# Structural Calculations

(Revisions to Permit Documents)

Project:

## Ostroff-Galiotto Residence

4244 Shoreclub Drive
Mercer Island, WA 98040

For:

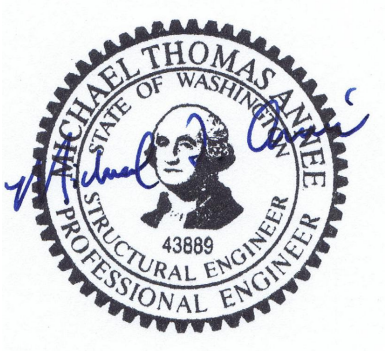
Axiom Design Build
5424 Ballard Avenue NW
Seattle, WA 98107

By:

Année Structural Engineering, LLC
1801 18th Ave S
Seattle, WA 98144

Date:

September 16, 2022



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and then using the "Printing &
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Project Title:
Engineer:
Project Descr:

Project ID:

Printed: 15 SEP 2022, 3:30PM

# Concrete Beam

File = C:\ASE\Projects\OSTROF~1\CALCUL~1\CANTIL~1.EC6
ENERCALC, INC. 1983-2015, Build:6.15.7.30, Ver:6.15.12.31

**Lic. # : KW-06009341** — **Licensee : Annee Structural Engineering LLC**

Description : Cantilevered Slab at Garage

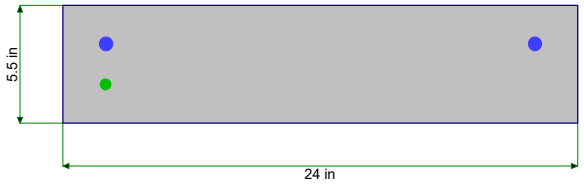
## CODE REFERENCES

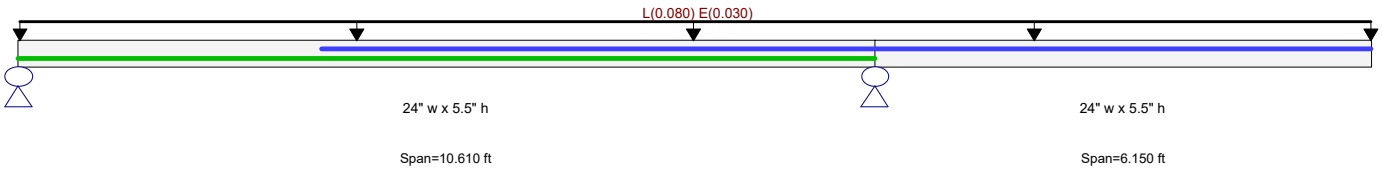
Calculations per ACI 318-11, IBC 2012, ASCE 7-10
Load Combination Set : ASCE 7-10

## Material Properties

| | | | | | |
|---|---|---|---|---|---|
| f'c | = | 2.50 ksi | $\phi$ Phi Values | Flexure : | 0.90 |
| fr = f'c $^{1/2}$ * 7.50 | = | 375.0 psi | | Shear : | 0.750 |
| $\psi$ Density | = | 145.0 pcf | $\beta_1$ | = | 0.850 |
| $\lambda$ LtWt Factor | = | 1.0 | | | |
| Elastic Modulus | = | 3,122.0 ksi | Fy - Stirrups | | 40.0 ksi |
| fy - Main Rebar | = | 60.0 ksi | E - Stirrups | = | 29,000.0 ksi |
| E - Main Rebar | = | 29,000.0 ksi | Stirrup Bar Size # | = | # 3 |
| | | | Number of Resisting Legs Per Stirrup | = | 1.0 |

Load Combination ASCE 7-10




## Cross Section & Reinforcing Details

Rectangular Section, Width = 24.0 in, Height = 5.50 in
Span #1 Reinforcing....
2-#5 at 1.80 in from Top, from 3.750 to 10.610 ft in this span
1-#4 at 1.80 in from Bottom, from 0.0 to 10.610 ft in this span
Span #2 Reinforcing....
2-#5 at 1.80 in from Top, from 0.0 to 6.150 ft in this span

## Applied Loads

Service loads entered. Load Factors will be applied for calculations.

**Beam self weight calculated and added to loads**
**Loads on all spans...**
L = 0.040, E = 0.0150
Uniform Load on ALL spans : L = 0.040, E = 0.0150 ksf, Tributary Width = 2.0 ft

## DESIGN SUMMARY

Maximum Bending Stress Ratio = **0.815** : 1
Section used for this span **Typical Section**
Mu : Applied 2.628 k-ft
Mn * Phi : Allowable 3.224 k-ft
Load Combination +1.20D+1.60L+0.50S+1.60H, LL Comb Run (L*)
Location of maximum on span 3.724 ft
Span # where maximum occurs Span # 1

Maximum Deflection

| | | | |
|---|---|---|---|
| Max Downward Transient Deflection | 0.000 in | Ratio = | 0 <360 |
| Max Upward Transient Deflection | 0.000 in | Ratio = | 0 <360 |
| Max Downward Total Deflection | 0.143 in | Ratio = | 1030 |
| Max Upward Total Deflection | -0.015 in | Ratio = | 8325 |

