FACILITIES DIVISION LAWRENCE BERKELEY LABORATORY	**CALCULATION COVER SHEET**	
	Discipline: **Civ/Struct**	Job No.: W0205883
		Revision No.: 0
	Calc. No.: 031.015	Date: 4/03/2020
	No. of Sheets: 6+ Appendix	Page 1 of 6

TITLE: B31-104 Drill Press Anchorage

SUBJECT: Seismic Anchorage

STATEMENT OF PROBLEMS:

Drill Press requires anchorage that can be easily removed at a later date. A built up steel angle system with epoxied anchors is used to provide less permanent anchorage.

SOURCES OF DATA:

Product Specs, site photo, existing building drawings 4B31S001,2,8A

SOURCES OF FORMULAS AND REFERENCES: 2019 CBC, ASCE 7-16

INTENDED USE: Construction

PRELIMINARY CALC [ ] FINAL CALC [X] SUPERCEDES CALC NO ____

0	N/A	S. De Leon	04/01/20	Y. Yin	04/02/20	T. Hart	04/03/20
Rev	Revision	Calculation by	Date	Checked by	Date	Approved by	Date

UNIT DEFINITIONS:

$k \equiv 1000 \cdot lb$ $\quad ftk \equiv ft \cdot k$ $\quad plf \equiv \frac{lb}{ft}$ $\quad klf \equiv \frac{k}{ft}$ $\quad psi \equiv \frac{lb}{in^2}$ $\quad psf \equiv \frac{lb}{ft^2}$ $\quad ksi \equiv \frac{k}{in^2}$ $\quad ksf \equiv \frac{k}{ft^2}$

$"k \equiv in \cdot k$ $\quad leg \equiv 1$ $\quad bolt \equiv 1$ $\quad isolator \equiv 1$ $\quad pcf \equiv \frac{lb}{ft^3}$ $\quad kcf \equiv \frac{k}{ft^3}$

Equipment per ASCE 7-16 Table 13.5-1

$I_p := 1.0 \quad a_p := 1.0 \quad R_p := 2.5 \quad \Omega_0 := 2.0$

for the LBNL site: $S_{DS} := 1.84$

distance from grade elevation to the floor
in where the equipment is located: $z := 0 \cdot ft$

Assumed distance from grade to the roof: $h_r := 19 \cdot ft$

$W_p := 400\ lb$ unit weight and assumed content weight

Seismic force:

$$F_p := \frac{(.4 \cdot a_p \cdot S_{DS})}{\left(\frac{R_p}{I_p}\right)} \cdot \left(1 + 2 \cdot \left(\frac{z}{h_r}\right)\right) \cdot W_p = 117.76\ lb \qquad F_{pv} := 0.2 \cdot S_{DS} \cdot W_p = 147.20\ lb$$

$$F_{pmin} := .3 \cdot S_{DS} \cdot I_p \cdot W_p = 220.80\ lb \qquad F_{p\_upper\_bound} := 1.6 \cdot S_{DS} \cdot I_p \cdot W_p = 1177.60\ lb$$

$$F_p := \mathbf{if}\left(F_{pmin} > F_p, F_{pmin}, \mathbf{if}\left(F_p < F_{p\_upper\_bound}, F_p, F_{p\_upper\_bound}\right)\right) = 220.80\ lb$$

% of "g": $\frac{F_p}{W_p} = 0.55 \qquad S_g := \frac{F_p}{W_p}$

Drill Press:

Unit Dimensions:

$a := 66\ in \qquad b := 13\ in \qquad c := 22\ in$

$e_x := 0\ in \qquad e_y := 0.25 \cdot c \qquad z' := 0.8\ a = 52.80\ in$ Estimated

Anchor Locations:

$n := 4$ Number of anchors

Propose 4 anchorage angles placed symmetrically at the two sides of the base frame

$ed_{side\_b} := 0 \cdot in \qquad ed_{side\_c} := 5 \cdot in$

$b_1 := \frac{b}{2} - ed_{side\_b} = 6.50\ in \qquad c_1 := \frac{c}{2} - ed_{side\_c} = 6.00\ in$

