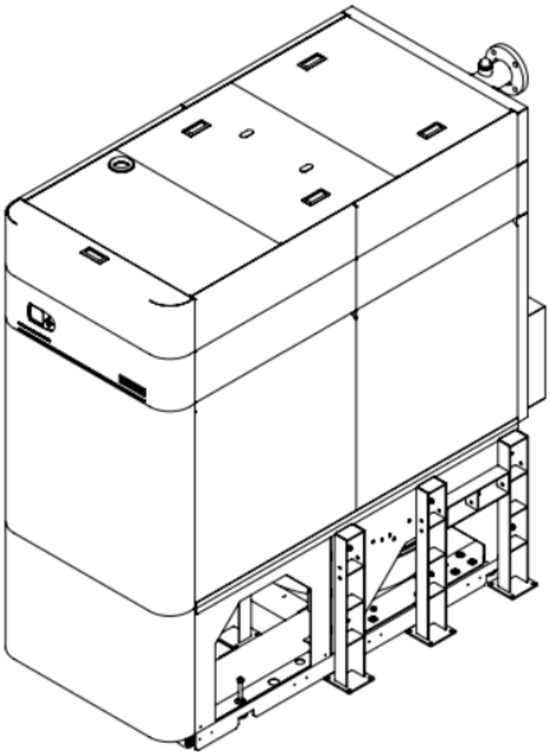
Submittal Documents

Seismic Analysis of the Boilers SVF 2000 and SVF 1500



August 06, 2019

For:
WEIL-McLAIN

Prepared By:
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Summary

The scope of this report is the seismic qualification, based on the structural analysis, of the boilers SVF 2000 and SVF 1500, under the seismic loads for the seismic zone 4 in the United States. The analyses are limited to the load path from the COG of the assembly to the floor and the interior parts of the boiler are not within the scope of this work.

The qualification is in accordance with the seismic design requirements of IBC 2015, ASCE 7-10 and AISC 14th edition for the seismic zone 4, for non-structural components and based on the seismic parameters used in this report.

The structural analyses carried out on the base frame assembly and based on the safety factors reported in section **5.4**, the design requirements of AISC, is met in all the analyses performed in this report.

It is concluded that the design of the main frame and the seismic stands meets the strength requirements of IBC 2015, ASCE 7-10 and ASME BPVC and AISC standards. This conclusion is contingence to the accuracy of the SolidWorks model and other input data provided by WEIL-McLAIN (WM) and used to build the FE models and set up the analyses (material, COG,...) appended in Appendix 1.

Revision History

Rev	Date	Scope of the revision	Created by
A	08/06/2019	First Issue	Sam Salissen

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1 Introduction

1.1 Scope

The scope of this report is the seismic qualification, based on the structural analysis, of the boilers SVF 2000 and SVF 1500, under the seismic loads for the seismic zone 4 in the states. The analyses are limited to the load path from the COG of the assembly to the floor and the interior parts of the boiler are not within the scope of this work. The qualification is in accordance with the design requirements of IBC 2015, ASCE 7-10 and AISC.

2 Assumptions and open issues

In this chapter, assumptions and open issues are presented in two categories. The definition of each is presented below.

Open issues- Is defined as issues that must be solved, otherwise the analysis cannot be completed.

Key assumption- Is defined as assumptions that may have noticeable impact on the analysis results.

2.1 Open Issues

- No open issues exist.

2.2 Key Assumptions

No fabrication drawing of the parts and assembly were provided and the analyses are based on the SolidWorks model that is provided by WM and no responsibility of the accuracy of the model with respect to the actual assembly will be taken by the author of this report.

- The weight and the location of the center of the gravity of the boiler assembly are estimated and provided by WM, Appendix 1.
- It is assumed that the material of the base frame and the top plate are S235JR.
- It is assumed that the welds have at least the same strength as the base material (Weld strength FEXX=70ksi>54ksi for base material) based on ASME allowable stress in welds under shear and tension is 0.3 *tensile strength =21000psi. In this case the allowable stresses of the structural members, based on (AISC), is less than the allowable stress in the welds. So, no weld analysis will be performed in this work.

