
98506

| | | | |
|---|---|---|---|
| **Standard:** | ASCE/SEI 7-16 | **Latitude:** | 47.066054 |
| **Risk Category:** | II | **Longitude:** | -122.896766 |
| **Soil Class:** | D - Default (see Section 11.4.3) | **Elevation:** | 15.78348409431032 ft (NAVD 88) |




## Wind

**Results:**

| | |
|---|---|
| Wind Speed | 97 Vmph |
| 10-year MRI | 67 Vmph |
| 25-year MRI | 73 Vmph |
| 50-year MRI | 77 Vmph |
| 100-year MRI | 82 Vmph |

| | |
|---|---|
| Data Source: | ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2 |
| Date Accessed: | Sat Jul 29 2023 |

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is not in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2.

AMERICAN SOCIETY OF CIVIL ENGINEERS

## Seismic

**Site Soil Class:** D - Default (see Section 11.4.3)

**Results:**

| | | | |
|---|---|---|---|
| $S_S$ : | 1.421 | $S_{D1}$ : | N/A |
| $S_1$ : | 0.525 | $T_L$ : | 16 |
| $F_a$ : | 1.2 | PGA : | 0.61 |
| $F_v$ : | N/A | $PGA_M$ : | 0.732 |
| $S_{MS}$ : | 1.705 | $F_{PGA}$ : | 1.2 |
| $S_{M1}$ : | N/A | $I_e$ : | 1 |
| $S_{DS}$ : | 1.137 | $C_v$ : | 1.384 |

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

**Data Accessed:** Sat Jul 29 2023

**Date Source:** USGS Seismic Design Maps

The sculpture is considered as a non-building structure per the requirements of ASCE 7-16, chapter 15. Seismic design is carried out using an equivalent lateral force analysis per chapter 12.8.

Equivalent lateral force analysis
SDC = D
Risk Category = II, Ie = 1.0
Design as an "amusement structure or monument" per ASCE 7 table 15.4-2.
R = 2, Cd = 2, Omega = 2

given the height of the structure, we can assume that its fundamental period is <0.55 sec and therefore the design period Sa = Sds

Min Cs = 0.044Sds Ie = 0.039g (15.4-1)

$$C_s = 0.044 S_{DS} I_e \qquad (15.4\text{-}1)$$

Cs = Sds/(R/I) = 1.137/2 = 0.57g

$$C_s = \frac{S_{DS}}{\left(\frac{R}{I_e}\right)}$$

W fig = 2k
W base = 3.7k

**12.8.1 Seismic Base Shear.** The seismic base shear, $V$, in a given direction shall be determined in accordance with the following equation:

$$V = C_s W \qquad (12.8\text{-}1)$$

where

$C_s$ = the seismic response coefficient determined in accordance with Section 12.8.1.1, and
$W$ = the effective seismic weight per Section 12.7.2.

V fig = 0.57 x 2k = 1.14k
V base = 1.14k + 0.57 x 3.7k = 3.25 k

Mot (bot of fig) = 1.14 k x 8' = 9.12 k-ft
Mot (base) = 1.14k x 11.5' + 2.1k x 2.3' = 18 k-ft
Mot (ftg) = 1.14k x 12.5' + 2.1k x 3.3' = 21.2 k-ft

rho can be taken as 1.0 (ASCE 7 15.6)

Eh = 1.0 x V

**12.4.2.2 Vertical Seismic Load Effect.** The vertical seismic load effect, $E_v$, shall be determined in accordance with Eq. (12.4-4a) as follows:

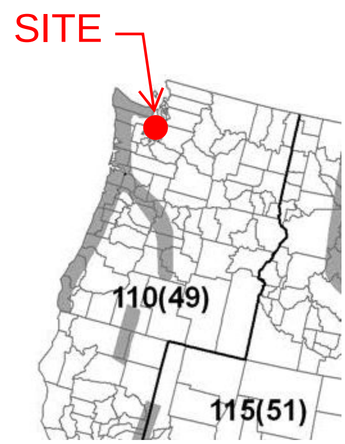
$$E_v = 0.2 S_{DS} D \qquad (12.4\text{-}4a)$$

Ev = 0.2 x 1.137 x D = 0.23 D

| ODD lot | Job Title: Martin Residence sculpture | | Job # 73 |
|---|---|---|---|
| | Reference: General | | |
| | Made By: CB | Date: 10/4/2023 | Sheet # 6/15 |