## Vertical Reactions

Support notation : Far left is #1

| Load Combination | Support 1 | Support 2 | Support 3 |
|---|---|---|---|
| Overall MAXimum | 0.893 | 2.818 | |
| Overall MINimum | 0.106 | 0.397 | |
| +D+H | 0.468 | 1.759 | |
| +D+L+H, LL Comb Run (*L) | 0.326 | 2.394 | |
| +D+L+H, LL Comb Run (L*) | 0.893 | 2.184 | |
| +D+L+H, LL Comb Run (LL) | 0.750 | 2.818 | |
| +D+Lr+H, LL Comb Run (*L) | 0.468 | 1.759 | |
| +D+Lr+H, LL Comb Run (L*) | 0.468 | 1.759 | |
| +D+Lr+H, LL Comb Run (LL) | 0.468 | 1.759 | |
| +D+S+H | 0.468 | 1.759 | |
| +D+0.750Lr+0.750L+H, LL Comb Run (* | 0.361 | 2.235 | |

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Lic. # : KW-06009341
Licensee : Annee Structural Engineering LLC

Description : Cantilevered Slab at Garage

## Vertical Reactions

Support notation : Far left is #1

| Load Combination | Support 1 | Support 2 | Support 3 |
|---|---|---|---|
| +D+0.750Lr+0.750L+H, LL Comb Run (L | 0.787 | 2.078 | |
| +D+0.750Lr+0.750L+H, LL Comb Run (L | 0.680 | 2.554 | |
| +D+0.750L+0.750S+H, LL Comb Run (*L | 0.361 | 2.235 | |
| +D+0.750L+0.750S+H, LL Comb Run (L* | 0.787 | 2.078 | |
| +D+0.750L+0.750S+H, LL Comb Run (LL | 0.680 | 2.554 | |
| +D+0.60W+H | 0.468 | 1.759 | |
| +D+0.70E+H | 0.542 | 2.037 | |
| +D+0.750Lr+0.750L+0.450W+H, LL Com | 0.361 | 2.235 | |
| +D+0.750Lr+0.750L+0.450W+H, LL Com | 0.787 | 2.078 | |
| +D+0.750Lr+0.750L+0.450W+H, LL Com | 0.680 | 2.554 | |
| +D+0.750L+0.750S+0.450W+H, LL Coml | 0.361 | 2.235 | |
| +D+0.750L+0.750S+0.450W+H, LL Coml | 0.787 | 2.078 | |
| +D+0.750L+0.750S+0.450W+H, LL Coml | 0.680 | 2.554 | |
| +D+0.750L+0.750S+0.5250E+H, LL Com | 0.417 | 2.444 | |
| +D+0.750L+0.750S+0.5250E+H, LL Com | 0.842 | 2.286 | |
| +D+0.750L+0.750S+0.5250E+H, LL Com | 0.735 | 2.762 | |
| +0.60D+0.60W+0.60H | 0.281 | 1.056 | |
| +0.60D+0.70E+0.60H | 0.355 | 1.334 | |
| D Only | 0.468 | 1.759 | |
| Lr Only, LL Comb Run (*L) | | | |
| Lr Only, LL Comb Run (L*) | | | |
| Lr Only, LL Comb Run (LL) | | | |
| L Only, LL Comb Run (*L) | -0.143 | 0.635 | |
| L Only, LL Comb Run (L*) | 0.424 | 0.424 | |
| L Only, LL Comb Run (LL) | 0.282 | 1.059 | |
| S Only | | | |
| W Only | | | |
| E Only | 0.106 | 0.397 | |
| H Only | | | |

## Shear Stirrup Requirements

Entire Beam Span Length : Vu < PhiVc/2, Req'd Vs = Not Reqd 11.4.6.1, use stirrups spaced at 0.000 in