3 Requirements and Prerequisites

3.1 Stress criteria

The seismic loads are calculated based on the IBC 2015 code. The detail of the used parameters and the calculations are as follows. Seismic analyses are performed (using FEM) based on ASD approach of the AISC 14 edition & ASCE 7-10 for the steel parts and LRFD for the anchorage calculations.

3.2 Loads

The following inputs are used for the weight of the boilers.

Boiler Model Number	Maximum Input	Minimum Input – Natural Gas	Minimum Input – Propane Gas	Gross Output	Net Rating	Thermal Efficiency	Combustion Efficiency	Boiler Water Content	Vent/ Air Pipe Size	Stack/ vent flow rate	Boiler weight (pounds)		
	Btuh (Note 1)	Btuh (Note 1)	Btuh (Note 1)	Btuh (Note 1)	Btuh (Note 2)	% (Note 3)	% (Note 4)	Gallons	Inches (Note 5)	scfm (Note 6)	Dry weight (no water)	Operating weight (filled)	Shipping weight
SVF 1500	1,500,000	199,000	300,000	1,448,000	1,259,000	96.5	—	118	8	415	2020	3000	2445
SVF 2000	1,999,000	199,000	300,000	1,923,000	1,672,000	96.2	—	118	8	553	2020	3000	2445
SVF 2500	2,499,000	300,000	300,000	2,419,000	2,104,000	96.8	—	149	10	692	2225	3470	2650
SVF 3000	3,000,000	300,000	300,000	2,874,000	2,499,000	—	95.8	149	10	830	2225	3470	2650

Three load cases are considered in this report, the analyses are based on the worst load combinations specified in ASCE 7-10. The following parameters are used in calculation of the seismic loads as follows:

1- Load case 1: Used for the analyses of the steel parts

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PH (949) 923 9073 FX (949) 264 7184
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"CALL US - TO SET THINGS RIGHT"

JOB NAME: SA-SVF-2000
CUSTOMER: WEIL-McLAIN

DATE:	PRP. BY.:	CAE PIPING JOB #:
8/4/2019		

SEISMIC CALCULATION WORKSHEET

BUILDING CODE: IBC-2012 / 2015

SEISMIC DESIGN:
S_{ds} = 2
I_p = 1
a_p = 1
R_p = 2.5
Ω_o = 2.0

a_p, R_p, Ω_o per ASCE 7-10

BLDG, ELEVATION / EQUIP. LOCATION:
h = 40 fl
**z = 40 fl
** Assume worst case location.

X 40 ft. RF
0 ft. GF or below ground

LOAD COMBINATION: LRFD
(0.9 DL + 1.00 E)

EQUIPMENT TAG:

EQUIPMENT Information:
W_p = max. operating weight = 3000 lbs.

APPLIED SEISMIC FORCE/ CALCULATIONS:

ANCHORAGE TO CONCRETE

SHT. NUMBER: 1 OF 1

$F_p / W_p = (0.4 \times a_p \times S_{ds} \times (1 + (2 \times (z / h))) / (R_p / I_p)) = 0.96$

F_p / W_p = 0.96g ; $F_{p,min} / W_p$ = 0.3 x S_{ds} x I_p = 0.60 ; $F_{p,max} / W_p$ = 1.6 x S_{ds} x I_p = 3.20

F_{ph} = Applied Lateral Seismic Force = 1.0 x 0.96g x W_p = 2880 lbs. *WORST CASE

F_{pv} = Vertical component of seismic force = 1.0 x 0.2 x S_{ds} x W_p = 1200 lbs. *WORST CASE

F_v = Vertical total load = F_{pv} - .9*Wp = -1500 lbs.