## Wind Basis of Design

For wind load, consider as a hexagonal "chimney" structure




RC II structure.
Exposure D (coastal)
v = 97
Kzt = 1.0
Kd = 0.95 (table 26.6-1)
Kz = 1.03 (table 29.3.1 for max ht = 15 ft)
G = 0.85 (non flexible structure)

$$q_z = 0.00256\ K_z K_{zt} K_d V^2 \text{ (lb/ft}^2\text{)} \qquad (29.3\text{-}1)$$

qz = 23.6 psf

**29.5 DESIGN WIND LOADS—OTHER STRUCTURES**

The design wind force for other structures (chimneys, tanks, rooftop equipment for $h > 60°$, and similar structures; open signs; lattice frameworks; and trussed towers) shall be determined by the following equation:

$$F = q_z G C_f A_f \text{ (lb) (N)} \qquad (29.5\text{-}1)$$

Force coeffecient Cf = 1.2 per table 29.5-1 for a hexagonal chimney with h/D =7 (conservative as actual h/D ~ 4)

Design pressure = 23.6 psf x 0.85 x 1.2 = 24 psf

Projected width of sculpture taken as 2.7 ft so

total wind load (V base) = 2.7' x 15' x 24 psf = 0.97 k
wind load at base of figure (V fig) = 0.78 k

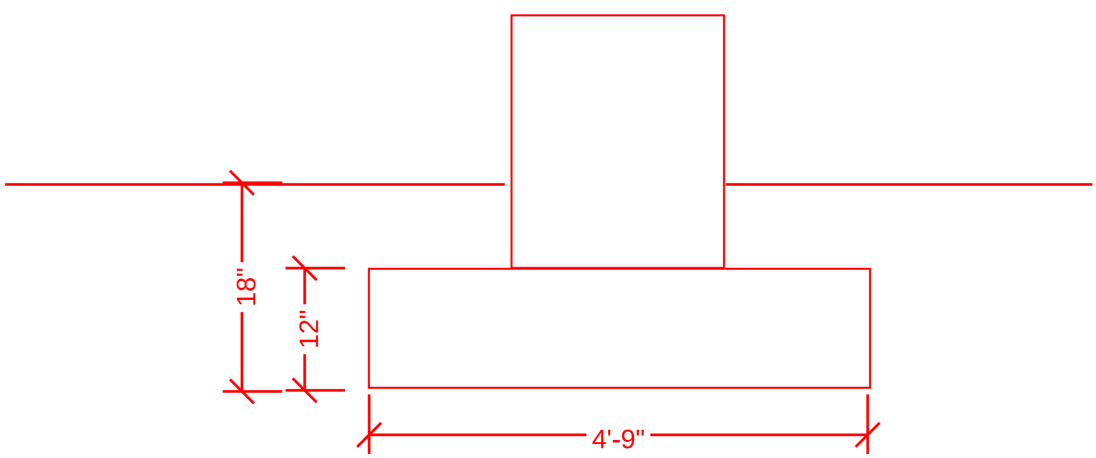
Mot (at base of figure) = 0.78k x 6' = 4.7 k-ft
Mot (at fdn base) = 0.97k x 8.5' = 8.25 k-ft

This is less than the seismic load so it can be assumed that seismic governs design and effects of wind loading do not need to be checked explicitly.

| ODD lot | Job Title: Martin Residence sculpture | Job # 73 |
|---|---|---|
| | Reference: General | |
| | Made By: CB Date: 10/4/2023 | Sheet # 7/15 |

**Sigo footing overturning calculations**

| | | | |
|---|---|---|---|
| Footing D | 1 | | |
| Footing L | 5 | Mxx direction | |
| Footing W | 5 | Myy direction | |
| Wt ftg | 3,750.0 | | |
| Wt above | 5,710.0 | lb | |
| D (total) | 9,460.0 | lb | |
| D Mxx | 750.0 | lb-ft | |
| D Myy | 750.0 | lb-ft | |
| Wind ASD (0.6W) Shear x | 582 | lb | |
| Wind ASD (0.6W) Shear y | 582 | lb | |
| Wind ASD (0.6W) Mxx | 4,950 | lb-ft | |
| Wind ASD (0.6W) Myy | 4,950 | lb-ft | |
| Seismic ASD (0.7E) Shear x | 2,275 | lb | |
| Seismic ASD (0.7E) Shear y | 2,275 | lb | |
| Seismic ASD (0.7E) Mxx | 14,840 | lb-ft | |
| Seismic ASD (0.7E) Myy | 14,800 | lb-ft | |
| Ground Coeffecient of friction | 0.300 | | |



| ODD lot | Job Title: Martin Residence sculpture | Job # 73 |
|---|---|---|
| | Reference: General | |
| | Made By: CB  Date: 10/4/2023 | Sheet # 8/15 |

