BYKONEN
CARTER
QUINN

STRUCTURAL
ENGINEERING

# STRUCTURAL CALCULATIONS

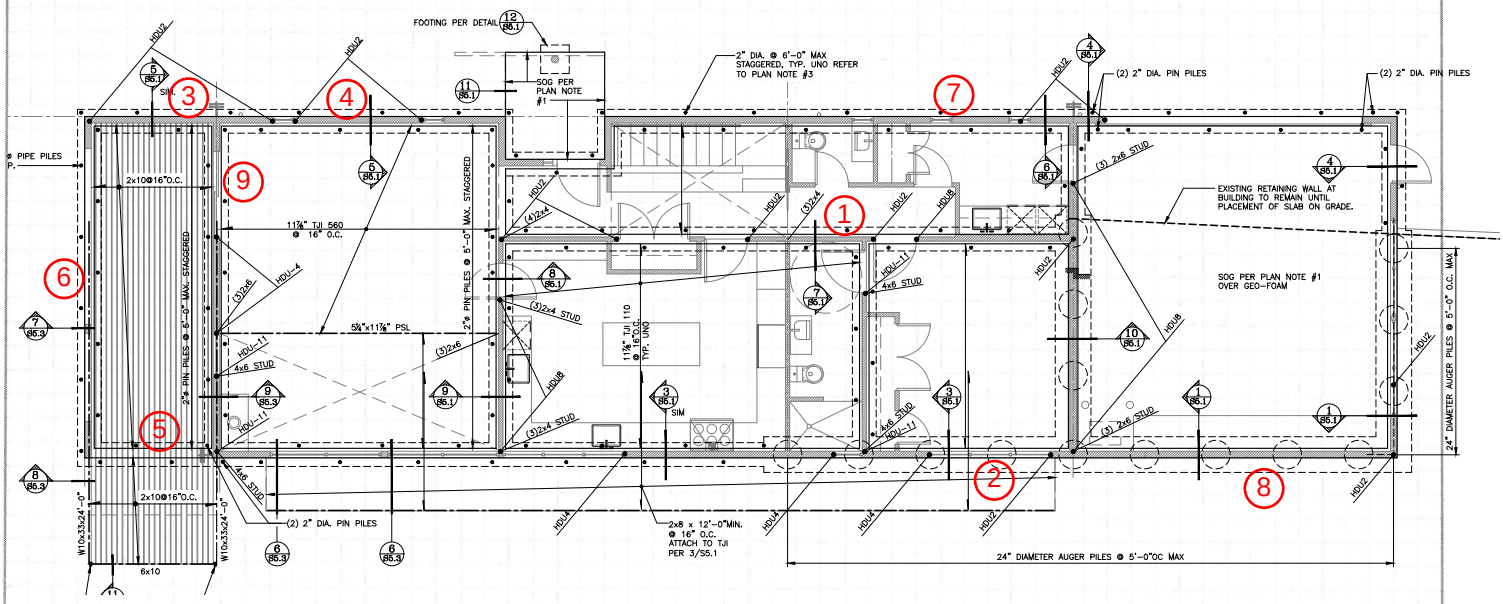
**Vaney Shinde Residence**
4207 W Mercer Way,
Mercer Island, WA 98040

**Studio Ectypos**
4212 W Mercer Way,
Mercer Island, WA 98040

**June 24, 2020**

**Supplemental Calculations – Intake comments**


2033 Sixth Avenue #995 Seattle, WA 98121 206-264-7784 www.BCQ-SE.com




Key - Footing load cases

BYKONEN CARTER QUINN
STRUCTURAL ENGINEERING
► 2033 Sixth Avenue #995 Seattle, WA 98121 206-264-7784 www.BCQ-SE.com

PROJECT: Vaney Shinde DATE: 6/23/2020

DESIGNER: JAJ SHEET #: -

# Vaney Shinde - Footing Loads & Tribs

Foundations are structurally acceptable for the loading below, including 5 psf wet snow surcharge.