2- Load case 2: Used for the analyses of the steel parts

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JOB NAME:		
SA-SVF-2000		
CUSTOMER:		
WEIL-McLAIN		
DATE:	PRP. BY.:	CAE PIPING JOB #:
8/4/2019		

SEISMIC CALCULATION WORKSHEET
BUILDING CODE
IBC-2012 / 2015

SEISMIC DESIGN		BLDG. ELEVATION / EQUIP. LOCATION	
S_{ds} =	2		
I_p =	1	h =	40 fl
a_p =	1	**z =	40 fl
R_p =	2.5	** Assume worst case location.	
Ω_o =	2.0		

a_p, R_p, Ω_o per ASCE 7-10

X 40 ft. RF
0 ft. GF or below ground

LOAD COMBINATION
LRFD
(1.2 DL + 1.00 E)

EQUIPMENT TAG:

APPLIED SEISMIC FORCE/ CALCULATIONS: ANCHORAGE TO CONCRETE — SHT. NUMBER: 1 OF 1

EQUIPMENT Information:
W_p = max. operating weight = 3000 lbs.

F_p / W_p = (0.4 x a_p x S_{ds} x (1 + (2 x (z / h))) / (R_p / I_p) = 0.96

F_p / W_p = 0.96g ; $F_{p,min}$ / W_p = 0.3 x S_{ds} x I_p = 0.60 ; $F_{p,max}$ / W_p = 1.6 x S_{ds} x I_p = 3.20

F_{ph} = Applied Lateral Seismic Force = 1.0 x 0.96g x W_p .... = 2880 lbs. *WORST CASE

F_{pv} = Vertical component of seismic force = 1.0 x 0.2 x S_{ds} x W_p .... = 1200 lbs. *WORST CASE

F_v = Vertical total load = F_{pv} - .2*Wp = -2400 lbs.

3- Load case 3: Used in the analyses of the anchorage

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JOB NAME:		
SA-SVF-2000		
CUSTOMER:		
WEIL-McLAIN		
DATE:	PRP. BY.:	CAE PIPING JOB #:
8/4/2019		

SEISMIC CALCULATION WORKSHEET
BUILDING CODE
IBC-2012 / 2015

SEISMIC DESIGN		BLDG. ELEVATION / EQUIP. LOCATION	
S_{ds} =	2		
I_p =	1	h =	40 fl
a_p =	1	**z =	40 fl
R_p =	2.5	** Assume worst case location.	
Ω_o =	2.0		

a_p, R_p, Ω_o per ASCE 7-10

X 40 ft. RF
0 ft. GF or below ground

LOAD COMBINATION
LRFD 2013
(0.9 DL + 2.50 E)

EQUIPMENT TAG:

APPLIED SEISMIC FORCE/ CALCULATIONS: ANCHORAGE TO CONCRETE — SHT. NUMBER: 1 OF 1

EQUIPMENT Information:
W_p = max. operating weight = 3000 lbs.

F_p / W_p = (0.4 x a_p x S_{ds} x (1 + (2 x (z / h))) / (R_p / I_p) = 0.96

F_p / W_p = 0.96g ; $F_{p,min}$ / W_p = 0.3 x S_{ds} x I_p = 0.60 ; $F_{p,max}$ / W_p = 1.6 x S_{ds} x I_p = 3.20

F_{ph} = Applied Lateral Seismic Force = 2.5 x 0.96g x W_p .... = 7200 lbs. *WORST CASE

F_{pv} = Vertical component of seismic force = 1.0 x 0.2 x S_{ds} x W_p .... = 1200 lbs. *WORST CASE

F_v = Vertical total load = F_{pv} - .2*Wp = -1500 lbs.

The seismic (& dead weights) loads are applied at the location of the center of the gravity of boiler's assembly, using rigid elements, see Fig. 1.