----------------- WIND CALCULATIONS -----------------

| | | | | | | |
|---|---|---|---|---|---|---|
| **Stability** | | | | **Max Pressure calculations** | | |
| 0.6D | 5,676.0 | lb | | 1.0 D | 9,460.0 | lb |
| 0.6W shear | 582 | lb | | Mot xx | 5,700 | lb-ft |
| 0.6W Mot xx | 5,400 | lb-ft | | Mot yy | 5,700 | lb-ft |
| 0.6W Mot yy | 5,400 | lb-ft | | | | |
| | | | | P/A | 378 | psf |
| **Overturning Mxx** | | | | e xx | 0.60 | ft |
| Overturning at toe (Mot xx) | 5,400 | lb-ft | | OT pressure q xx | 652 | psf |
| Resisting at toe (Mr) | 14,190 | lb-ft | | pressure block length | 5.00 | ft |
| Overturning D/C | 38% | | | | | |
| | | | | P/A | 378 | psf |
| **Overturning Myy** | | | | e yy | 0.60 | ft |
| Overturning at toe (Mot yy) | 5,400 | lb-ft | | OT pressure q yy | 652 | psf |
| Resisting at toe (Mr) | 14,190 | lb-ft | | pressure block length | 5.00 | ft |
| Overturning D/C | 38% | | | | | |
| | | | | | | |
| **Sliding** | | | | | | |
| Sliding friction demand | 582 | lb | | | | |
| Sliding friction capacity | 1702.8 | lb | | | | |
| Sliding D/C | 34% | | | | | |

----------------- SEISMIC CALCULATIONS -----------------

| | | | | | | |
|---|---|---|---|---|---|---|
| **Stability** | | | | **Max Pressure calculations** | | |
| 0.6D | 5,676.0 | lb | | 1.0 D | 9,460.0 | lb |
| 0.7E shear reduced 25% | 1,706 | lb | | Mot xx reduced 25% | 11,880 | lb-ft |
| Mot xx reduced 25% | 11,580 | lb-ft | | Mot yy reduced 25% | 11,850 | lb-ft |
| Mot yy reduced 25% | 11,550 | lb-ft | | | | |
| | | | | P/A | 378 | psf |
| **Overturning Mxx** | | | | e xx | 1.26 | ft |
| Overturning at toe (Mot xx) | 11,580 | lb-ft | | OT pressure q xx | 1014 | psf |
| Resisting at toe (Mr) | 14,190 | lb-ft | | pressure block length | 3.73 | ft |
| Overturning D/C | 82% | | | | | |
| | | | | P/A | 378 | psf |
| **Overturning Myy** | | | | e yy | 1.25 | ft |
| Overturning at toe (Mot yy) | 11,550 | lb-ft | | OT pressure q yy | 1011 | psf |
| Resisting at toe (Mr) | 14,190 | lb-ft | | pressure block length | 3.74 | ft |
| Overturning D/C | 81% | | | | | |
| | | | | | | |
| **Sliding** | | | | | | |
| Sliding friction demand | 1,706 | lb | | | | |
| Sliding friction capacity | 1702.8 | lb | | | | |
| Sliding D/C | 100% | | | | | |

Bearing pressure under sustained gravity loads is low

OK for clay / silty soils on site. under max overturning demands

| ODD lot | Job Title: Martin Residence sculpture | Job # 73 |
|---|---|---|
| | Reference: Base Connection | |
| | Made By: CB  Date: 10/4/2023 | Sheet # 9/15 |

**Sculpture structural system - Base connection - upper to lower steel plate**

(2) Galvanized A307 bolts are located in each corner of the frame
Bolt span = 14.625"

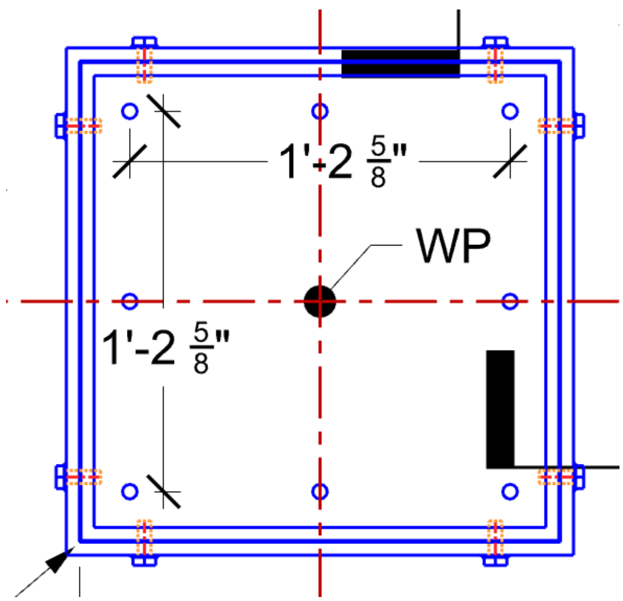
Moment due to seismic at base = 9.12 kip-ft = 109.4 kip-in / 14.625" = 7.5 kip tension / compression

