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**Specifier's comments:**

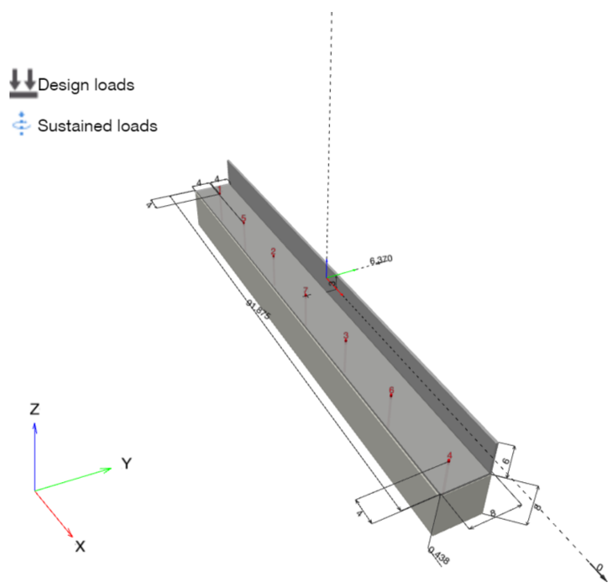
# 1 Anchor Design

## 1.1 Input data


| | |
|---|---|
| **Anchor type and diameter:** | **HIT-HY 200 V3 + HAS-E 3/8** |
| Item number: | 385420 HAS 5.8 3/8"x8" (element) / 2334276 HIT-HY 200-R V3 (adhesive) |
| Effective embedment depth: | $h_{ef,act}$ = 6.000 in. ($h_{ef,limit}$ = - in.) |
| Material: | 5.8 |
| Evaluation Service Report: | ESR-4868 |
| Issued I Valid: | 11/1/2021 \| 11/1/2022 |
| Proof: | Design Method ACI 318-14 / Chem |
| Stand-off installation: | $e_b$ = 0.000 in. (no stand-off); t = 0.438 in. |
| Ledger Angle[CBFEM] : | $L_1 \times L_2 \times t_{L1} \times t_{L2} \times l$ = 6.000 in. x 8.000 in. x 0.438 in. x 0.438 in. x 91.875 in.; |
| Load Point Height: | $h_{pl}$ = 3.000 in. |
| Base material: | cracked concrete, 3000, $f_c'$ = 3,000 psi; h = 8.000 in., Temp. short/long: 32/32 °F |
| **Installation:** | **hammer drilled hole, Installation condition: Dry** |
| Reinforcement: | tension: condition B, shear: condition B; no supplemental splitting reinforcement present |
| | edge reinforcement: > No. 4 bar |

[CBFEM] - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

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



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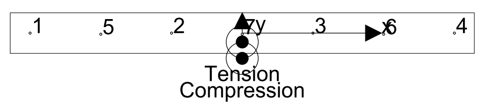
#### 1.1.1 Design results

| Case | Description | Forces [lb] / Moments [in.lb] | Seismic | Max. Util. Anchor [%] |
|---|---|---|---|---|
| 1 | Combination 1 | $N = 0; V_x = 0; V_y = -6{,}370;$ $M_x = 0; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$ | no | 433 |

### 1.2 Load case/Resulting anchor forces

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

| Anchor | Tension force | Shear force | Shear force x | Shear force y |
|---|---|---|---|---|
| 1 | 813 | 866 | -5 | -866 |
| 2 | 946 | 934 | -2 | -934 |
| 3 | 946 | 934 | 2 | -934 |
| 4 | 813 | 866 | 5 | -866 |
| 5 | 833 | 916 | -4 | -916 |
| 6 | 833 | 916 | 4 | -916 |
| 7 | 872 | 938 | -0 | -938 |




resulting tension force in (x/y)=(-0.001/-1.752): 6,057 [lb]
resulting compression force in (x/y)=(-0.011/-4.983): 6,494 [lb]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

### 1.3 Tension load

| | Load $N_{ua}$ [lb] | Capacity $\phi$ $N_n$ [lb] | Utilization $\beta_N = N_{ua}/\phi$ $N_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 946 | 3,653 | 26 | OK |
| Bond Strength** | 6,057 | 23,400 | 26 | OK |
| Sustained Tension Load Bond Strength* | N/A | N/A | N/A | N/A |
| Concrete Breakout Failure** | 6,057 | 20,503 | 30 | OK |