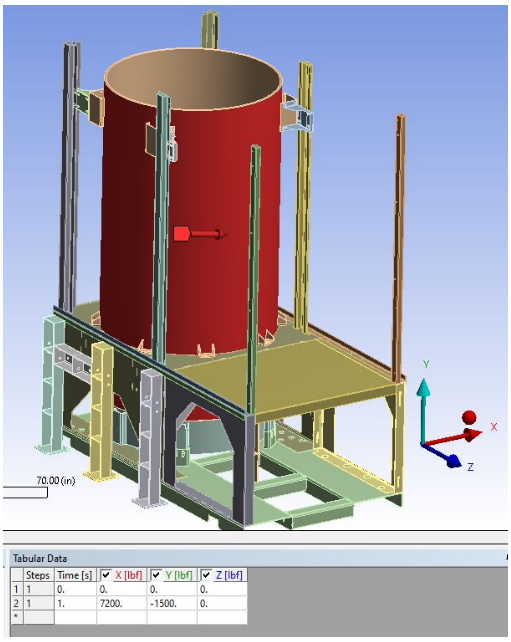


Figure 1- Loads acting on the boiler structure

5.3.1 Anchor Bolts

Hilti KBZ anchor bolts, 3/8" (2 3/4" embedment), are used to anchor the base plates to the floor. The maximum reaction loads at the location of the joints are extracted from the FE-analyses (load case 3 above). The detail of the anchor bolt calcs are provided in Appendix 3. The minimum concrete thickness of 5" and PSI rating of 3.000 psi are considered in the analyses).

Table-3: Reaction loads in the base plate, Fig. 11

Reaction forces [lbf]			Reaction moments [lbf-ft]		
FX	FY	FZ	MX	MY	MZ
892	2390	-373	-180	20	-663

5.4 Results Evaluation

Minimum required strength specified in ASCE (LRFD design approach) is obtained in the analyses of the assembly carried out in sections 5.1 to 5.4, (minimum safety factor of 1 for LRFD load). The stresses reported in section 5 are the local stresses and the average stress through the thickness of the members are much lower and that can be shown by stress linearization through the thickness. However, since even the maximum local peak stresses don't exceed the allowable values, the stress linearization work is skipped here.

6 Conclusion

Seismic analysis of the boilers SVF 2000 and SVF 1500 is carried out in this report and based on the safety factors reported in section **5.4**, minimum required strength factor is obtained in all the analyses performed in this report.

It is concluded that the design of the structure of the boilers SVF 2000 and SVF 1500meets the strength requirements of AISC, ASCE7-10 and IBC 2012 standards.