7.5 kip / 4 bolts = 1.9 kip / bolt (note that global tension/compression is carried by bolt shear)

Dead load at base = (2 kip x (1.2+0.23) ) / 8 bolts = 0.36 k / bolt

Total bolt force = 2.3 kip - single shear capacity of 1/2" A307 bolt is 3.98 kip - ok

Welded connections between the frames and top / bottom plate are ok by inspection




**Sculpture structural system - Base connection anchor bolts**

Anchor bolt span = 14.625"
effective dead load (assuming light estimate) = 0.9D = 1800 lb

Anchor design performed in Hilti Profis (See profis output on page 11)

Use (8) CIP 3/4" anchors

| | | | | |
|---|---|---|---|---|
| ODD lot | Job Title: Martin Residence sculpture | | Job # 73 | |
| | Reference: Base Connection | | | |
| | Made By: CB | Date: 10/4/2023 | Sheet # 10/15 | |

**Sculpture structural system - Base connection - steel plate to sculpture**

sculpture base = 32" dia
Maintaining 3" edge distance, the screw group is centered around a 19.5" square frame

Based on the square screw pattern, assume that shear is carried by the side screws and flexure is carried by the top and bottom lines of screws.

**Shear** - 1.14 k x 0.7 x omega = 2 = 1.6 k
Carried by 16 screws = 100 lb per screw
allowable shear load = 235 lb / screw x 1.6 duration x 0.67 end grain = 252 lb > 100 ok

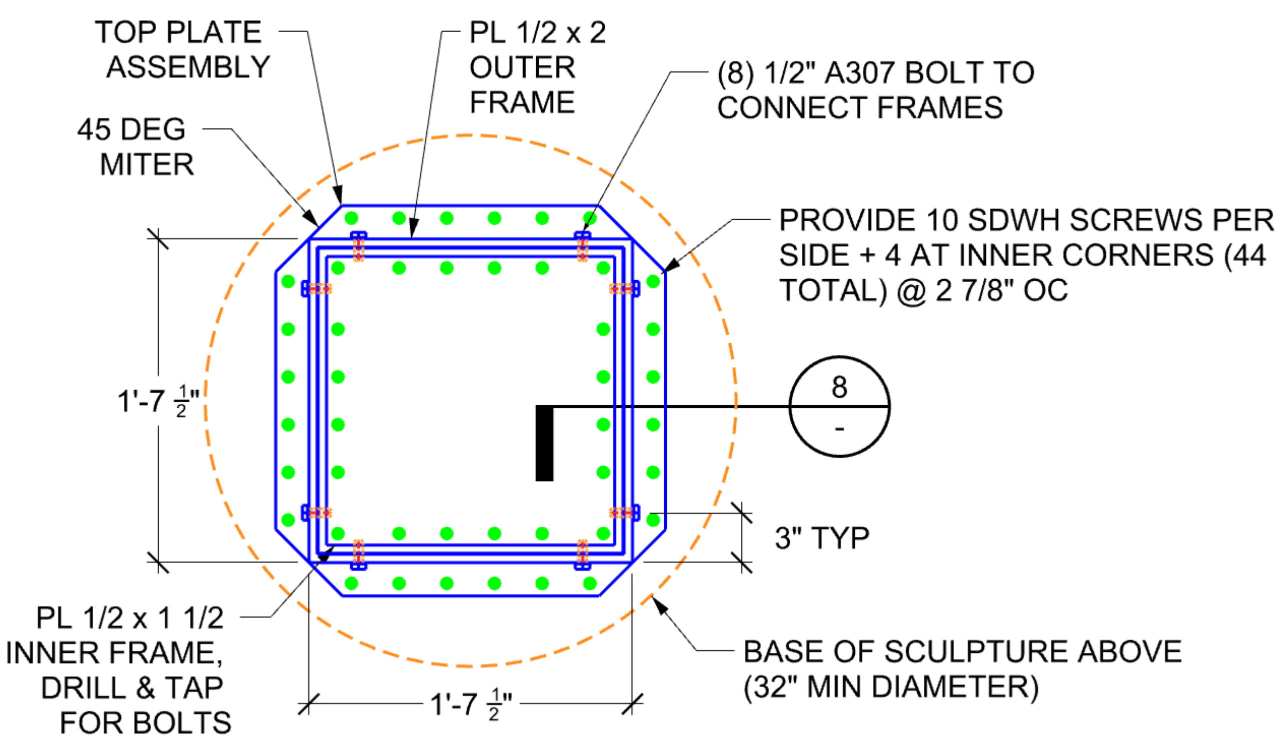
**Flexure**

Moment due to seismic at base of figure = 9.12 k-ft = 109.4 k-in
Convert to ASD (0.7) E = 76.6 k-in
factor up by omega = 2 = 153.2 k-in