## Maximum Forces & Stresses for Load Combinations

| Load Combination / Segment Length | Span # | Location (ft) in Span | Bending Stress Results ( k-ft ) Mu : Max | Phi*Mnx | Stress Ratio |
|---|---|---|---|---|---|
| MAXimum BENDING Envelope | | | | | |
| Span # 1 | 1 | 10.610 | 2.63 | 3.22 | 0.81 |
| Span # 2 | 2 | 6.150 | -5.44 | 9.31 | 0.58 |
| +1.40D+1.60H | | | | | |
| Span # 1 | 1 | 10.610 | 1.15 | 3.22 | 0.36 |
| Span # 2 | 2 | 6.150 | -3.52 | 9.31 | 0.38 |
| +1.20D+1.60L+0.50S+1.60H, LL Comb R | | | | | |
| Span # 1 | 1 | 10.610 | -5.38 | 10.09 | 0.53 |
| Span # 2 | 2 | 6.150 | -5.44 | 9.31 | 0.58 |
| +1.20D+1.60L+0.50S+1.60H, LL Comb R | | | | | |
| Span # 1 | 1 | 10.610 | 2.63 | 3.22 | 0.81 |
| Span # 2 | 2 | 6.150 | -3.02 | 9.31 | 0.32 |
| +1.20D+1.60L+0.50S+1.60H, LL Comb R | | | | | |
| Span # 1 | 1 | 10.610 | 1.78 | 3.22 | 0.55 |
| Span # 2 | 2 | 6.150 | -5.44 | 9.31 | 0.58 |
| +1.20D+0.50L+0.20S+E+1.60H, LL Coml | | | | | |
| Span # 1 | 1 | 10.610 | -4.28 | 10.09 | 0.42 |
| Span # 2 | 2 | 6.150 | -4.34 | 9.31 | 0.47 |
| +1.20D+0.50L+0.20S+E+1.60H, LL Coml | | | | | |
| Span # 1 | 1 | 10.610 | 1.68 | 3.22 | 0.52 |
| Span # 2 | 2 | 6.150 | -3.58 | 9.31 | 0.39 |
| +1.20D+0.50L+0.20S+E+1.60H, LL Coml | | | | | |
| Span # 1 | 1 | 10.610 | 1.42 | 3.22 | 0.44 |
| Span # 2 | 2 | 6.150 | -4.34 | 9.31 | 0.47 |
| +0.90D+E+0.90H | | | | | |
| Span # 1 | 1 | 10.610 | 0.93 | 3.22 | 0.29 |
| Span # 2 | 2 | 6.150 | -2.83 | 9.31 | 0.30 |

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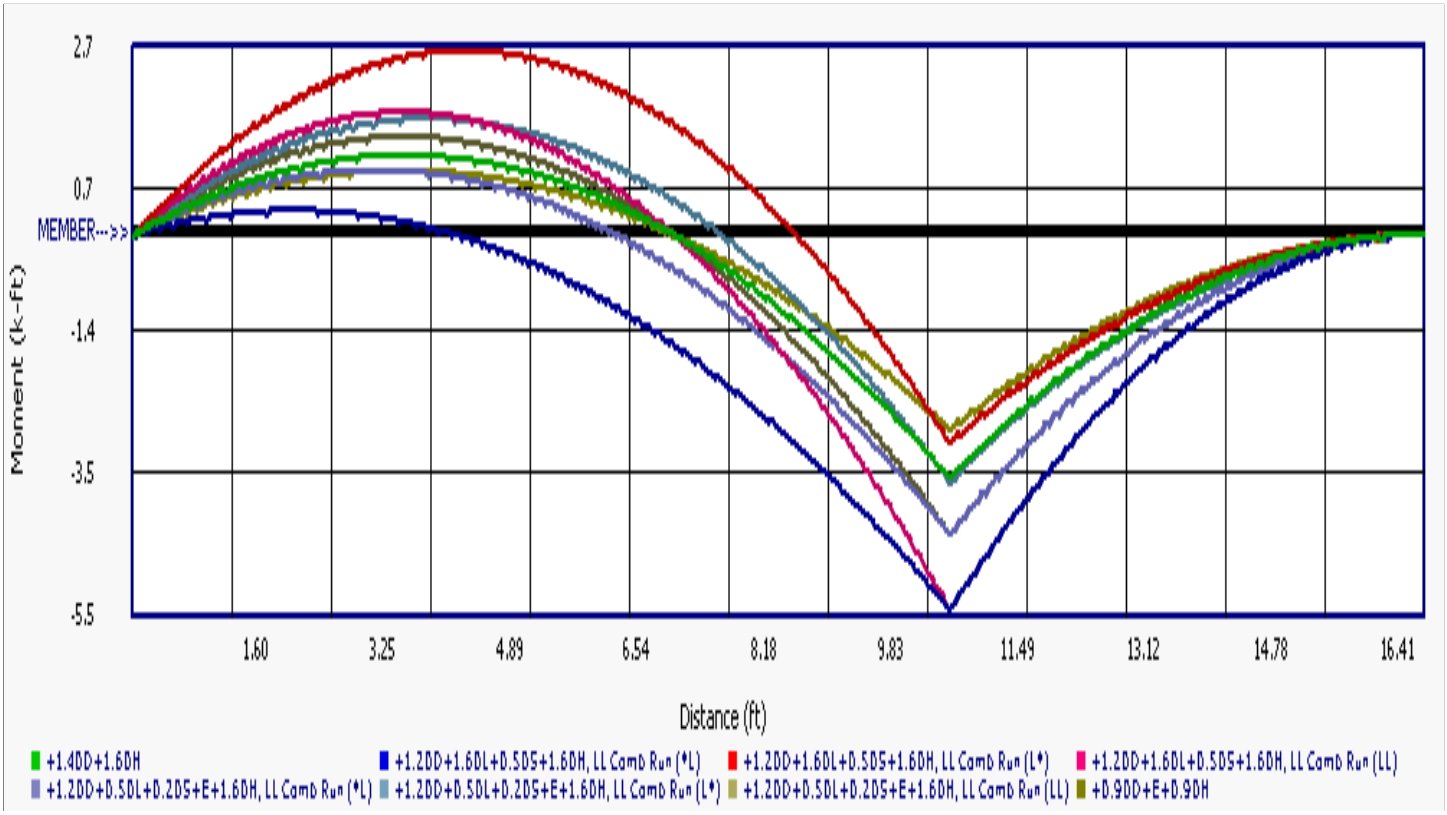
Description : Cantilevered Slab at Garage