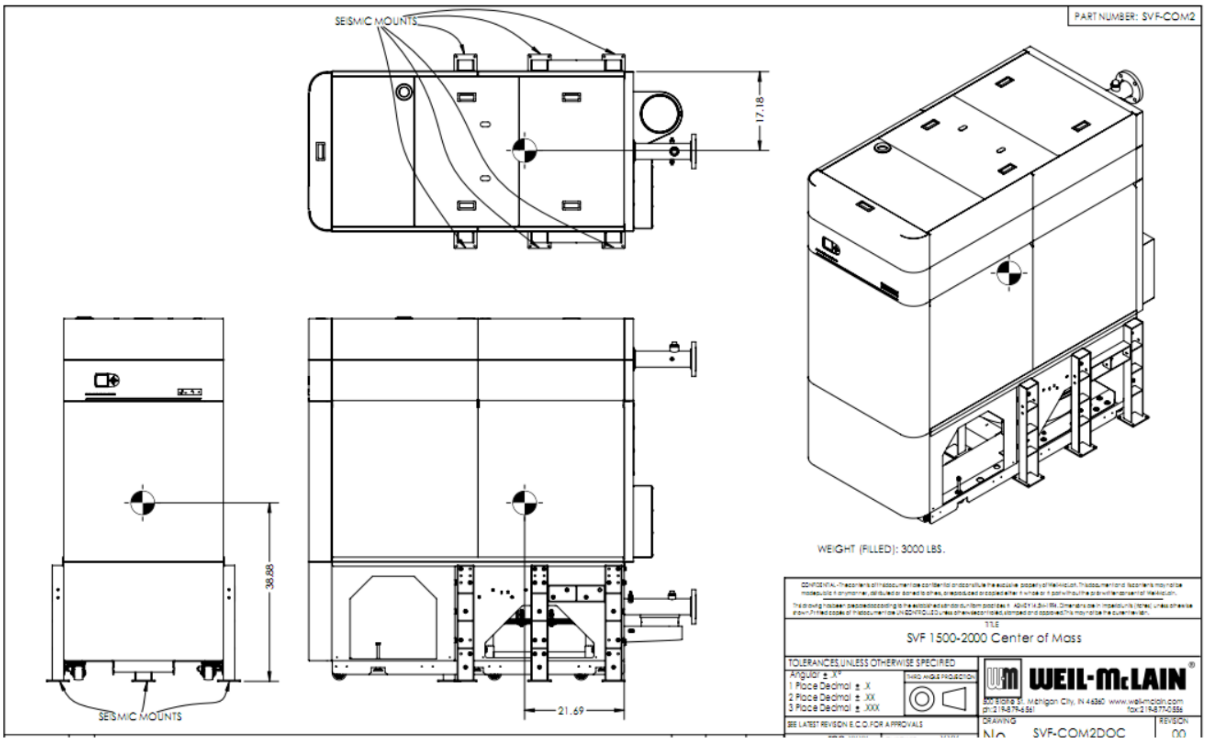
7 References

[1]- IBC 2012.

[2]- AISC 14th Edition.

[3]- ASCE 7-10.

APPENDIX ***1-*** Drawing with COG markup



*Appendix **2***- Anchor Bolt Calculation

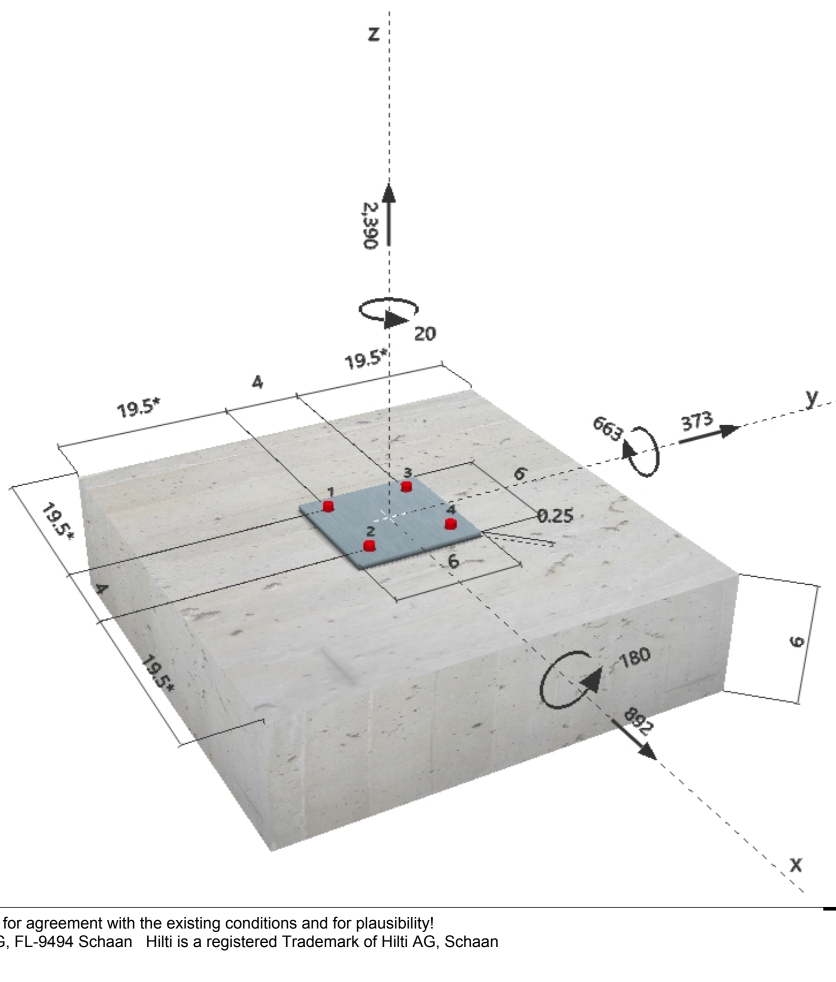
Company:	CAE PIPING INC.	Page:	1
Specifier:	SAM SALISSEN	Project:	AC-SVF 2000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	8/5/2019
E-Mail:	SSALISSEN@CAEPIPING.COM		