153.2 k-in / 19 in = 8 k per screw line
8k / 14 screws = 571 lb per screw

Simpson SDWH screw has 160 lb/in withdrawal capacity in WRC (0.36 G)
Factored capacity = 1.6 duration x 160 lb/in x 2.95" x 0.75 EG factor = 566 lb per screw

566 lb per screw is slightly (1%) less than 571 lb required, but likely ok as this calculation assumes fully elastic seismic behavior with R=2 and Omega = 2. Allowing for limited ductility, the force would be less than 571 lb. Also, the code does not require omega to be applied to this connection,



**Hilti PROFIS Engineering 3.0.88**

**www.hilti.com**

| | | | |
|---|---|---|---|
| Company: | | Page: | 1 |
| Address: | | Specifier: | |
| Phone I Fax: | \| | E-Mail: | |
| Design: | Base Anchors - Oct 3, 2023 | Date: | 10/4/2023 |
| Fastening point: | | | |

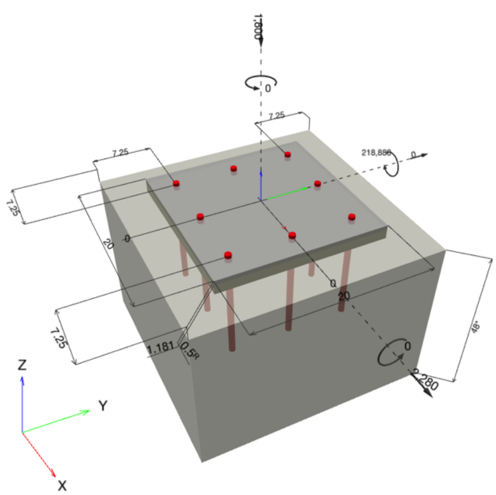
**Specifier's comments:**

## 1 Input data

| | |
|---|---|
| **Anchor type and diameter:** | **Heavy Hex Head ASTM F 1554 GR. 36 3/4** |
| Item number: | not available |
| Additional plate or washer (17.4.2.8): | $d_{plate}$ = 0.100 in., $t_{plate}$ = 0.100 in. |
| Effective embedment depth: | $h_{ef}$ = 12.000 in., $h_{ef,17.4.2.8}$ = 12.033 in. |
| Material: | ASTM F 1554 |
| Evaluation Service Report: | Hilti Technical Data |
| Issued I Valid: | - \| - |
| Proof: | Design Method ACI 318-14 / CIP |
| Stand-off installation: | without clamping (anchor); restraint level (anchor plate): 2.00; $e_b$ = 1.181 in.; t = 0.500 in. |
| | Hilti Grout: CB-G EG, epoxy, $f_{c,Grout}$ = 14,939 psi |
| Anchor plate[R] : | $l_x$ x $l_y$ x t = 20.000 in. x 20.000 in. x 0.500 in.; (Recommended plate thickness: not calculated) |
| Profile: | no profile |
| Base material: | cracked concrete, 3000, $f_c'$ = 3,000 psi; h = 48.000 in. |
| Reinforcement: | tension: condition A, shear: condition A; |
| | edge reinforcement: none or < No. 4 bar |
| Seismic loads (cat. C, D, E, or F) | Tension load: yes (17.2.3.4.3 (d)) |
| | Shear load: yes (17.2.3.5.3 (c)) |

[R] - The anchor calculation is based on a rigid anchor plate assumption.

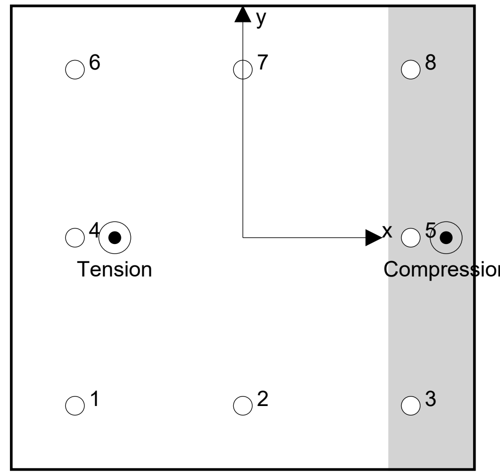
**Geometry [in.] & Loading [lb, in.lb]**



**1.1 Design results**

| Case | Description | Forces [lb] / Moments [in.lb] | Seismic | Max. Util. Anchor [%] |
|---|---|---|---|---|
| 1 | Combination 1 | N = -1,800; $V_x$ = 2,280; $V_y$ = 0; $M_x$ = 0; $M_y$ = 218,880; $M_z$ = 0; | yes | 84 |

