January 13, 2020

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Bob Foley

Connect-EZ
184 Maple St.
Harveysburg, OH 45032

Re: Connect-EZ Column Socket Uplift Review
Schaefer Project Number: 1911.20

Dear Bob,

At your request, we've reviewed the structural capacity of the Connect-EZ Column Socket System components listed below to meet a prescriptive uplift demand of 20,000 lbs. (based on ASD load combinations). This review is limited to the Connect-EZ socket system for a structural steel HSS10x10x5/16 column, with a 16"x16"x1" base plate, and connections per the attached sketch. The Connect-EZ socket system is to be used in the construction of the new building for Hopewell 91 in Tolleson, Arizona, per the structural drawings dated 7/15/19 by GF Group Structural Engineers. The engineering seal on this cover letter shall apply to the attached sketch and calculation submittal pertaining to the defined scope of work performed by Schaefer.

We reviewed the following components for capacity per the attached calculation submittal:

- Double-U Shaped Sleeve
- Weld between Sleeve and Baseplate (16"x16"x1")
- Weld between Sleeve and Column (HSS10x10x5/16)
- Baseplate (16"x16"x1")

Based on our review, the socket system components listed below have adequate capacity to meet this prescriptive uplift demand based on the following assumptions, per the attached sketch:

- The sleeve and base plate are of 50 ksi steel
- The thickness of the sleeve is a minimum of 3/8"
- The welds are a minimum of 1/4" fillet welds
- The gap between the column and the sleeve on any given side is 1/16" when the column is centered within the sleeve (1/8" max if the column is off-centered within the sleeve)

schaefer-inc.com
537 East Pete Rose Way, Suite 400
Cincinnati, Ohio 45202
800.542.3302

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Note that the resulting reaction at each anchor bolt (designed by others) is 5,570 lbs. (based on ASD load combinations).

If any of the assumptions shown on the attached sketch cannot be met, please contact Schaefer for a supplemental review.

Thank you for the opportunity to assist you with this project. If you have any questions, or if I may be of further assistance, please do not hesitate to contact me.

Sincerely,

Prepared By:
Matt Kozma
Project Engineer

Reviewed By:
Robert Rogers, S.E. (AZ)
Principal

Registered Professional Engineer (Structural)
CERTIFICATE NO
49372
ROBERT C.
ROGERS
Date Signed 01/13/20
ARIZONA U.S.A.
Expires 09/30/21