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

### 1.3.1 Steel Strength

$N_{sa}$ = ESR value refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

**Variables**

| $A_{se,N}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.08 | 72,500 |

**Calculations**

| $N_{sa}$ [lb] |
|---|
| 5,620 |

**Results**

| $N_{sa}$ [lb] | $\phi_{steel}$ | $\phi\ N_{sa}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 5,620 | 0.650 | 3,653 | 946 |

### 1.3.2 Bond Strength

| | |
|---|---|
| $N_{ag} = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ec1,Na}\ \psi_{ec2,Na}\ \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ | ACI 318-14 Eq. (17.4.5.1b) |
| $\phi\ N_{ag} \geq N_{ua}$ | ACI 318-14 Table 17.3.1.1 |
| $A_{Na}$ see ACI 318-14, Section 17.4.5.1, Fig. R 17.4.5.1(b) | |
| $A_{Na0} = (2\ c_{Na})^2$ | ACI 318-14 Eq. (17.4.5.1c) |
| $c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ | ACI 318-14 Eq. (17.4.5.1d) |
| $\psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ | ACI 318-14 Eq. (17.4.5.3) |
| $\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ | ACI 318-14 Eq. (17.4.5.4b) |
| $\psi_{cp,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ | ACI 318-14 Eq. (17.4.5.5b) |
| $N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ | ACI 318-14 Eq. (17.4.5.2) |

**Variables**

| $\tau_{k,c,uncr}$ [psi] | $d_a$ [in.] | $h_{ef}$ [in.] | $c_{a,min}$ [in.] | $\alpha_{overhead}$ | $\tau_{k,c}$ [psi] |
|---|---|---|---|---|---|
| 2,261 | 0.375 | 6.000 | 4.000 | 1.000 | 1,064 |

| $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{ac}$ [in.] | $\lambda_a$ |
|---|---|---|---|
| 0.001 | 0.002 | 16.977 | 1.000 |

**Calculations**

| $c_{Na}$ [in.] | $A_{Na}$ [in.$^2$] | $A_{Na0}$ [in.$^2$] | $\psi_{ed,Na}$ |
|---|---|---|---|
| 5.352 | 593.60 | 114.57 | 0.924 |

| $\psi_{ec1,Na}$ | $\psi_{ec2,Na}$ | $\psi_{cp,Na}$ | $N_{ba}$ [lb] |
|---|---|---|---|
| 1.000 | 1.000 | 1.000 | 7,523 |

**Results**

| $N_{ag}$ [lb] | $\phi_{bond}$ | $\phi\ N_{ag}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 36,001 | 0.650 | 23,400 | 6,057 |

### 1.3.3 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.] | $\psi_{c,N}$ |
|---|---|---|---|---|
| 4.667 | 0.001 | 0.002 | 4.000 | 1.000 |

| $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|
| 16.977 | 17 | 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] |
|---|---|---|---|---|---|---|
| 756.15 | 196.00 | 1.000 | 1.000 | 0.871 | 1.000 | 9,387 |

**Results**

| $N_{cbg}$ [lb] | $\phi_{concrete}$ | $\phi\ N_{cbg}$ [lb] | $N_{ua}$ [lb] |
|---|---|---|---|
| 31,543 | 0.650 | 20,503 | 6,057 |

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### 1.4 Shear load

| | Load $V_{ua}$ [lb] | Capacity $\phi$ $V_n$ [lb] | Utilization $\beta_V = V_{ua}/\phi$ $V_n$ | Status |
|---|---|---|---|---|
| Steel Strength* | 938 | 2,022 | 47 | OK |
| Steel failure (with lever arm)* | N/A | N/A | N/A | N/A |
| Pryout Strength (Concrete Breakout Strength controls)** | 6,370 | 44,180 | 15 | OK |
| Concrete edge failure in direction x-** | 6,370 | 1,474 | 433 | not recommended |

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

#### 1.4.1 Steel Strength

$V_{sa}$ = ESR value refer to ICC-ES ESR-4868

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

**Variables**

| $A_{se,V}$ [in.$^2$] | $f_{uta}$ [psi] |
|---|---|
| 0.08 | 72,500 |

**Calculations**

| $V_{sa}$ [lb] |
|---|
| 3,370 |

**Results**

| $V_{sa}$ [lb] | $\phi$ $_{steel}$ | $\phi$ $V_{sa}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 3,370 | 0.600 | 2,022 | 938 |

### 1.4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cpg} = k_{cp} \left[ \left( \frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b \right]$ 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)