## 2 Load case/Resulting anchor forces




**Anchor reactions [lb]**
Tension force: (+Tension, -Compression)

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 3,608 | 285 | 285 | 0 |
| 2 | 1,683 | 285 | 285 | 0 |
| 3 | 0 | 285 | 285 | 0 |
| 4 | 3,608 | 285 | 285 | 0 |
| 5 | 0 | 285 | 285 | 0 |
| 6 | 3,608 | 285 | 285 | 0 |
| 7 | 1,683 | 285 | 285 | 0 |
| 8 | 0 | 285 | 285 | 0 |

max. concrete compressive strain: 0.10 [‰]
max. concrete compressive stress: 437 [psi]
resulting tension force in (x/y)=(-5.530/-0.000): 14,192 [lb]
resulting compression force in (x/y)=(8.779/-0.000): 15,992 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

## 3 Tension load

| | **Load $N_{ua}$ [lb]** | **Capacity $\phi$ $N_n$ [lb]** | **Utilization $\beta_N = N_{ua}/\phi$ $N_n$** | **Status** |
|---|---|---|---|---|
| Steel Strength* | 3,608 | 14,529 | 25 | OK |
| Pullout Strength* | 3,608 | 11,479 | 32 | OK |
| Concrete Breakout Failure** | 14,192 | 17,468 | 82 | OK |
| Concrete Side-Face Blowout, direction ** | N/A | N/A | N/A | N/A |

* highest loaded anchor **anchor group (anchors in tension)

### 3.1 Steel Strength

$N_{sa} = A_{se,N} f_{uta}$ ACI 318-14 Eq. (17.4.1.2)
$\phi N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,N}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.33 | 58,000 |

**Calculations**

| $N_{sa}$ [lb] |
|---|
| 19,372 |

**Results**

| $N_{sa}$ [lb] | $\phi_{steel}$ | $\phi N_{sa}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 19,372 | 0.750 | 14,529 | 3,608 |

### 3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-14 Eq. (17.4.3.1)
$N_p = 8 A_{brg} f'_c$ ACI 318-14 Eq. (17.4.3.4)
$\phi N_{pN} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $\psi_{c,p}$ | $A_{brg}$ [in.$^2$] | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| 1.000 | 0.91 | 1.000 | 3,000 |

**Calculations**

| $N_p$ [lb] |
|---|
| 21,864 |

**Results**

| $N_{pn}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi N_{pn}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|---|---|
| 21,864 | 0.700 | 0.750 | 1.000 | 11,479 | 3,608 |

### 3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ ACI 318-14 Eq. (17.4.2.1b)
$\phi N_{cbg} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1
$A_{Nc}$ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)
$A_{Nc0} = 9 h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e'_N}{3 h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)
$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)
$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

**Variables**

| $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] | $\psi_{c,N}$ |
|---|---|---|---|---|
| 9.667 | 1.180 | 0.000 | 7.250 | 1.000 |

| $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| - | 24 | 1.000 | 3,000 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 841.00 | 841.00 | 0.925 | 1.000 | 0.850 | 1.000 | 39,508 |

**Results**

| $N_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi N_{cbg}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|---|---|
| 31,054 | 0.750 | 0.750 | 1.000 | 17,468 | 14,192 |

## 4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi$ $V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi$ $V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 285 | 6,044 | 5 | OK |
| Steel failure (with lever arm)* | 285 | 977 | 30 | OK |
| Pryout Strength** | 2,280 | 78,222 | 3 | OK |
| Concrete edge failure in direction x+** | 2,280 | 8,661 | 27 | OK |

* highest loaded anchor  **anchor group (relevant anchors)

### 4.1 Steel Strength

$V_{sa} = 0.6\ A_{se,V}\ f_{uta}$  ACI 318-14 Eq. (17.5.1.2b)
$\phi\ V_{steel} \geq V_{ua}$  ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.33 | 58,000 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 11,623 |

**Results**

| $V_{sa}$ [lb] | $\phi_{steel}$ | $\phi_{eb}$ | $\phi\ V_{sa,eq}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|---|
| 11,623 | 0.650 | 0.800 | 6,044 | 285 |