Enclosure

Project Name: CONNECT-EZ COLUMN SOCKET REVIEW

Project Number: 1911.20 Subject: UPLIFT REVIEW

Date: 01/14/20 Author: MAK Page: SK-1

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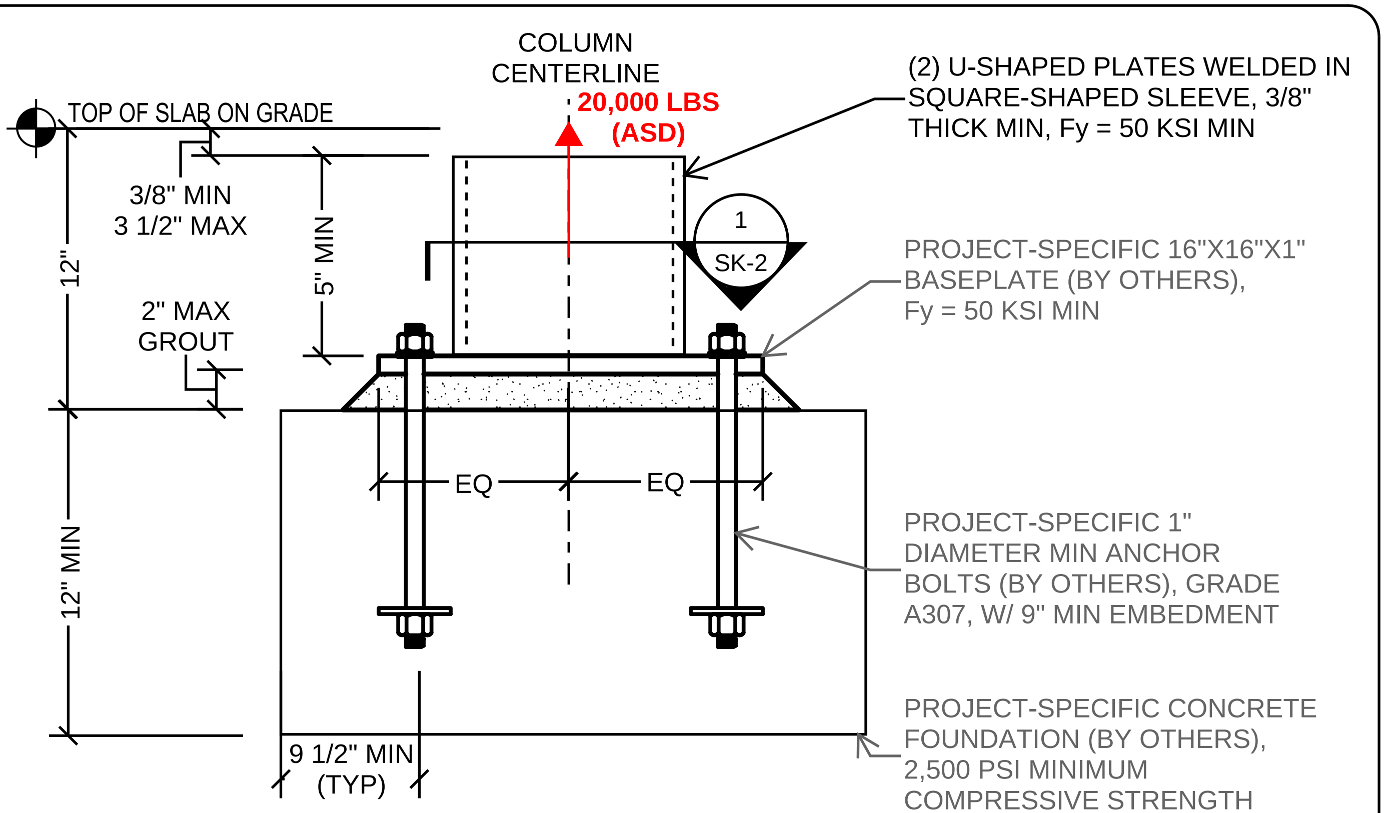
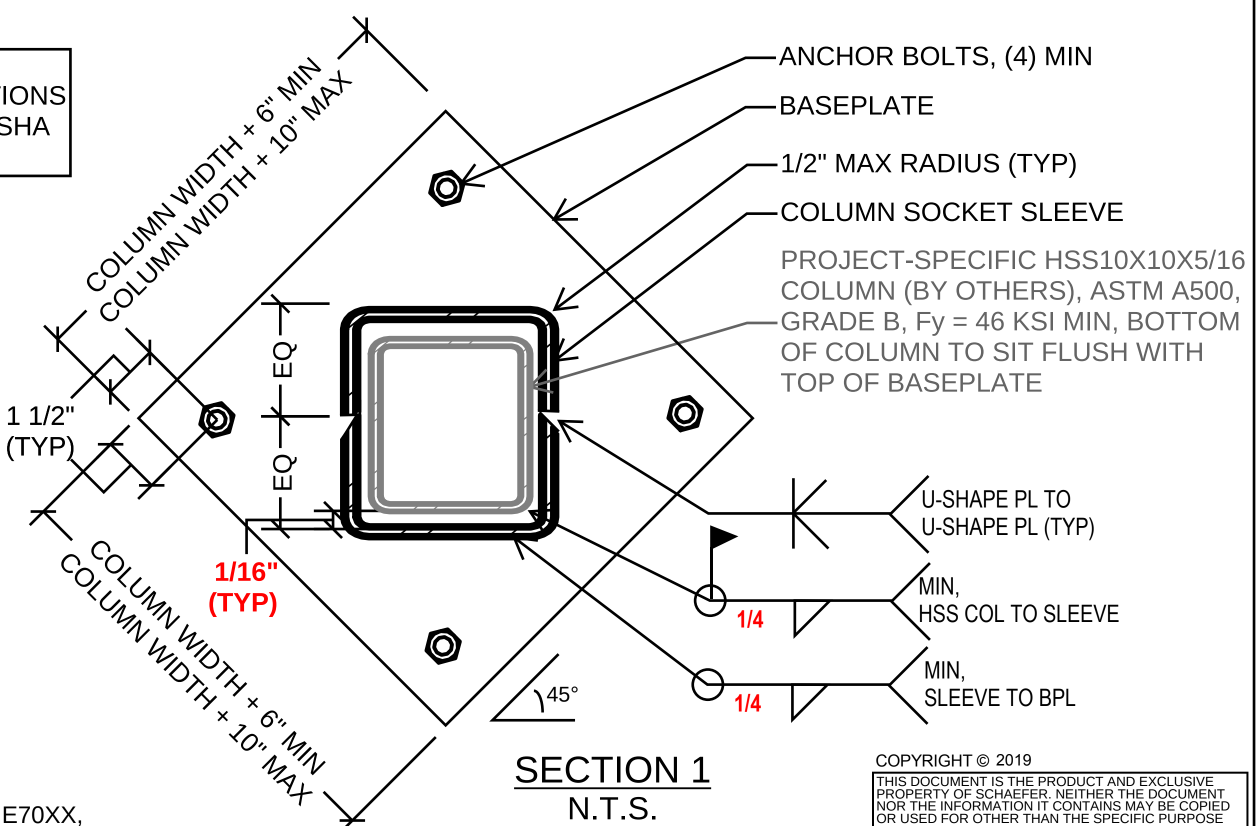