## Overall Maximum Deflections

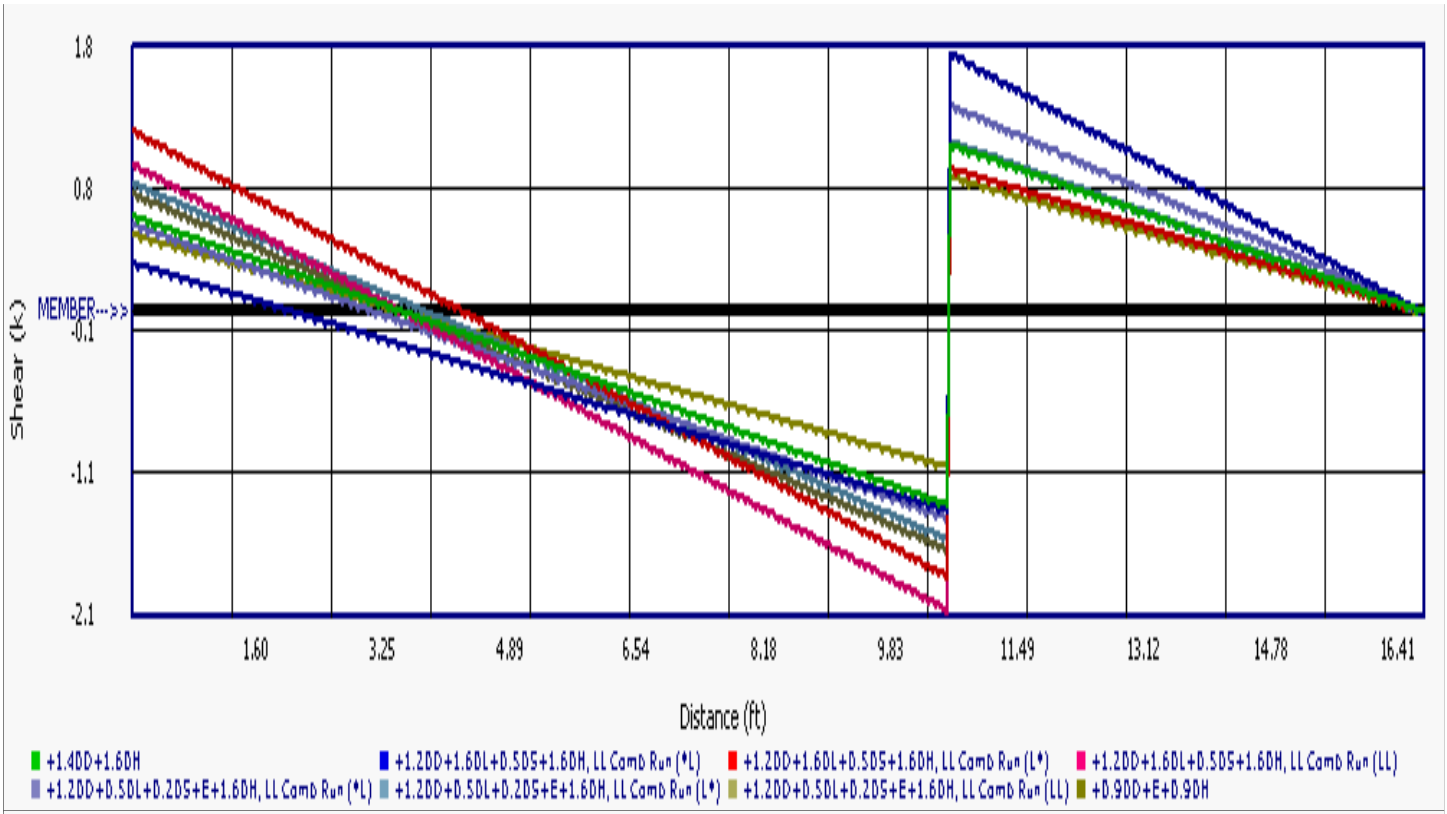
| Load Combination | Span | Max. "-" Defl | Location in Span | Load Combination | Max. "+" Defl | Location in Span |
|---|---|---|---|---|---|---|
| +D+L+H, LL Comb Run (L*) | 1 | 0.0296 | 4.699 | +D+L+H, LL Comb Run (*L) | -0.0148 | 8.336 |
| +D+L+H, LL Comb Run (*L) | 2 | 0.1431 | 6.150 | | 0.0000 | 8.336 |