$\psi_{cp,N} = \text{MAX}\left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ 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**

| $k_{cp}$ | $h_{ef}$ [in.] | $e_{c1,N}$ [in.] | $e_{c2,N}$ [in.] | $c_{a,min}$ [in.] |
|---|---|---|---|---|
| 2 | 4.667 | 0.000 | 0.000 | 4.000 |

| $\psi_{c,N}$ | $c_{ac}$ [in.] | $k_c$ | $\lambda_a$ | $f'_c$ [psi] |
|---|---|---|---|---|
| 1.000 | 16.977 | 17 | 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] |
|---|---|---|---|---|---|---|
| 756.15 | 196.00 | 1.000 | 1.000 | 0.871 | 1.000 | 9,387 |

**Results**

| $V_{cpg}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cpg}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 63,115 | 0.700 | 44,180 | 6,370 |

### 1.4.3 Concrete edge failure in direction x-

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

$\phi\ V_{cb} \geq V_{ua}$ 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)

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

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

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-14 Eq. (17.5.2.2a)

**Variables**

| $c_{a1}$ [in.] | $c_{a2}$ [in.] | $\psi_{c,V}$ | $h_a$ [in.] | $l_e$ [in.] |
|---|---|---|---|---|
| 4.000 | 4.000 | 1.200 | 8.000 | 3.000 |

| $\lambda_a$ | $d_a$ [in.] | $f'_c$ [psi] | $\psi_{parallel,V}$ |
|---|---|---|---|
| 1.000 | 0.375 | 3,000 | 1.000 |

calculation for single anchor instead of for group that is being checked in this section

**Calculations**

| $A_{Vc}$ [in.$^2$] | $A_{Vc0}$ [in.$^2$] | $\psi_{ed,V}$ | $\psi_{h,V}$ | $V_b$ [lb] |
|---|---|---|---|---|
| 49.31 | 72.00 | 0.900 | 1.000 | 2,847 |

**Results**

This for the group is greater than 6370 lbs

| $V_{cb}$ [lb] | $\phi_{concrete}$ | $\phi\ V_{cb}$ [lb] | $V_{ua}$ [lb] |
|---|---|---|---|
| 2,106 | 0.700 | 1,474 | 6,370 |

Vua =938 lbs per steel strength section, so okay for single anchor

### 1.5 Combined tension and shear loads

| $\beta_N$ | $\beta_V$ | $\zeta$ | Utilization $\beta_{N,V}$ [%] | Status |
|---|---|---|---|---|
| 0.295 | 4.321 | 1.000 | 385 | not recommended |

$\beta_{NV} = (\beta_N + \beta_V) / 1.2 <= 1$

this comes out to be less than 100

### 1.6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-14, Section 17.8.1.
- The anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."

## 1.7 Installation data

Anchor type and diameter: HIT-HY 200 V3 + HAS-E 3/8
Item number: 385420 HAS 5.8 3/8"x8" (element) / 2334276
HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 180 in.lb

Hole diameter in the base material: 0.438 in.

Hole depth in the base material: 6.000 in.

Minimum thickness of the base material: 7.250 in.

Hole diameter in the fixture: $d_f$ = 0.438 in.

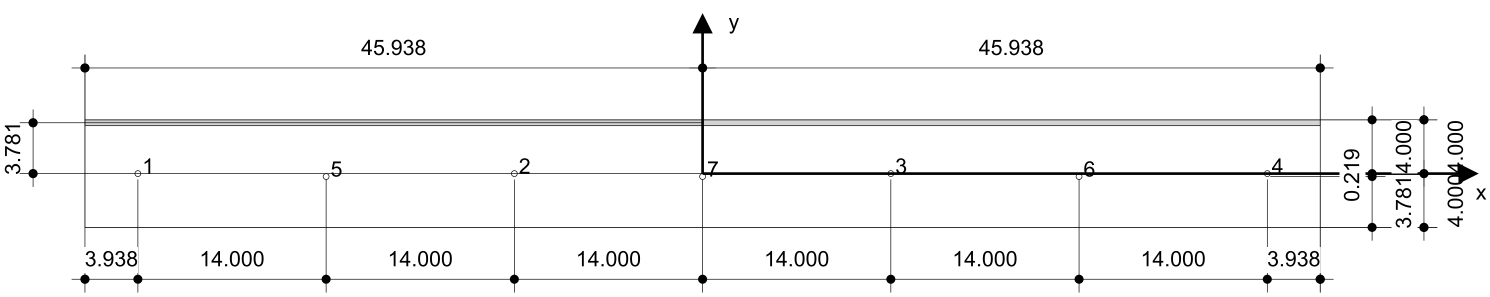
Plate thickness (input): 0.438 in.