COLUMN SOCKET SLEEVE ASSUMPTIONS

N.T.S.

COLUMN SOCKET SLEEVE ASSUMPTIONS REVIEWED FOR OSHA 1926.755(a)(2)



SECTION 1

N.T.S.

WELD MATERIAL: AWS E70XX, LOW HYDROGEN ELECTRODES

CONNECT -EZ Column Socket in Tension

Building Code: IBC 2015 / ASCE 7-10

Design Loads:

$P_{uplift} := 20kip$ Max net upfilt load at the base of the column

Base Plate:

$t_{plate} := \frac{3}{4} in$ Min thickness

$B_{plate} := 16in$

$F_{y\_plate} := 50ksi$ Min strength

Column:

$t_{column} := \frac{3}{16} in$ Min thickness

$B_{column} := 10in$

$F_{y\_column} := 46ksi$ Min strength

$5 \cdot t_{plate} = 3.75 \cdot in$ < B column per AISC K1 2

$R_{n\_\Omega} := \frac{2 \cdot F_{y\_column} \cdot t_{column} \cdot (5 \cdot t_{plate})}{1.50} = 43.125 \cdot kip$ AISC K1-14a

Sleeve:

$t_{sleeve} := \frac{3}{8} in$ Min thickness

$radius_{sleeve} := \frac{1}{2} in$ Max radius

$A_g := t_{sleeve} \cdot 4 (B_{column} + t_{sleeve} - 3 \cdot radius_{sleeve}) = 13.313 \cdot in^2$

$F_{y\_sleeve} := 50ksi$ Min strength

$P_{n\_\Omega t} := \frac{F_{y\_sleeve} \cdot A_g}{1.67} = 398.578 \cdot kip$ AISC D2-1

Welds:

$F_{EXX} := 70ksi$ Min strength

$t_w := \frac{1}{4} in \cdot \left(\frac{\sqrt{2}}{2}\right)$ Min size

$l_w := 4\left(B_{column} + t_{sleeve} - 3 \cdot radius_{sleeve}\right) = 35.5 \cdot in$

$F_{nw} := 0.6 \cdot F_{EXX} = 42 \cdot ksi$

$A_{we} := t_w \cdot l_w = 6.276 \cdot in^2$

$R_{n\_\Omega} := \frac{F_{nw} \cdot A_{we}}{2.00} = 131.787 \cdot kip$ AISC J2-3

1.7 Installation data

Profile: Square HSS (AISC), HSS10X10X.1875; (L x W x T) = 10.000 in. x 10.000 in. x 0.188 in.

Hole diameter in the fixture: d_f = 0.813 in.

Plate thickness (input): 1.000 in.

Drilling method: Hammer drilled

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

Anchor type and diameter: HIT-RE 500 V3 + HAS-V-36 (ASTM F1554 Gr.36) 3/4

Item number: 2198032 HAS-V-36 3/4"x16" (element) / 2123401 HIT-RE 500 V3 (adhesive)

Installation torque: 1,200 in.lb

Hole diameter in the base material: 0.875 in.