| Load Map | DL (psf) | LL (psf) | SL (psf)* |
|---|---|---|---|
| Roof, typ | 15 | | 30 |
| Floors, typ | 15 | 40 | |
| Decks | 15 | 60 | |

** Includes 5 psf surcharge for low slope roof*

| **Case 1** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
|---|---|---|---|---|---|---|---|---|---|
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 11.5 | 141 | 314 | | 345 | | | |
| | Upper | 11.5 | 134 | 306 | 460 | | | | |
| | Main | 11.5 | | 173 | 460 | | | | |
| | Σ | | | 792 | 920 | 345 | 1712 | 1137 | 1741 |
| **Case 2** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 8.0 | 141 | 261 | | 240 | | | |
| | Upper | 9.5 | 134 | 276 | 380 | | | | |
| | Main | 9.5 | 146 | 289 | 380 | | | | |
| | Σ | | | 826 | 760 | 240 | 1586 | 1066 | 1576 |
| **Case 3** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 12.0 | 141 | 321 | | 360 | | | |
| | Upper | 7.5 | 134 | 246 | 300 | | | | |
| | Main | 0.7 | | 10 | 27 | | | | |
| | Σ | | | 577 | 327 | 360 | 904 | 937 | 1092 |
| **Case 4** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 7.5 | 141 | 254 | | 225 | | | |
| | Upper | 0.7 | 134 | 144 | 27 | | | | |
| | Main | 0.7 | | 10 | 27 | | | | |
| | Σ | | | 407 | 53 | 225 | 460 | 632 | 616 |
| **Case 5** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 12.0 | 141 | 321 | | 360 | | | |
| | Upper | 1.3 | 134 | 154 | 80 | | | | |
| | Main | 1.3 | 60 | 80 | 80 | | | | |
| | Σ | | | 555 | 160 | 360 | 715 | 915 | 945 |
| **Case 6** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 2.0 | 141 | 171 | | 60 | | | |
| | Upper | 0.7 | 134 | 144 | 40 | | | | |
| | Main | 4.5 | 60 | 128 | 270 | | | | |
| | Σ | | | 442 | 310 | 60 | 752 | 502 | 720 |
| **Case 7** | | | **Walls** | | **Net loads** | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 4.0 | 141 | 201 | | 120 | | | |
| | Upper | 4.0 | 134 | 194 | 160 | | | | |
| | Main | 4.0 | | 60 | 160 | | | | |
| | Σ | | | 455 | 320 | 120 | 775 | 575 | 785 |

| Case 8 | | | Walls | Net loads | | | D+L | D+S | D+0.75(L+S) |
|---|---|---|---|---|---|---|---|---|---|
| | | Trib (ft) | DL (plf) | DL (plf) | LL (plf) | SL (plf) | (plf) | (plf) | (plf) |
| | Roof | | | 0 | | 0 | | | |
| | Upper | 12.0 | 134 | 314 | 720 | | | | |
| | Main | | 1219 | 1219 | 0 | | | | |
| | Σ | | | 1532 | 720 | 0 | 2252 | 1532 | 2072 |
| **Case 9** | | | **Walls** | **Net loads** | | | **D+L** | **D+S** | **D+0.75(L+S)** |
| | | **Trib (ft)** | **DL (plf)** | **DL (plf)** | **LL (plf)** | **SL (plf)** | **(plf)** | **(plf)** | **(plf)** |
| | Roof | 2.0 | 141 | 171 | | 60 | | | |
| | Upper | 10.0 | 134 | 284 | 400 | | | | |
| | Main | 14.5 | 60 | 278 | 670 | | | | |
| | Σ | | | 732 | 1070 | 60 | 1802 | 792 | 1580 |

| | | | |
|---|---|---|---|
| Company: | | Date: | 6/22/2020 |
| Engineer: | | Page: | 1/5 |
| Project: | | | |
| Address: | | | |
| Phone: | | | |
| E-mail: | | | |