Drilling method: Hammer drilled
Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

3/8 Hilti HAS Carbon steel threaded rod with Hilti HIT-HY 200 V3 Safe Set System

### 1.7.1 Recommended accessories

| Drilling | Cleaning | Setting |
|---|---|---|
| • Suitable Rotary Hammer<br>• Properly sized drill bit | • Compressed air with required accessories to blow from the bottom of the hole<br>• Proper diameter wire brush | • Dispenser including cassette and mixer<br>• Torque wrench |




**Coordinates Anchor [in.]**

| Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ | Anchor | x | y | $c_{-x}$ | $c_{+x}$ | $c_{-y}$ | $c_{+y}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -42.000 | -0.000 | 4.000 | 88.000 | 4.219 | 4.000 | 5 | -28.000 | -0.219 | 18.000 | 74.000 | 4.000 | 4.219 |
| 2 | -14.000 | -0.000 | 32.000 | 60.000 | 4.219 | 4.000 | 6 | 28.000 | -0.219 | 74.000 | 18.000 | 4.000 | 4.219 |
| 3 | 14.000 | -0.000 | 60.000 | 32.000 | 4.219 | 4.000 | 7 | 0.000 | -0.219 | 46.000 | 46.000 | 4.000 | 4.219 |
| 4 | 42.000 | -0.000 | 88.000 | 4.000 | 4.219 | 4.000 | | | | | | | |

# 2 Anchor plate design

## 2.1 Input data

| | |
|---|---|
| Anchor plate: | Ledger angle: height = 6.000 in, width = 8.000 in, thickness = 0.438 in, length = 91.875 in<br>Calculation: CBFEM<br>Material: ASTM A36; $F_y$ = 36,000 psi; $\varepsilon_{lim}$ = 5.00% |
| Anchor type and size: | HIT-HY 200 V3 + HAS-E 3/8, $h_{ef}$ = 6.000 in |
| Anchor stiffness: | The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results. |
| Design method: | AISC and LRFD-based design using component-based FEM |
| Stand-off installation: | $e_b$ = 0.000 in (No stand-off); t = 0.438 in |
| Base material: | Cracked concrete; 3000; $f_{c,cyl}$ = 3,000 psi; h = 8.000 in |
| Mesh size: | Number of elements on edge: 8<br>Min. size of element: 0.394 in<br>Max. size of element: 1.969 in |

## 2.2 Summary

| | Description | Plate - vertical | | Plate - horizontal | | | Concrete [%] |
|---|---|---|---|---|---|---|---|
| | | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Hole bearing [%] | |
| 1 | Combination 1 | 5,433 | 0.00 | 15,122 | 0.00 | 6 | 2 |

## 2.3 Anchor plate classification

Results below are displayed for the decisive load combinations: Combination 1

| Anchor tension forces | Equivalent rigid anchor plate (CBFEM) | Component-based Finite Element Method (CBFEM) anchor plate design |
|---|---|---|
| Anchor 1 | 796 lb | 813 lb |
| Anchor 2 | 805 lb | 946 lb |
| Anchor 3 | 805 lb | 946 lb |
| Anchor 4 | 796 lb | 813 lb |
| Anchor 5 | 762 lb | 833 lb |
| Anchor 6 | 762 lb | 833 lb |
| Anchor 7 | 767 lb | 872 lb |