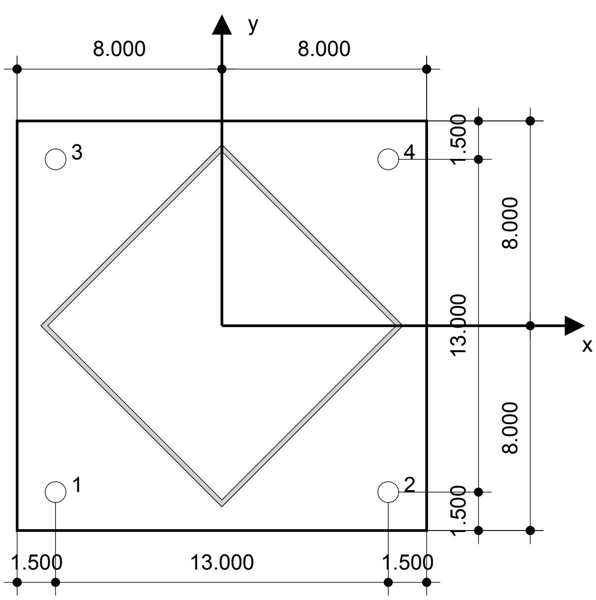
Hole depth in the base material: 10.250 in.

Minimum thickness of the base material: 12.000 in.

3/4 Hilti HAS Carbon steel threaded rod with Hilti HIT-RE 500 V3

1.7.1 Recommended accessories

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



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.500	-6.500	26.500	39.500	26.500	39.500
2	6.500	-6.500	39.500	26.500	26.500	39.500
3	-6.500	6.500	26.500	39.500	39.500	26.500
4	6.500	6.500	39.500	26.500	39.500	26.500

2 Anchor plate design

2.1 Input data

Anchor plate:	Shape: Rectangular l_x x l_y x t = 16.000 in x 16.000 in x 1.000 in Calculation: CBFEM Material: ASTM A992; f_y = 50,000 psi; ε_{lim} = 5.00%
Anchor type and size:	HIT-RE 500 V3 + HAS-V-36 (ASTM F1554 Gr.36) 3/4, h_{ef} = 10.250 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 = 2.000 in (Stand-off with grouting); t = 1.000 in
Profile:	HSS10X10X.1875; (L x W x T x FT) = 10.000 in x 10.000 in x 0.188 in x - Material: ASTM A500 Gr.B Rect;f_y = 46,000 psi; ε_{lim} = 5.00% Eccentricity x: 0.000 in Eccentricity y: 0.000 in
Base material:	Cracked concrete; 2500; $f_{c,cyl}$ = 2,500 psi; h = 12.000 in
Welds (profile to anchor plate):	Type of redistribution: Plastic Material: E70xx
Mesh size:	Number of elements on edge: 8 Min. size of element: 0.394 in Max. size of element: 1.969 in

2.2 Summary

	Description	Profile		Anchor plate			Welds [%]	Concrete [%]
		σ_{Ed} [psi]	ε_{Pl} [%]	σ_{Ed} [psi]	ε_{Pl} [%]	Hole bearing [%]		
1	Combination 1	14,858	0.00	24,220	0.00	1	75	15

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	8,333 lb	9,236 lb
Anchor 2	8,333 lb	9,282 lb
Anchor 3	8,333 lb	9,282 lb
Anchor 4	8,333 lb	9,237 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

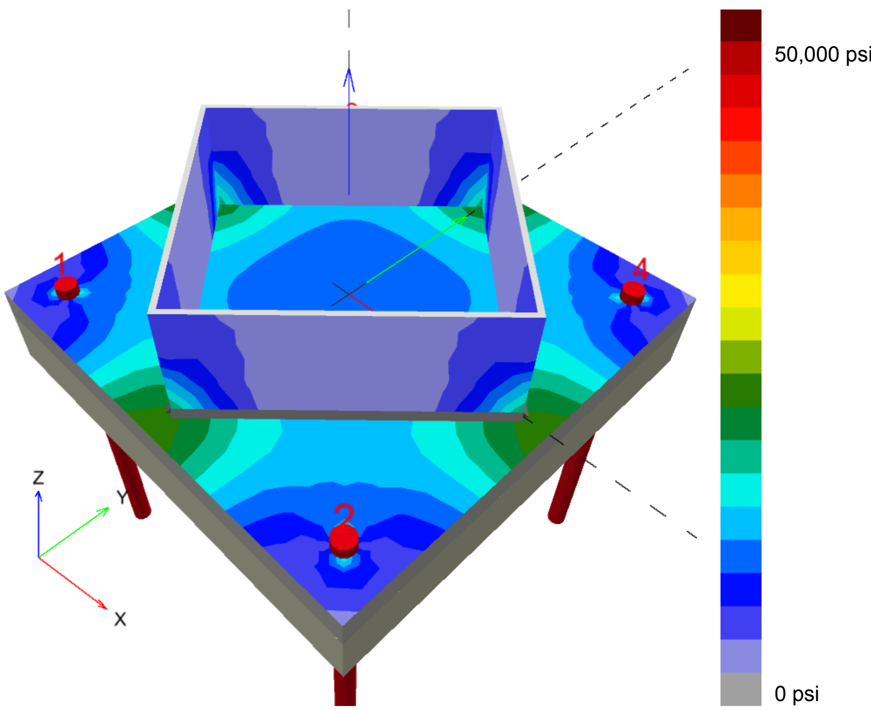
Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