## 1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

## 2. Input Data & Anchor Parameters

**General**
Design method:ACI 318-14
Units: Imperial units

**Anchor Information:**
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 0.875
Effective Embedment depth, $h_{ef}$ (inch): 12.000
Anchor category: -
Anchor ductility: Yes
$h_{min}$ (inch): 14.38
$C_{min}$ (inch): 5.25
$S_{min}$ (inch): 5.25

**Base Material**
Concrete: Normal-weight
Concrete thickness, h (inch): 15.00
State: Cracked
Compressive strength, $f'_c$ (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: No
Build-up grout pad: No

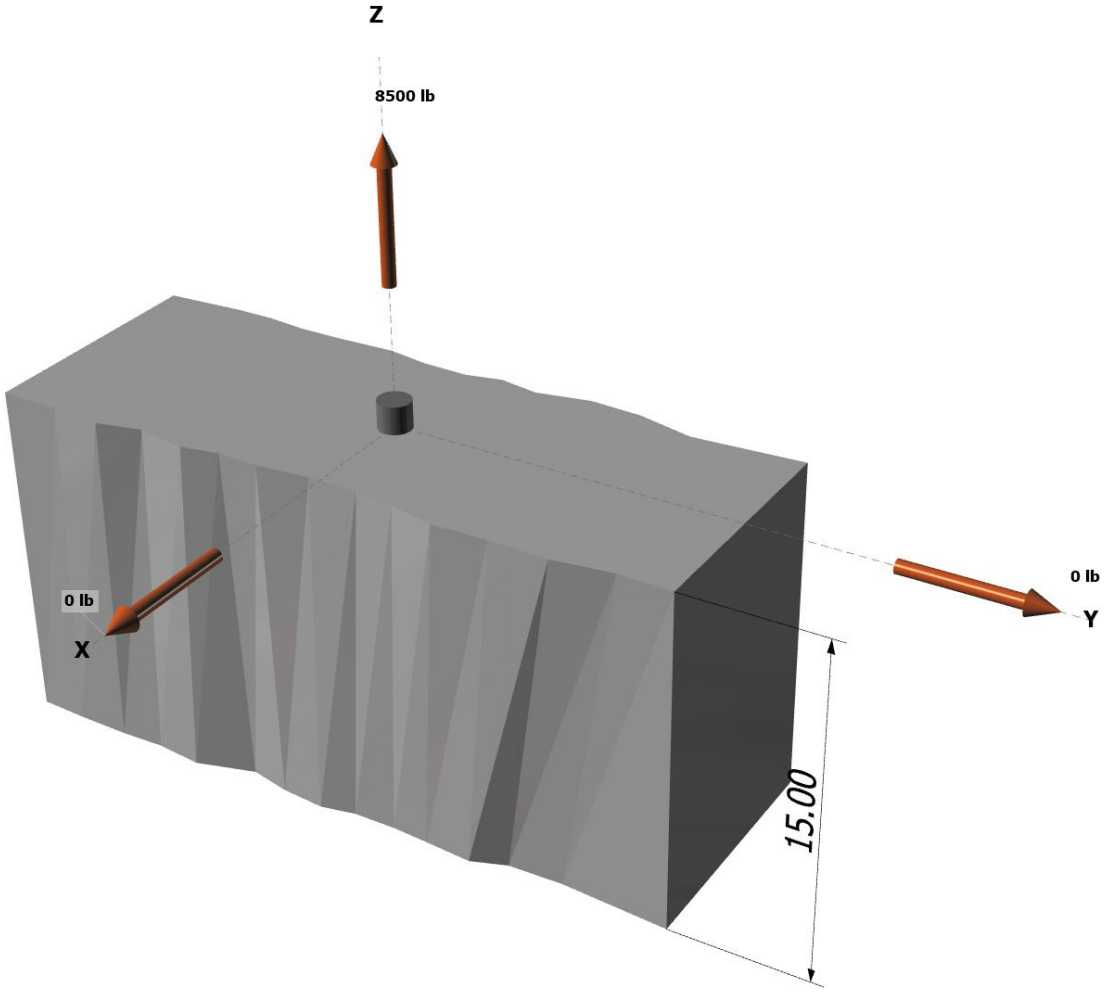
**Recommended Anchor**
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB7 (7/8"Ø)