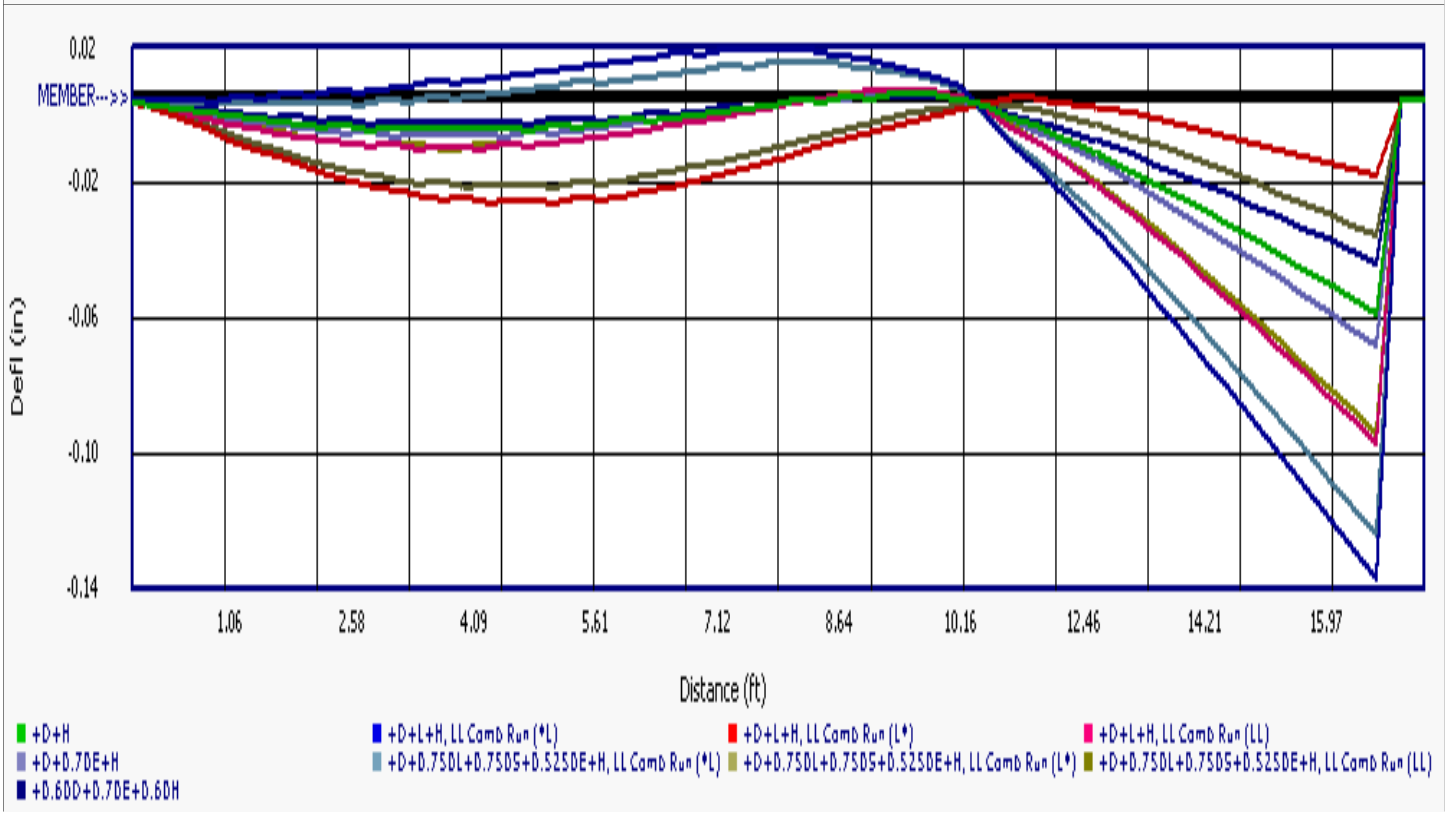


# Concrete Beam

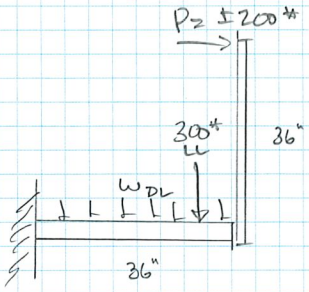


Description : Cantilevered Slab at Garage



CANTILEVERED STAIR STRINGER:




$M = (40+11)\frac{3^2}{2} + 300(2.5') + 200(3') = 1,579$ ft-#

$M_u = 2.435$ k-ft.