2.4.1 Equivalent stress and plastic strain

Part	Load combination	Material	f_y [psi]	ε_{lim} [%]	σ_{Ed} [psi]	ε_{Pl} [%]	Status
Plate	Combination 1	ASTM A992	50,000	5.00	24,220	0.00	OK
Profile	Combination 1	ASTM A500 Gr.B Rect	46,000	5.00	14,822	0.00	OK
Profile	Combination 1	ASTM A500 Gr.B Rect	46,000	5.00	14,858	0.00	OK
Profile	Combination 1	ASTM A500 Gr.B Rect	46,000	5.00	14,767	0.00	OK
Profile	Combination 1	ASTM A500 Gr.B Rect	46,000	5.00	14,726	0.00	OK

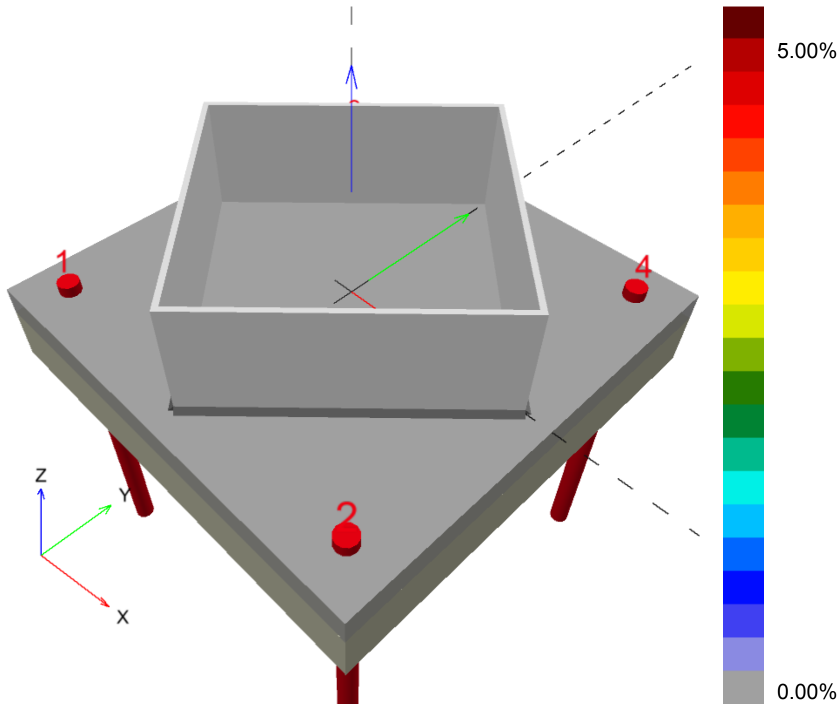
2.4.1.1 Equivalent stress

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)

ΦR_n = 0.75 R_n

V ≤ ΦR_n

Variables

	l_c [in]	t [in]	F_u [psi]	d [in]	R_n [lb]
Anchor 1	1.710	1.000	65,000	0.750	117,000
Anchor 2	1.712	1.000	65,000	0.750	117,000
Anchor 3	1.713	1.000	65,000	0.750	117,000
Anchor 4	1.715	1.000	65,000	0.750	117,000

Results

	V [lb]	ΦR_n [lb]	Utilization [%]	Status
Anchor 1	45	87,750	1	OK
Anchor 2	46	87,750	1	OK
Anchor 3	46	87,750	1	OK
Anchor 4	45	87,750	1	OK

2.5 Welds

Profiles are modeled without taking the corner radius into account. Special rules for welding (e.g. for cold-formed profiles ...) are not taken into account by the software.