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 1/2 (3 1/4)**
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.625 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	6/1/2016 | 5/1/2017
Proof:	Design method ACI 318-14 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.250 in.
Anchor plate:	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.250 in.; (Recommended plate thickness: not calculated
Profile:	no profile
Base material:	cracked concrete, 3000, f_c' = 3000 psi; h = 6.000 in.
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	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))

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



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Address:		Sub-Project I Pos. No.:	
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E-Mail:	SSALISSEN@CAEPIPING.COM		

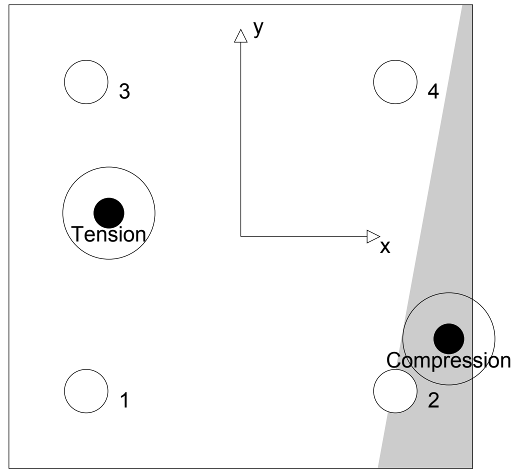
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1388	251	238	78
2	0	261	238	108
3	1644	222	208	78
4	240	234	208	108

max. concrete compressive strain: 0.15 [‰]
max. concrete compressive stress: 641 [psi]
resulting tension force in (x/y)=(-1.706/0.304): 3272 [lb]
resulting compression force in (x/y)=(2.692/-1.324): 882 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1644	8029	21	OK
Pullout Strength*	1644	2625	63	OK
Concrete Breakout Strength**	3272	3714	89	OK

* anchor having the highest loading **anchor group (anchors in tension)

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-1917
$\phi\ N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.10	106000

Calculations

N_{sa} [lb]
10705

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
10705	0.750	1.000	8029	1644

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3.2 Pullout Strength

$N_{pn,f'_c} = N_{p,2500}\ \lambda_a \sqrt{\frac{f'_c}{2500}}$ refer to ICC-ES ESR-1917

$\phi\ N_{pn,f'_c} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

f'_c [psi]	λ_a	$N_{p,2500}$ [lb]
3000	1.000	4915

Calculations

$\sqrt{\frac{f'_c}{2500}}$
1.095

Results

N_{pn,f'_c} [lb]	ϕ concrete	ϕ seismic	ϕ nonductile	$\phi\ N_{pn,f'_c}$ [lb]	N_{ua} [lb]
5384	0.650	0.750	1.000	2625	1644

3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ 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)

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

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ 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.]	$\psi_{c,N}$
3.250	1.040	0.363	19.500	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
7.500	17	1.000	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
173.06	95.06	0.824	0.931	1.000	1.000	5455

Results

N_{cbg} [lb]	ϕ concrete	ϕ seismic	ϕ nonductile	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
7618	0.650	0.750	1.000	3714	3272

Company:	CAE PIPING INC.	Page:	4
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Address:		Sub-Project I Pos. No.:	
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E-Mail:	SSALISSEN@CAEPIPING.COM		

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	261	3572	8	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	967	14229	7	OK
Concrete edge failure in direction x+**	967	7860	13	OK

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa,eq}$ = ESR value — refer to ICC-ES ESR-1917

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

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.10	106000

Calculations

$V_{sa,eq}$ [lb]
5495

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
5495	0.650	1.000	3572	261

4.2 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)

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

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — 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	3.250	0.096	0.229	19.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	7.500	17	1.000	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
189.06	95.06	0.981	0.955	1.000	1.000	5455

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
20327	0.700	1.000	1.000	14229	967

4.3 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)

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

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ 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.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
13.000	19.500	0.124	1.000	6.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
3.250	1.000	0.500	3000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
258.00	760.50	0.994	1.000	1.803	18477

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
11229	0.700	1.000	1.000	7860	967

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.881	0.123	1.000	84	OK

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

6 Warnings

- Load re-distributions 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 loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-14, Chapter 17, Section 17.2.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Section 17.2.3.4.3 (b), Section 17.2.3.4.3 (c), or Section 17.2.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Section 17.2.3.5.3 (a), Section 17.2.3.5.3 (b), or Section 17.2.3.5.3 (c).
-
- Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-14, Section 17.8.1.