### 4.2 Steel failure (with lever arm)

| | | |
|---|---|---|
| $V_s^M$ | $= \frac{\alpha_M \cdot M_s}{L_b}$ | bending equation for stand-off |
| $M_s$ | $= M_s^0 \left(1 - \frac{N_{ua}}{\phi\ N_{sa}}\right)$ | resultant flexural resistance of anchor |
| $M_s^0$ | $= (1.2)\ (S)\ (f_{u,min})$ | characteristic flexural resistance of anchor |
| $\left(1 - \frac{N_{ua}}{\phi\ N_{sa}}\right)$ | | reduction for tensile force acting simultaneously with a shear force on the anchor |
| $S$ | $= \frac{\pi(d)^3}{32}$ | elastic section modulus of anchor bolt at concrete surface |
| $L_b$ | $= z + (n)(d_0)$ | internal lever arm adjusted for spalling of the surface concrete |
| $\phi\ V_s^M$ | $\geq V_{ua}$ | ACI 318-14 Table 17.3.1.1 |

**Variables**

| $\alpha_M$ | $f_{u,min}$ [psi] | $N_{ua}$ [lb] | $\phi\ N_{sa}$ [lb] | z [in.] | n | $d_0$ [in.] |
|---|---|---|---|---|---|---|
| 2.00 | 58,000 | 3,608 | 14,529 | 1.431 | 0.500 | 0.750 |

**Calculations**

| $M_s^0$ [in.lb] | $\left(1 - \frac{N_{ua}}{\phi\ N_{sa}}\right)$ | $M_s$ [in.lb] | $L_b$ [in.] |
|---|---|---|---|
| 1,806 | 0.752 | 1,357 | 1.806 |

**Results**

| $V_s^M$ [lb] | $\phi_{steel}$ | $\phi\ V_s^M$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 1,503 | 0.650 | 977 | 285 |

**4.3 Pryout Strength**

$V_{cpg} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N} \ \psi_{ed,N} \ \psi_{c,N} \ \psi_{cp,N} \ N_b \right]$ ACI 318-14 Eq. (17.5.3.1b)

$\phi \ V_{cpg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

$A_{Nc}$ see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9 \ h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ec,N} = \left( \frac{1}{1 + \frac{2 \ e_N'}{3 \ h_{ef}}} \right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)

$\psi_{ed,N} = 0.7 + 0.3 \left( \frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = MAX\left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c \ \lambda_a \ \sqrt{f_c'} \ h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

**Variables**

| $k_{cp}$ | $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|
| 2 | 4.833 | 0.000 | 0.000 | 7.250 |

| $\psi_{c,N}$ | $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f_c'$ [psi] |
|---|---|---|---|---|
| 1.000 | ∞ | 24 | 1.000 | 3,000 |

**Calculations**

| $A_{Nc}$ [in.$^2$] | $A_{Nc0}$ [in.$^2$] | $\psi_{ec1,N}$ | $\psi_{ec2,N}$ | $\psi_{ed,N}$ | $\psi_{cp,N}$ | $N_b$ [lb] |
|---|---|---|---|---|---|---|
| 841.00 | 210.25 | 1.000 | 1.000 | 1.000 | 1.000 | 13,968 |

**Results**

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi \ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|---|---|
| 111,746 | 0.700 | 1.000 | 1.000 | 78,222 | 2,280 |

**4.4 Concrete edge failure in direction x+**

$V_{cbg} = \left( \frac{A_{Vc}}{A_{Vc0}} \right) \psi_{ec,V} \ \psi_{ed,V} \ \psi_{c,V} \ \psi_{h,V} \ \psi_{parallel,V} \ V_b$ ACI 318-14 Eq. (17.5.2.1b)

$\phi \ V_{cbg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

$A_{Vc}$ see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)

$A_{Vc0} = 4.5 \ c_{a1}^2$ ACI 318-14 Eq. (17.5.2.1c)

$\psi_{ec,V} = \left( \frac{1}{1 + \frac{2 e_v'}{3 c_{a1}}} \right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.5)

$\psi_{ed,V} = 0.7 + 0.3 \left( \frac{c_{a2}}{1.5 c_{a1}} \right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.6b)

$\psi_{h,V} = \sqrt{\frac{1.5 c_{a1}}{h_a}} \geq 1.0$ ACI 318-14 Eq. (17.5.2.8)

$V_b = 9 \ \lambda_a \ \sqrt{f_c'} \ c_{a1}^{1.5}$ ACI 318-14 Eq. (17.5.2.2b)

**Variables**

| $c_{a1}$ [in.] | $c_{a2}$ [in.] | $e_{cV}$ [in.] | $\psi_{c,V}$ | $h_a$ [in.] |
|---|---|---|---|---|
| 7.250 | 7.250 | 0.000 | 1.000 | 48.000 |

| $l_e$ [in.] | $\lambda_a$ | $d_a$ [in.] | $f_c'$ [psi] | $\psi_{parallel,V}$ |
|---|---|---|---|---|
| 6.000 | 1.000 | 0.750 | 3,000 | 1.000 |