**Load and Geometry**
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (c) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
$\Omega_0$ factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

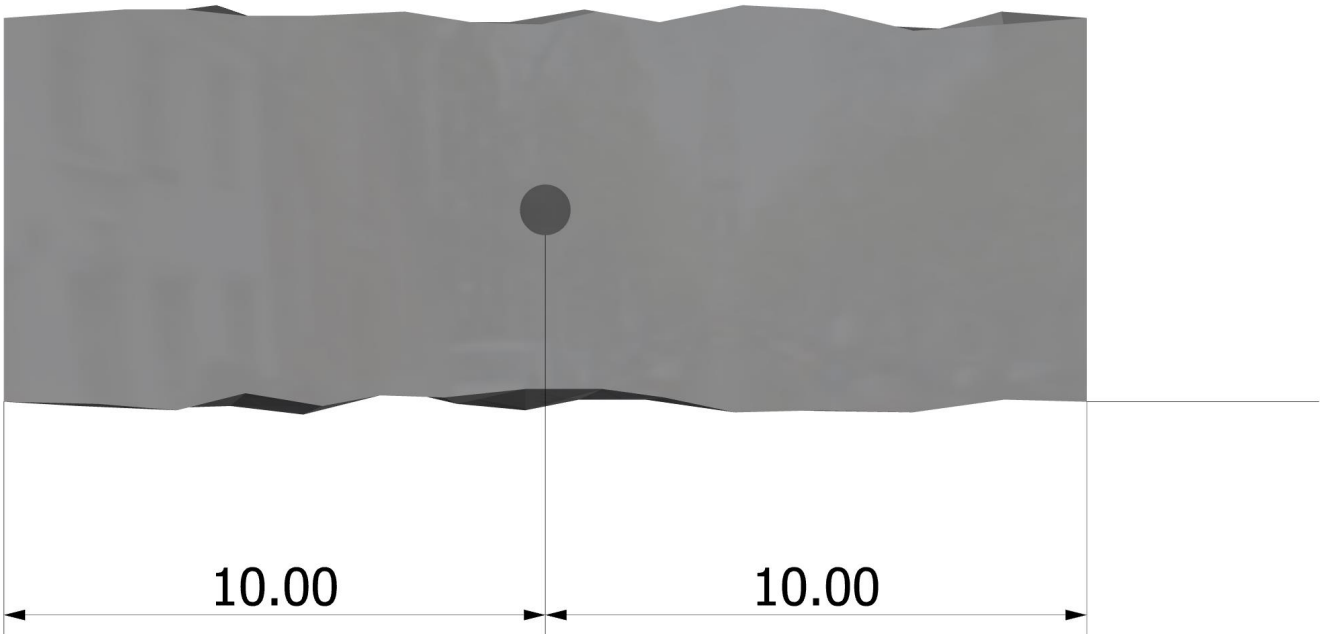
Strength level loads:

$N_{ua}$ [lb]: 8500
$V_{uax}$ [lb]: 0
$V_{uay}$ [lb]: 0

<Figure 1>



<Figure 2>



## 3. Resulting Anchor Forces

| Anchor | Tension load, $N_{ua}$ (lb) | Shear load x, $V_{uax}$ (lb) | Shear load y, $V_{uay}$ (lb) | Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb) |
|---|---|---|---|---|
| 1 | 8500.0 | 0.0 | 0.0 | 0.0 |
| Sum | 8500.0 | 0.0 | 0.0 | 0.0 |

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 8500
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, $e'_{Nx}$ (inch): 0.00
Eccentricity of resultant tension forces in y-axis, $e'_{Ny}$ (inch): 0.00

## 4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---|---|---|
| 26795 | 0.75 | 20096 |

## 5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = 16\lambda_a\sqrt{f'_c}h_{ef}^{5/3}$ (Eq. 17.4.2.2b)

| $\lambda_a$ | $f'_c$ (psi) | $h_{ef}$ (in) | $N_b$ (lb) |
|---|---|---|---|
| 1.00 | 2500 | 12.000 | 50318 |