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Fastening meets the design criteria!

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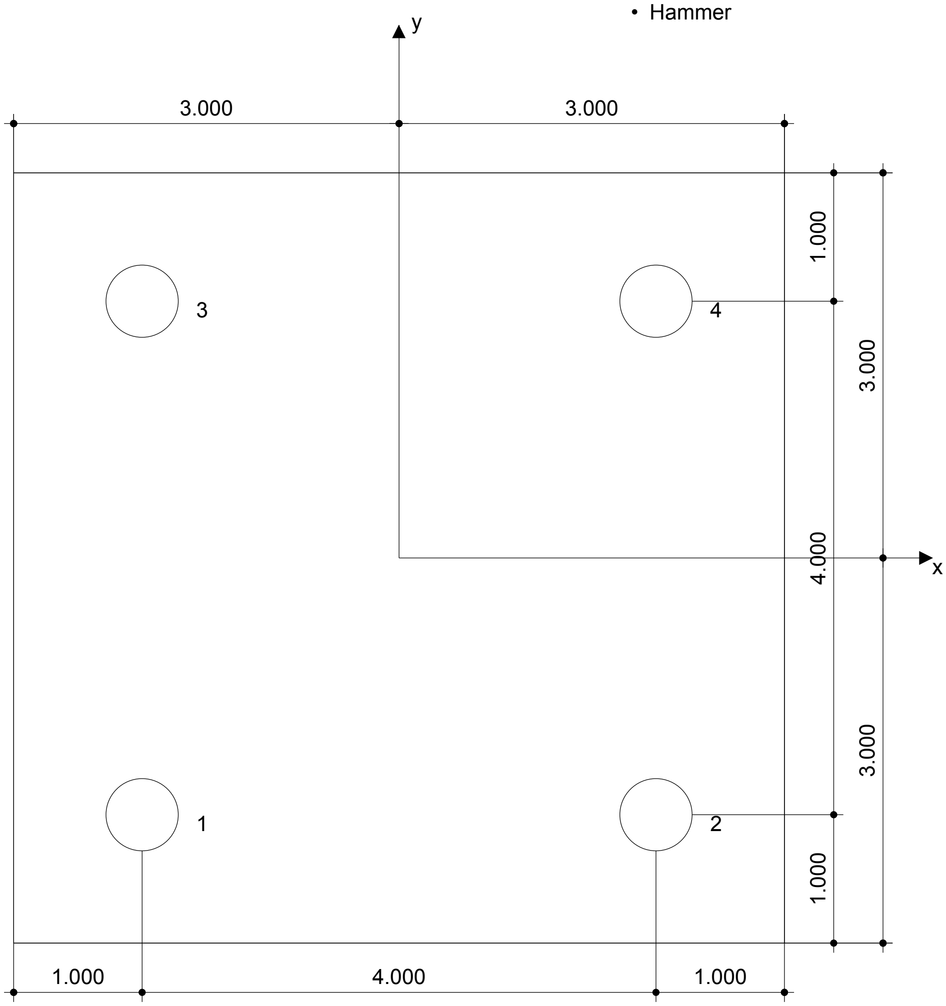
7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.563 in.
Plate thickness (input): 0.250 in.
Recommended plate thickness: not calculated
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ - CS 1/2 (3 1/4)
Installation torque: 40.000 ft.lb
Hole diameter in the base material: 0.500 in.
Hole depth in the base material: 4.000 in.
Minimum thickness of the base material: 6.000 in.

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer	• Manual blow-out pump	• Torque wrench
• Properly sized drill bit		• Hammer



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.000	-2.000	19.500	23.500	19.500	23.500
2	2.000	-2.000	23.500	19.500	19.500	23.500
3	-2.000	2.000	19.500	23.500	23.500	19.500
4	2.000	2.000	23.500	19.500	23.500	19.500

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8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.