2.5.1 Anchor plate to profile

Decisive load combination: 1 - Combination 1

Equations

$F_{nw} = 0.6\ F_{EXX}\ (1.0 + 0.5\sin^{1.5}\ \Theta)$

$\Phi R_n = \Phi\ F_{nw}\ A_w$

$\text{Utilization} = \dfrac{F_n}{\Phi\ R_n}$

Variables

Edge	X_u	T_h [in]	L_s [in]	L [in]	L_c [in]	F_{EXX} [psi]	Θ [°]	A_w [in²]
Member 1-tfl 1	E70xx	0.132◣	0.187	9.980	0.998	70,000	62.1	0.13
Member 1-bfl 1	E70xx	◢0.132	0.187	9.980	0.998	70,000	61.7	0.13
Member 1-w 1	E70xx	0.132◣	0.187	9.605	0.961	70,000	67.0	0.13
Member 1-w 2	E70xx	◢0.132	0.187	9.605	0.961	70,000	66.5	0.13

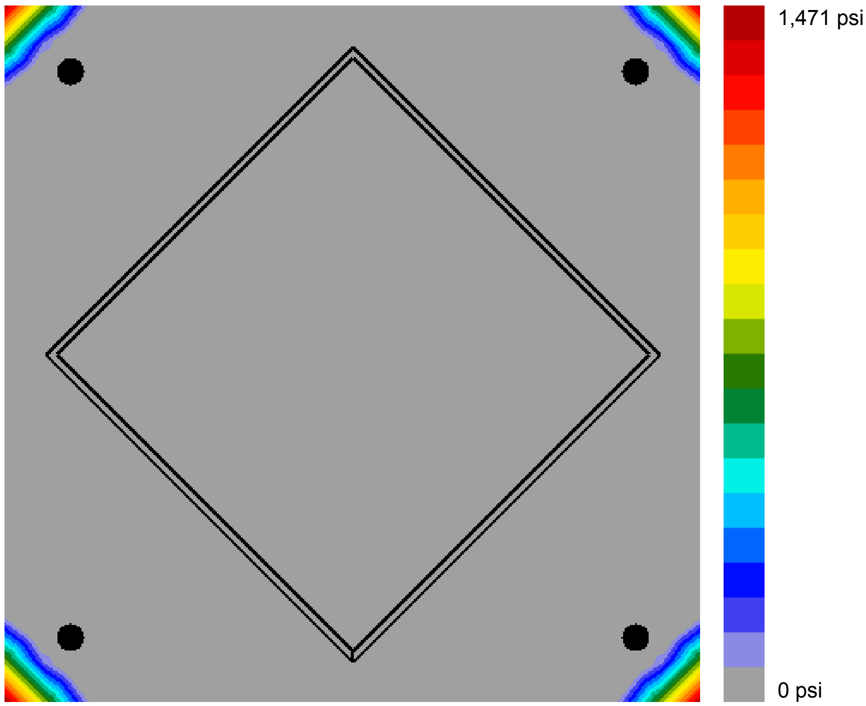
Results

Edge	F_n [lb]	ΦR_n [lb]	Utilization [%]	Status
Member 1-tfl 1	4,172	5,874	72	OK
Member 1-bfl 1	4,161	5,863	71	OK
Member 1-w 1	4,272	5,758	75	OK
Member 1-w 2	4,291	5,747	75	OK

2.6 Concrete

Decisive load combination: 1 - Combination 1

2.6.1 Compression in concrete under the anchor plate



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

Equations

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

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

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

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

Variables

N [lb]	f_c' [psi]	Φ	A_1 [in²]	A_2 [in²]
4,056	2,500	0.65	9.83	3,700.70

Results

Load combination	F_p [psi]	σ [psi]	Utilization [%]	Status
Combination 1	2,762	412	15	OK

2.7 Symbol explanation

A_1	Loaded area of concrete
A_2	Supporting area
A_w	Effective area of weld critical element
d	Nominal diameter of the fastener
ε_{lim}	Limit plastic strain
ε_{Pl}	Plastic strain from CBFEM results
f_c	Concrete compressive strength
f_c'	Concrete compressive strength
F_{EXX}	Electrode classification number, i.e. minimum specified tensile strength
F_u	Specified minimum tensile strength of the connected material
F_n	Force in weld critical element
F_{nw}	Nominal stress of the weld 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
L	Length of weld
L_c	Length of weld critical element
L_s	Leg size of weld
N	Resulting compression force
σ	Average stress in concrete
σ_{Ed}	Equivalent stress
Φ	Resistance factor
ΦR_n	Resistance
t	Thickness of the anchor plate
Θ	Angle of loading measured from the weld longitudinal axis
T_h	Throat thickness of weld
V	Resultant of shear forces Vy, Vz in bolt.
X_u	Filler metal tensile strength

2.8 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.