**Calculations**

| $A_{Vc}$ [in.$^2$] | $A_{Vc0}$ [in.$^2$] | $\psi_{ec,V}$ | $\psi_{ed,V}$ | $\psi_{h,V}$ | $V_b$ [lb] |
|---|---|---|---|---|---|
| 315.37 | 236.53 | 1.000 | 0.900 | 1.000 | 9,623 |

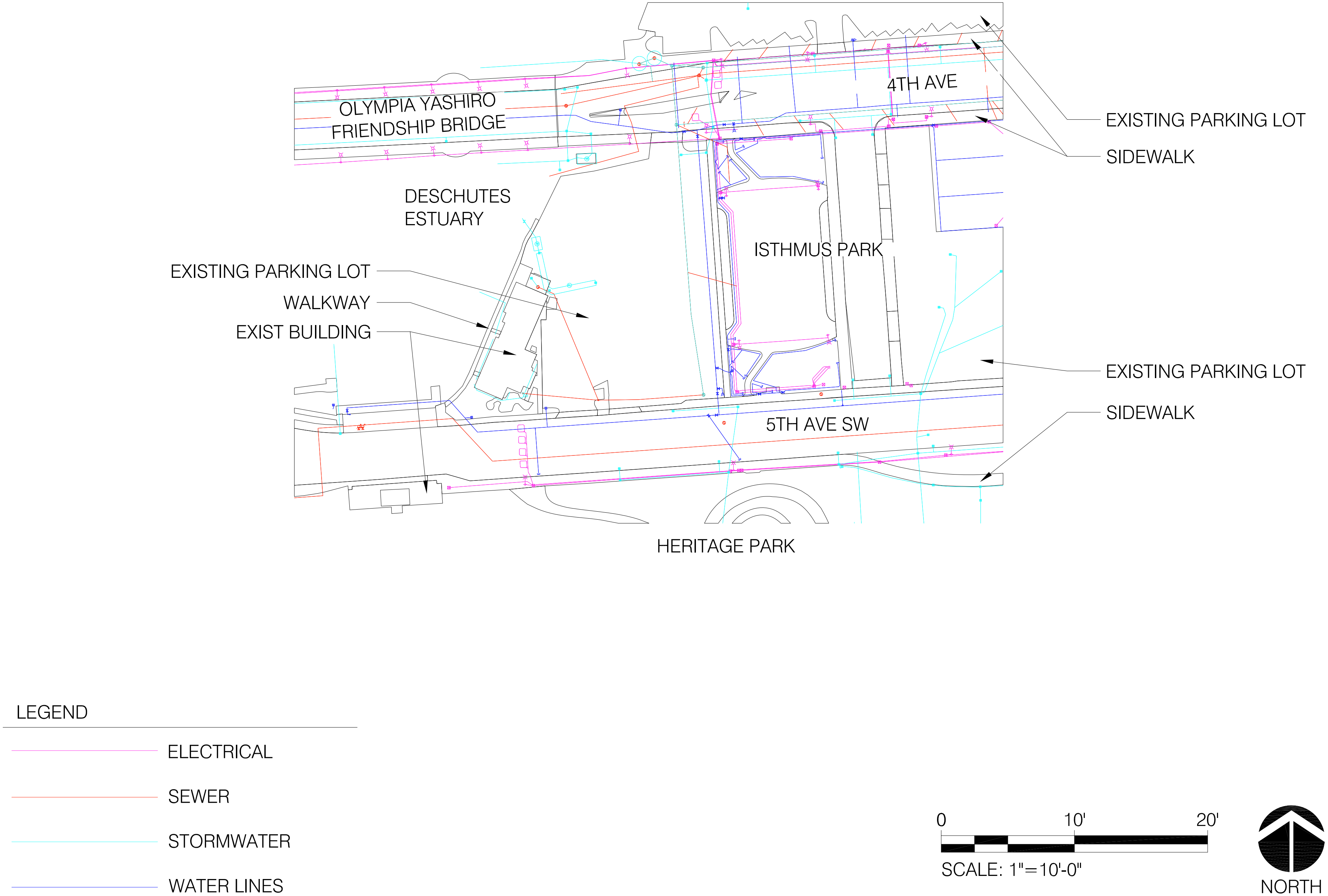
**Results**

| $V_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi_{seismic}$ | $\phi_{nonductile}$ | $\phi \ V_{cbg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|---|---|
| 11,548 | 0.750 | 1.000 | 1.000 | 8,661 | 2,280 |

## 5 Combined tension and shear loads

| $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|
| 0.812 | 0.292 | 5/3 | 84 | OK |

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$




# EXHIBIT C
# WELCOME FIGURE - EXISTING CONDITIONS PLAN

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