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

## 2.4 Profile/Stiffeners/Plate

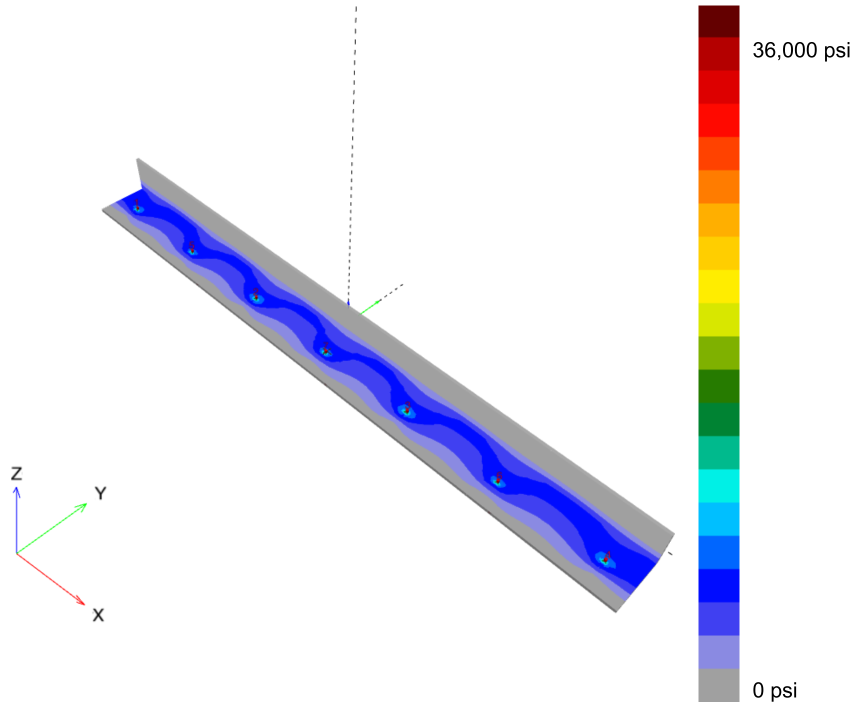
Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

### 2.4.1 Equivalent stress and plastic strain

| Part | Load combination | Material | $f_y$ [psi] | $\varepsilon_{lim}$ [%] | $\sigma_{Ed}$ [psi] | $\varepsilon_{Pl}$ [%] | Status |
|---|---|---|---|---|---|---|---|
| Plate - vertical | Combination 1 | ASTM A36 | 36,000 | 5.00 | 15,122 | 0.00 | OK |
| Plate - horizontal | Combination 1 | ASTM A36 | 36,000 | 5.00 | 5,433 | 0.00 | OK |

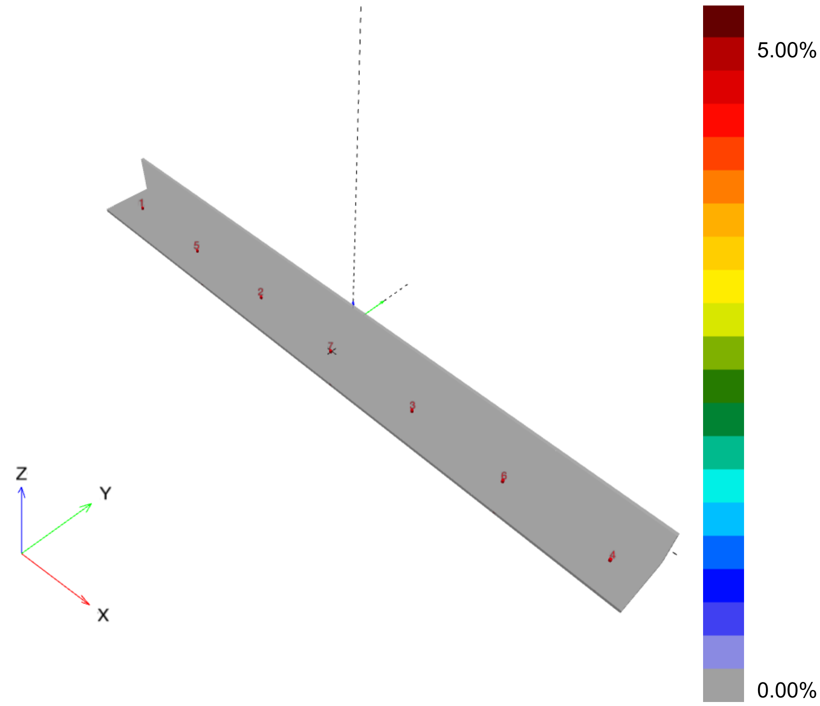
#### 2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Combination 1



#### 2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Combination 1




#### 2.4.2 Plate hole bearing resistance, AISC 360-16 Section J3

Decisive load combination: 1 - Combination 1

**Equations**

$R_n$ = $\min(1.2\ l_c\ t\ F_u\ ,\ 2.4\ d\ t\ F_u)$ (AISC 360-16 J3-6a, c)