$0.75\phi N_{cb} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1a)

| $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$ | $c_{a,min}$ (in) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $0.75\phi N_{cb}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 768.75 | 1296.00 | 10.00 | 0.867 | 1.00 | 1.000 | 50318 | 0.75 | 14551 |

## 6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

| $\Psi_{c,P}$ | $A_{brg}$ (in$^2$) | $f'_c$ (psi) | $\phi$ | $0.75\phi N_{pn}$ (lb) |
|---|---|---|---|---|
| 1.0 | 4.07 | 2500 | 0.70 | 42683 |

## 11. Results

### 11. Interaction of Tensile and Shear Forces (Sec. D.7)?

| Tension | Factored Load, $N_{ua}$ (lb) | Design Strength, $\phi N_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| Steel | 8500 | 20096 | 0.42 | Pass |
| **Concrete breakout** | **8500** | **14551** | **0.58** | **Pass (Governs)** |
| Pullout | 8500 | 42683 | 0.20 | Pass |

**PAB7 (7/8"Ø) with hef = 12.000 inch meets the selected design criteria.**

## 12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.

## 1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

## 2. Input Data & Anchor Parameters

**General**
Design method:ACI 318-14
Units: Imperial units

**Anchor Information:**
Anchor type: Cast-in-place
Material: AB
Diameter (inch): 1.000
Effective Embedment depth, $h_{ef}$ (inch): 12.000
Anchor category: -
Anchor ductility: Yes
$h_{min}$ (inch): 14.63
$C_{min}$ (inch): 6.00
$S_{min}$ (inch): 6.00

**Base Material**
Concrete: Normal-weight
Concrete thickness, h (inch): 15.00
State: Cracked
Compressive strength, $f'_c$ (psi): 2500
$\Psi_{c,V}$: 1.0
Reinforcement condition: A tension, A shear
Supplemental reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: No
Build-up grout pad: No

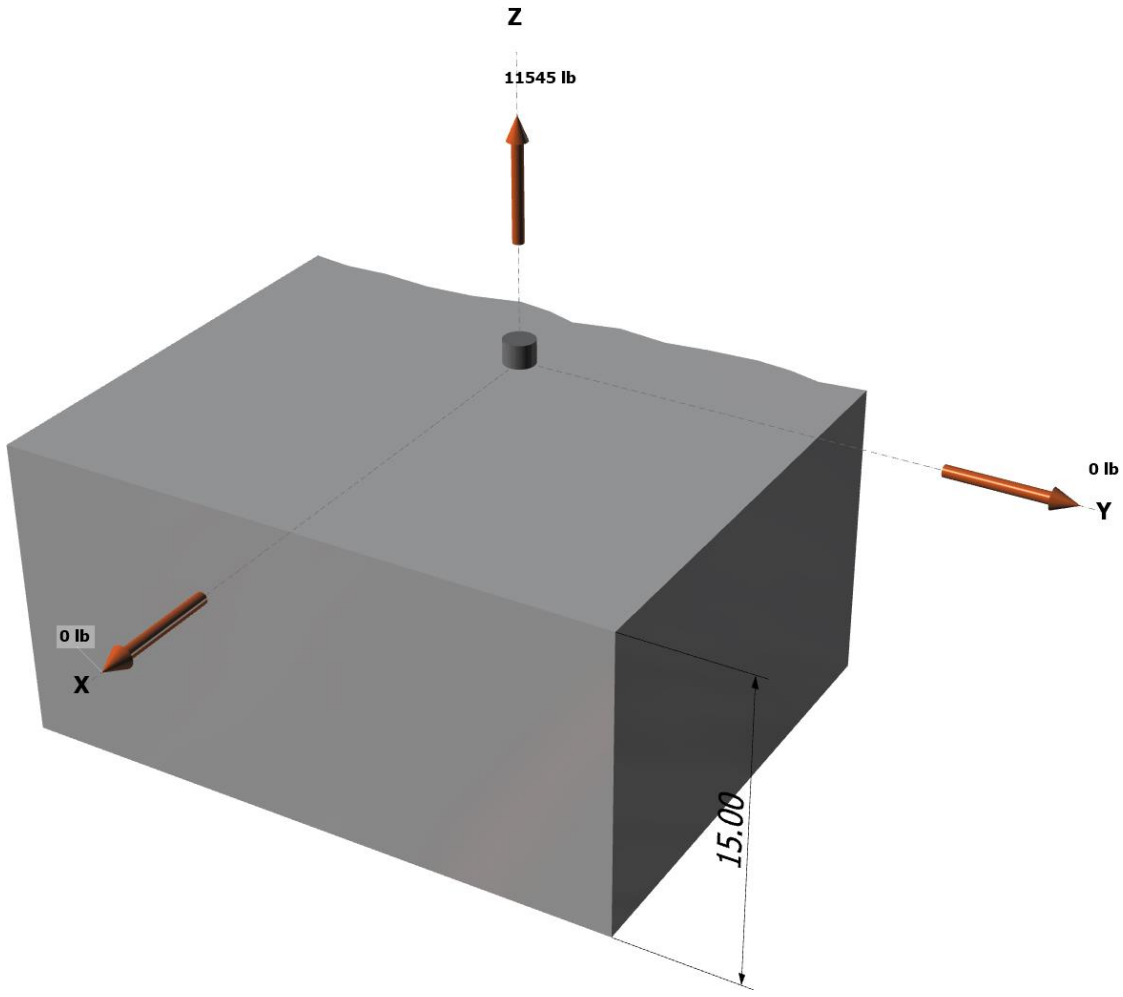
**Recommended Anchor**
Anchor Name: PAB Pre-Assembled Anchor Bolt - PAB8 (1"Ø)