$S = \frac{1,579 \times 12}{(0.6 \times 36)} = 0.88\ in^3 \leq 1.72\ in^3$

$\Delta = \frac{PL^3}{3EI} + \frac{wL^4}{8EI} = \left[\frac{PL^3}{3} + \frac{wL^4}{8}\right]/EI$

$= \left[\frac{250(30")^3}{3} + \frac{(51/12)36"^4}{8}\right]/29 \times 10^6 (6.88\ in^4)$

$= 0.016" = 1/2286 = 21/4572$

$\therefore$ WT5x11 OK

SEE ATTACHED CALC. FOR ANCHORAGE TO CONC.

| | | | |
|---|---|---|---|
| Company: | | Date: | 9/15/2022 |
| Engineer: | | Page: | 1/6 |
| 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: Bonded anchor
Material: F1554 Grade 36
Diameter (inch): 0.625
Effective Embedment depth, $h_{ef}$ (inch): 4.250
Code report: ICC-ES ESR-2508
Anchor category: -
Anchor ductility: Yes
$h_{min}$ (inch): 8.00
$c_{ac}$ (inch): 7.31
$C_{min}$ (inch): 1.75
$S_{min}$ (inch): 3.00

**Base Material**
Concrete: Normal-weight
Concrete thickness, h (inch): 8.00
State: Uncracked
Compressive strength, $f'_c$ (psi): 2500
$\Psi_{c,V}$: 1.4
Reinforcement condition: B tension, B shear
Supplemental reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Hole condition: Dry concrete
Inspection: Continuous
Temperature range, Short/Long: 150/110°F
Ignore 6do requirement: Not applicable
Build-up grout pad: No

**Base Plate**
Length x Width x Thickness (inch): 8.00 x 8.00 x 0.25

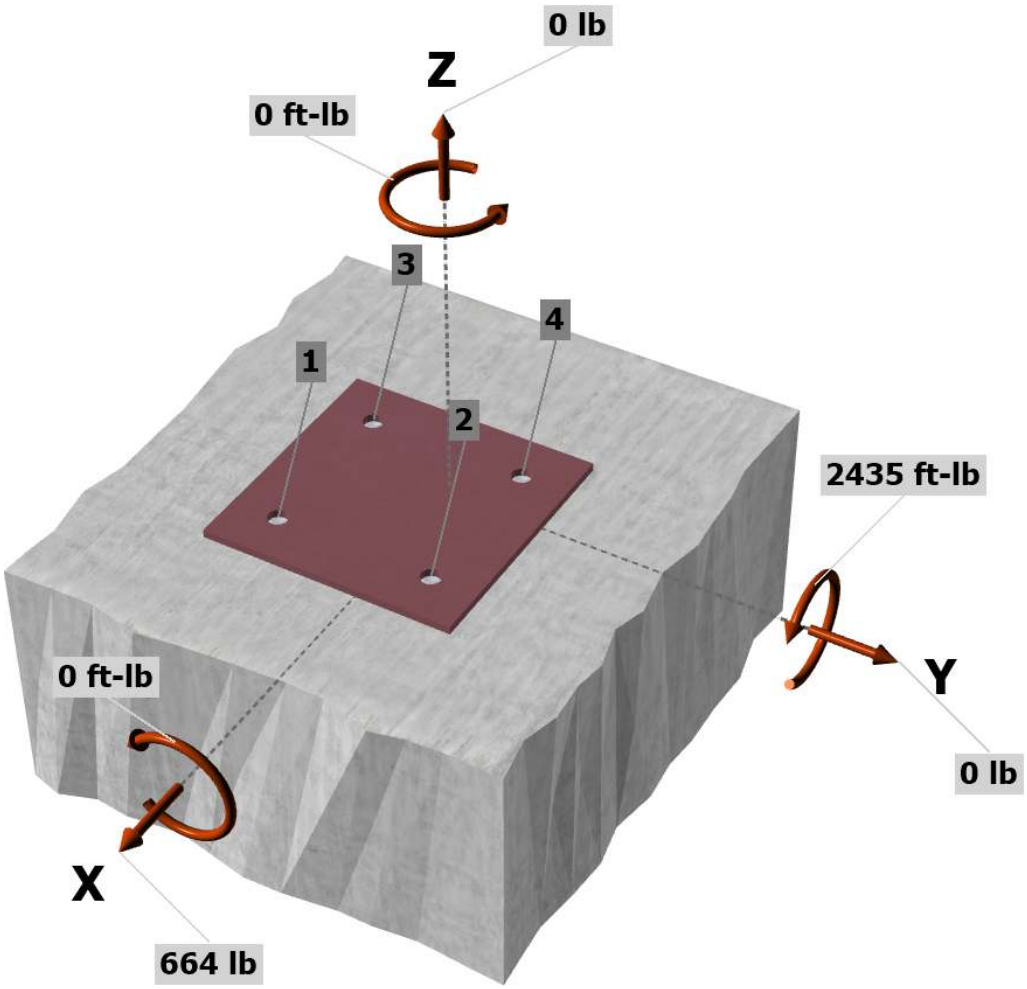
**Recommended Anchor**
Anchor Name: SET-XP® - SET-XP w/ 5/8"Ø F1554 Gr. 36
Code Report: ICC-ES ESR-2508

**Load and Geometry**
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: Yes
Anchors subjected to sustained tension: Yes
Ductility section for tension: 17.2.3.4.2 not applicable
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: No