$b_3 := b_1 \qquad c_2 := c_1$

$b_2 := \frac{b}{2} - ed_{side\_b} = 6.50\ in \qquad c_3 := \frac{c}{2} - ed_{side\_c} = 6.00\ in$

$b_4 := b_2 \qquad c_4 := c_3$

$b_{leg} := 0.5\ b = 6.50\ in \qquad c_{leg} := 0.5 \cdot c = 11.00\ in$

$b_{max} := \max\left(b_1, b_2, b_{leg}\right) = 6.50\ \boldsymbol{in}$ $\qquad c_{max} := \max\left(c_1, c_3, c_{leg}\right) = 11.00\ \boldsymbol{in}$

$$S_y := \frac{\left(2 \cdot bolt \cdot b_1^{\,2}\right) + \left(2 \cdot bolt \cdot b_{leg}^{\,2}\right)}{b_{max}} = 26.00\ \boldsymbol{in} \qquad S_x := \frac{\left(2 \cdot bolt \cdot c_1^{\,2}\right) + \left(2 \cdot bolt \cdot c_{leg}^{\,2}\right)}{c_{max}} = 28.55\ \boldsymbol{in}$$

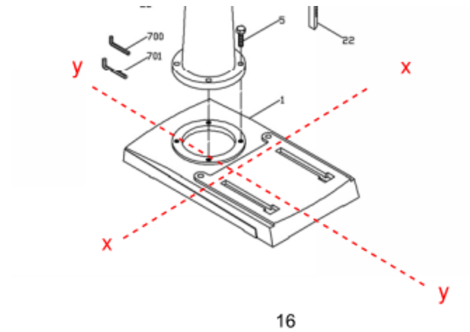
Seismic Forces: Overturning about each axis for strength design load case 0.9D +/- Ω_0 E will be added in for the design of the anchors to the concrete but is not to be included in the check of the brackets:

Seismic Force front to back of unit (Fp in Y Direction):

$$M_{ot} := F_p \cdot z' = 971.52\ \boldsymbol{lb} \cdot \boldsymbol{ft}$$

$$T_1 := \frac{\left(M_{ot} + \left(F_{pv} \cdot e_y\right)\right)}{S_x} + \frac{F_{pv}}{n} - \frac{0.9 \cdot W_p}{n} = 383.57\ \boldsymbol{lb}$$

$$V_1 := \frac{F_p}{n} = 55.20\ \boldsymbol{lb}$$



Seismic Force Across Unit (Fp in X Direction):

$$T_2 := \frac{\left(M_{ot} + \left(F_{pv} \cdot e_x\right)\right)}{S_y} + \frac{F_{pv}}{n} - \frac{0.9 \cdot W_p}{n} = 395.19\ \boldsymbol{lb}$$

$$V_2 := \frac{F_p}{n} = 55.20\ \boldsymbol{lb}$$

Seismic Force At an Angle to the Unit:

$\theta := 0 \cdot \boldsymbol{deg}, 1 \cdot \boldsymbol{deg} .. 90 \cdot \boldsymbol{deg}$ $\qquad F_y(\theta) := F_p \cdot \sin(\theta)$ $\qquad F_x(\theta) := F_p \cdot \cos(\theta)$

$$f_t(\theta) := \frac{\left(F_y(\theta) \cdot z'\right) + \left(F_{pv} \cdot e_y\right)}{S_x} + \frac{\left(F_x(\theta) \cdot z'\right) + \left(F_{pv} \cdot e_x\right)}{S_y} + \frac{F_{pv}}{n} - \frac{.9 \cdot W_p}{n}$$

$f_{t\theta_{\frac{\theta}{deg}}} := f_t(\theta)$ $\qquad \max\left(f_{t\theta}\right) = 581.66\ \boldsymbol{lb}$ $\qquad T_{max} := \max\left(f_{t\theta}\right) = 581.66\ \boldsymbol{lb}$