**Load and Geometry**
Load factor source: ACI 318 Section 5.3
Load combination: U = 0.9D + 1.0E
Seismic design: Yes
Anchors subjected to sustained tension: Not applicable
Ductility section for tension: 17.2.3.4.3 (c) is satisfied
Ductility section for shear: 17.2.3.5.2 not applicable
$\Omega_0$ factor: not set
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

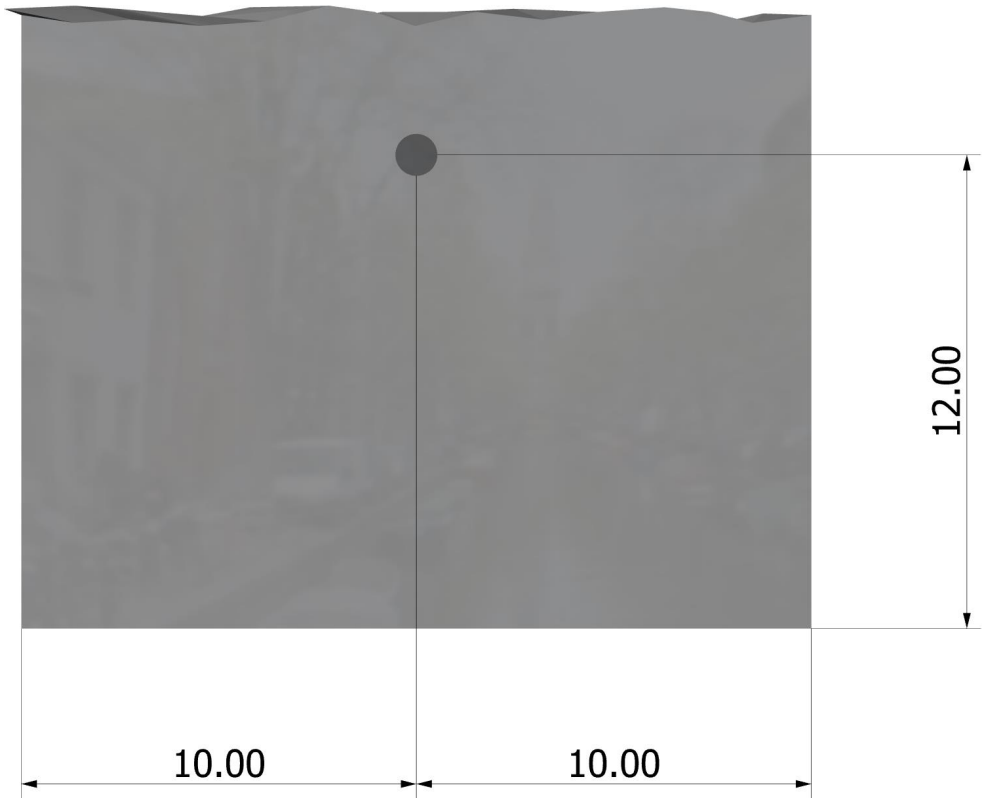
Service level loads:

| | D | E | *Strength level loads* |
|---|---|---|---|
| $N_a$ [lb]: | -506 | 12000 | *11545* |
| $V_{ax}$ [lb]: | 0 | 0 | *0* |
| $V_{ay}$ [lb]: | 0 | 0 | *0* |

<Figure 1>



<Figure 2>



## 3. Resulting Anchor Forces

| Anchor | Tension load, $N_{ua}$ (lb) | Shear load x, $V_{uax}$ (lb) | Shear load y, $V_{uay}$ (lb) | Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb) |
|---|---|---|---|---|
| 1 | 11545.0 | 0.0 | 0.0 | 0.0 |
| Sum | 11545.0 | 0.0 | 0.0 | 0.0 |

Maximum concrete compression strain (‰): 0.00
Maximum concrete compression stress (psi): 0
Resultant tension force (lb): 11545
Resultant compression force (lb): 0
Eccentricity of resultant tension forces in x-axis, $e'_{Nx}$ (inch): 0.00
Eccentricity of resultant tension forces in y-axis, $e'_{Ny}$ (inch): 0.00

## 4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---|---|---|
| 35150 | 0.75 | 26363 |

## 5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = 16\lambda_a\sqrt{f'_c}h_{ef}^{5/3}$ (Eq. 17.4.2.2b)

| $\lambda_a$ | $f'_c$ (psi) | $h_{ef}$ (in) | $N_b$ (lb) |
|---|---|---|---|
| 1.00 | 2500 | 8.000 | 25600 |

$0.75\phi N_{cb} = 0.75\phi\,(A_{Nc}/A_{Nco})\,\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1a)

| $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$ | $c_{a,min}$ (in) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $0.75\phi N_{cb}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 507.50 | 576.00 | 10.00 | 0.950 | 1.00 | 1.000 | 25600 | 0.75 | 12053 |

## 6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$0.75\phi N_{pn} = 0.75\phi\Psi_{c,P}N_p = 0.75\phi\Psi_{c,P}8A_{brg}f'_c$ (Sec. 17.3.1, Eq. 17.4.3.1 & 17.4.3.4)

| $\Psi_{c,P}$ | $A_{brg}$ (in$^2$) | $f'_c$ (psi) | $\phi$ | $0.75\phi N_{pn}$ (lb) |
|---|---|---|---|---|
| 1.0 | 5.15 | 2500 | 0.70 | 54117 |

## 11. Results

### 11. Interaction of Tensile and Shear Forces (Sec. D.7)?

| Tension | Factored Load, $N_{ua}$ (lb) | Design Strength, $\phi N_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| Steel | 11545 | 26363 | 0.44 | Pass |
| **Concrete breakout** | **11545** | **12053** | **0.96** | **Pass (Governs)** |
| Pullout | 11545 | 54117 | 0.21 | Pass |

**PAB8 (1"Ø) with hef = 12.000 inch meets the selected design criteria.**

## 12. Warnings

- Per designer input, ductility requirements for tension have been determined to be satisfied – designer to verify.

- Per designer input, the shear component of the strength-level earthquake force applied to anchors does not exceed 20 percent of the total factored anchor shear force associated with the same load combination. Therefore the ductility requirements of ACI 318 17.2.3.5.2 for shear need not be satisfied – designer to verify.

- Designer must exercise own judgement to determine if this design is suitable.