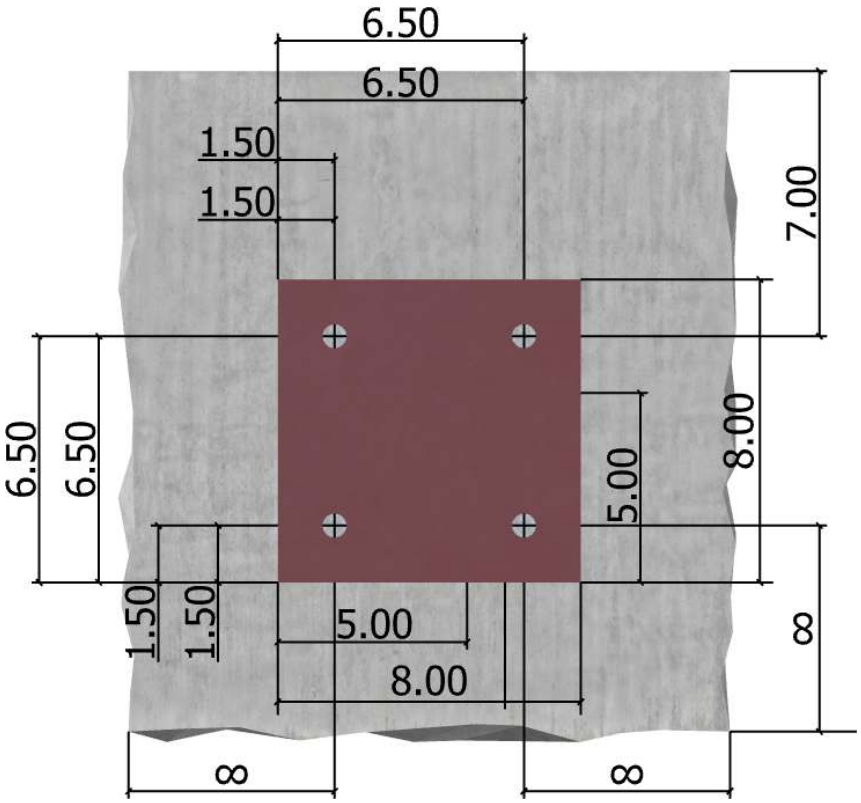
Strength level loads:

$N_{ua}$ [lb]: 0
$V_{uax}$ [lb]: 664
$V_{uay}$ [lb]: 0
$M_{ux}$ [ft-lb]: 0
$M_{uy}$ [ft-lb]: 2435
$M_{uz}$ [ft-lb]: 0

<Figure 1>



<Figure 2>

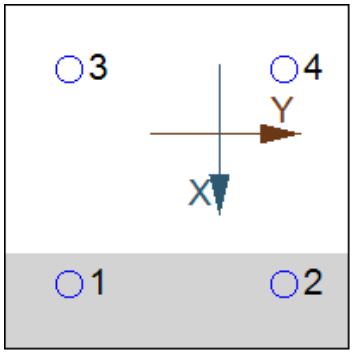


## 3. Resulting Anchor Forces

| 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 | 0.0 | 132.8 | -33.2 | 136.9 |
| 2 | 0.0 | 199.2 | -33.2 | 201.9 |
| 3 | 2535.8 | 132.8 | 33.2 | 136.9 |
| 4 | 2535.8 | 199.2 | 33.2 | 201.9 |
| Sum | 5071.5 | 664.0 | 0.0 | 677.7 |

Maximum concrete compression strain (‰): 0.13
Maximum concrete compression stress (psi): 571
Resultant tension force (lb): 5072
Resultant compression force (lb): 5072
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
Eccentricity of resultant shear forces in x-axis, $e'_{Vx}$ (inch): 0.00
Eccentricity of resultant shear forces in y-axis, $e'_{Vy}$ (inch): 0.00

<Figure 3>




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

| $N_{sa}$ (lb) | $\phi$ | $\phi N_{sa}$ (lb) |
|---|---|---|
| 13110 | 0.75 | 9833 |

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

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

| $k_c$ | $\lambda_a$ | $f'_c$ (psi) | $h_{ef}$ (in) | $N_b$ (lb) |
|---|---|---|---|---|
| 24.0 | 1.00 | 2500 | 4.250 | 10514 |

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

| $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$) | $c_{a,min}$ (in) | $\Psi_{ec,N}$ | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $\phi$ | $0.75\phi N_{cbg}$ (lb) |
|---|---|---|---|---|---|---|---|---|---|
| 226.31 | 162.56 | 7.00 | 1.000 | 1.000 | 1.00 | 0.958 | 10514 | 0.65 | 6836 |

## 6. Adhesive Strength of Anchor in Tension (Sec. 17.4.5)

$\tau_{k,uncr} = \tau_{k,uncr} f_{short\text{-}term} K_{sat} \alpha_{N,seis}$

| $\tau_{k,uncr}$ (psi) | $f_{short\text{-}term}$ | $K_{sat}$ | $\alpha_{N,seis}$ | $\tau_{k,uncr}$ (psi) |
|---|---|---|---|---|
| 1060 | 1.00 | 1.00 | 1.00 | 1060 |