$\Phi R_n$ = $0.75\ R_n$

$V$ $\leq$ $\Phi R_n$

**Variables**

| | $l_c$ [in] | t [in] | $F_u$ [psi] | d [in] | $R_n$ [lb] |
|---|---|---|---|---|---|
| Anchor 1 | 3.672 | 0.438 | 58,000 | 0.375 | 22,864 |
| Anchor 2 | 3.672 | 0.438 | 58,000 | 0.375 | 22,864 |
| Anchor 3 | 3.672 | 0.438 | 58,000 | 0.375 | 22,864 |
| Anchor 4 | 3.672 | 0.438 | 58,000 | 0.375 | 22,864 |
| Anchor 5 | 3.891 | 0.438 | 58,000 | 0.375 | 22,864 |
| Anchor 6 | 3.891 | 0.438 | 58,000 | 0.375 | 22,864 |
| Anchor 7 | 3.891 | 0.438 | 58,000 | 0.375 | 22,864 |

**Results**

| | | | |
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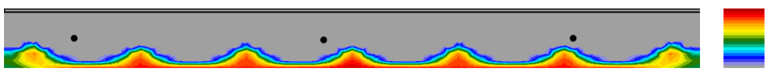
| Fastening point: | | | |

| | V [lb] | $\Phi R_n$ [lb] | Utilization [%] | Status |
|---|---|---|---|---|
| Anchor 1 | 866 | 17,148 | 6 | OK |
| Anchor 2 | 934 | 17,148 | 6 | OK |
| Anchor 3 | 934 | 17,148 | 6 | OK |
| Anchor 4 | 866 | 17,148 | 6 | OK |
| Anchor 5 | 916 | 17,148 | 6 | OK |
| Anchor 6 | 916 | 17,148 | 6 | OK |
| Anchor 7 | 938 | 17,148 | 6 | OK |

**2.5 Concrete**

Decisive load combination: 1 - Combination 1

**2.5.1 Compression in concrete under the anchor plate**




**2.5.2 Concrete block compressive strength resistance check, AISC 360-16 Section J8**

**Equations**

$F_p = \Phi f_{p,max}$

$f_{p,max} = 0.85 f_c' \sqrt{\left(\frac{A_2}{A_1}\right)} \leq 1.7 f_c; \sqrt{\left(\frac{A_2}{A_1}\right)} \leq 2$

$\sigma = \frac{N}{A_1}$

$\text{Utilization} = \frac{\sigma}{F_p}$

**Variables**

| N [lb] | $f_c'$ [psi] | $\Phi$ | $A_1$ [in²] | $A_2$ [in²] |
|---|---|---|---|---|
| 6,494 | 3,000 | 0.65 | 222.94 | 236.51 |

**Results**

| Load combination | $F_p$ [psi] | $\sigma$ [psi] | Utilization [%] | Status |
|---|---|---|---|---|
| Combination 1 | 1,707 | 29 | 2 | OK |

### 2.6 Symbol explanation

| | |
|---|---|
| $A_1$ | Loaded area of concrete |
| $A_2$ | Supporting area |
| d | Nominal diameter of the bolt |
| $\varepsilon_{lim}$ | Limit plastic strain |
| $\varepsilon_{Pl}$ | Plastic strain from CBFEM results |
| $f_c$ | Concrete compressive strength |
| $f_c'$ | Concrete compressive strength |
| $F_u$ | Specified minimum tensile strength of the connected material |
| $F_p$ | Concrete block design bearing strength |
| $f_{p,max}$ | Concrete block design bearing strength maximum |
| $f_y$ | Yield strength |
| $l_c$ | Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material |
| N | Resulting compression force |
| $\sigma$ | Average stress in concrete |
| $\sigma_{Ed}$ | Equivalent stress |
| $\Phi$ | Resistance factor |
| $\Phi R_n$ | Factored resistance |
| t | Thickness of the anchor plate |
| V | Resultant of shear forces Vy, Vz in bolt. |

### 2.7 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

| | | | |
|---|---|---|---|
| Company: | | Page: | 16 |
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| Phone I Fax: | \| | E-Mail: | |
| Design: | Drafts_Concrete - May 13, 2022 (1) (1) | Date: | 5/15/2022 |
| Fastening point: | | | |

## 3 Summary of results

Design of the anchor plate, anchors, welds and other elements are based on CBFEM (component based finite element method) and AISC.

| | Load combination | Max. utilization | Status |
|---|---|---|---|
| Anchors | Combination 1 | 433% | NOT OK |
| Plate - horizontal | Combination 1 | 43% | OK |
| Concrete | Combination 1 | 2% | OK |
| Plate - vertical | Combination 1 | 16% | OK |

**Fastening does not meet the design criteria!**

## 4 Remarks; Your Cooperation Duties

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