$N_{ba} = \lambda_a \tau_{uncr} \pi d_a h_{ef}$ (Eq. 17.4.5.2)

| $\lambda_a$ | $\tau_{uncr}$ (psi) | $d_a$ (in) | $h_{ef}$ (in) | $N_{ba}$ (lb) |
|---|---|---|---|---|
| 1.00 | 1060 | 0.63 | 4.250 | 8846 |

$0.75\phi N_{ag} = 0.75\phi \, (A_{Na} / A_{Na0}) \, \Psi_{ec,Na} \, \Psi_{ed,Na} \, \Psi_{cp,Na} N_{ba}$ (Sec. 17.3.1 & Eq. 17.4.5.1b)

| $A_{Na}$ (in$^2$) | $A_{Na0}$ (in$^2$) | $c_{Na}$ (in) | $c_{a,min}$ (in) | $\Psi_{ec,Na}$ | $\Psi_{ed,Na}$ | $\Psi_{cp,Na}$ | $N_{ba}$(lb) | $\phi$ | $0.75\phi N_{ag}$ (lb) |
|---|---|---|---|---|---|---|---|---|---|
| 211.92 | 150.57 | 6.14 | 7.00 | 1.000 | 1.000 | 0.958 | 8846 | 0.65 | 5815 |

$\phi N_{sust} = 0.55\phi N_{ba}$ (Eq. 17.3.1.2)

| $\phi$ | $N_{ba}$(lb) | $\phi N_{sust}$ (lb) |
|---|---|---|
| 0.65 | 8846 | 3162 |

## 8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

| $V_{sa}$ (lb) | $\phi_{grout}$ | $\phi$ | $\alpha_{V,seis}$ | $\phi_{grout}\alpha_{V,seis}\phi V_{sa}$ (lb) |
|---|---|---|---|---|
| 7865 | 1.0 | 0.65 | 0.68 | 3476 |

## 9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

***Shear parallel to edge in x-direction:***

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5};\ 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

| $l_e$ (in) | $d_a$ (in) | $\lambda_a$ | $f'_c$ (psi) | $c_{a1}$ (in) | $V_{by}$ (lb) |
|---|---|---|---|---|---|
| 4.25 | 0.625 | 1.00 | 2500 | 7.00 | 7519 |

$\phi V_{cbgx} = \phi\ (2)(A_{Vc} / A_{Vco})\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

| $A_{Vc}$ (in$^2$) | $A_{Vco}$ (in$^2$) | $\Psi_{ec,V}$ | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (lb) | $\phi$ | $\phi V_{cbgx}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 208.00 | 220.50 | 1.000 | 1.000 | 1.400 | 1.146 | 7519 | 0.70 | 15926 |

## 10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi \min|k_{cp}N_a\ ;\ k_{cp}N_{cb}| = \phi \min|k_{cp}(A_{Na} / A_{Na0})\Psi_{ed,Na}\Psi_{cp,Na}N_{ba}\ ;\ k_{cp}(A_{Nc} / A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b|$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

| $k_{cp}$ | $A_{Na}$ (in$^2$) | $A_{Na0}$ (in$^2$) | $\Psi_{ed,Na}$ | $\Psi_{cp,Na}$ | $N_{ba}$ (lb) | $N_a$ (lb) |
|---|---|---|---|---|---|---|
| 2.0 | 74.57 | 150.57 | 1.000 | 0.958 | 8846 | 4197 |

| $A_{Nc}$ (in$^2$) | $A_{Nco}$ (in$^2$) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (lb) | $N_{cb}$ (lb) | $\phi$ | $\phi V_{cp}$ (lb) |
|---|---|---|---|---|---|---|---|---|
| 78.77 | 162.56 | 1.000 | 1.000 | 0.872 | 10514 | 4445 | 0.70 | 6133 |

## 11. Results

### Interaction of Tensile and Shear Forces (Sec. 17.6.)

| Tension | Factored Load, $N_{ua}$ (lb) | Design Strength, ø$N_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| Steel | 2536 | 9833 | 0.26 | Pass |
| Concrete breakout | 5072 | 6836 | 0.74 | Pass |
| **Adhesive** | **5072** | **5815** | **0.87** | **Pass (Governs)** |
| Adhesive (sustained) | 2536 | 3162 | 0.80 | Pass |

| Shear | Factored Load, $V_{ua}$ (lb) | Design Strength, ø$V_n$ (lb) | Ratio | Status |
|---|---|---|---|---|
| **Steel** | **202** | **3476** | **0.06** | **Pass (Governs)** |
| \|\| Concrete breakout x- | 66 | 15926 | 0.00 | Pass |
| Pryout | 202 | 6133 | 0.03 | Pass |

| Interaction check | $N_{ua}/\phi N_n$ | $V_{ua}/\phi V_n$ | Combined Ratio | Permissible | Status |
|---|---|---|---|---|---|
| Sec. 17.6..1 | 0.87 | 0.00 | 87.2% | 1.0 | Pass |

**SET-XP w/ 5/8"Ø F1554 Gr. 36 with hef = 4.250 inch meets the selected design criteria.**