$\theta f_{t_{\frac{\theta}{deg}}} := \mathbf{if}\left(\max\left(f_{t\theta}\right) = f_t(\theta), \theta, 0\right)$ $\qquad \max\left(\theta f_t\right) = 42.00\ \boldsymbol{deg}$ $\qquad \theta := \max\left(\theta f_t\right)$

$T_3 := T_{max} = 581.66\ \boldsymbol{lb}$ $\qquad V_{3x} := \dfrac{F_x(\theta)}{n} = 41.02\ \boldsymbol{lb}$ $\qquad V_{3y} := \dfrac{F_y(\theta)}{n} = 36.94\ \boldsymbol{lb}$

Check of Angle Bracket:

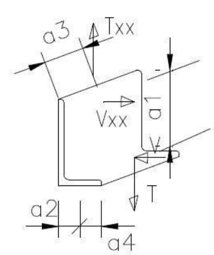
Angle Size Try 3" W x 3" D x 3" H x 1/4" thick

$b_a := 3\ \boldsymbol{in}$ $\qquad a3 := 0.5 \cdot b_a = 1.50\ \boldsymbol{in}$

$a1 := 3\ \boldsymbol{in}$ $\qquad a2 := 1.5\ \boldsymbol{in}$

$a4 := 3\ \boldsymbol{in} - a2 = 1.50\ \boldsymbol{in}$ $\qquad t_a := 0.25\ \boldsymbol{in}$

$F_{ya} := 36\ ksi$ $\qquad F_{ua} := 54\ ksi$ $\qquad \phi_b := 0.9$



Vertical Angle Leg Bending:

$V_{angle} := \max\left(V_2, V_{3x}\right) = 55.20\ \boldsymbol{lb}$

$M_{val} := V_{angle} \cdot a1 = 165.60\ \boldsymbol{lb \cdot in}$ $t_{a\_reqd1} := \sqrt{\dfrac{4 \cdot M_{val}}{\phi_b \cdot F_{ya} \cdot b_a}} = 0.08\ \boldsymbol{in}$

Horizontal Angle Leg Bending:

$T_{angle} := \max\left(T_1, T_2, T_3\right) = 581.66\ \boldsymbol{lb}$

$M_{hal} := T_{angle} \cdot \left(a2 + 1\ \boldsymbol{in}\right) = 1454.16\ \boldsymbol{lb \cdot in}$ $t_{a\_reqd2} := \sqrt{\dfrac{4 \cdot M_{hal}}{\phi_b \cdot F_{ya} \cdot b_a}} = 0.24\ \boldsymbol{in}$

Prying:

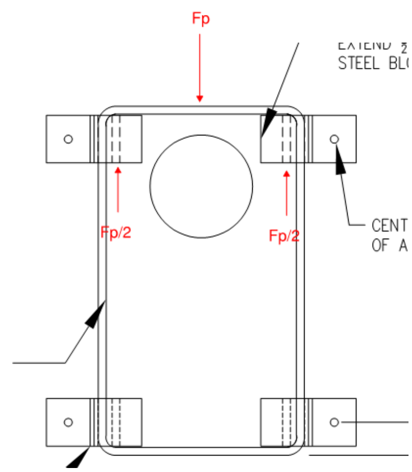
$b_p := a2 - 0.5 \cdot t_a - 0.5 \cdot 0.625\ \boldsymbol{in} = 1.06\ \boldsymbol{in}$

To avoid prying:

$$t_{a\_reqd3} := \sqrt{\frac{4 \cdot T_{angle} \cdot b_p}{\phi_b \cdot F_{ua} \cdot b_a}} = 0.13\ \boldsymbol{in}$$

$t_{min} := \max\left(t_{a\_reqd1}, t_{a\_reqd2}, t_{a\_reqd3}\right) = 0.24\ \boldsymbol{in}$

1/4" min steel angle is OK for shear



Evaluate loading in N-S direction:

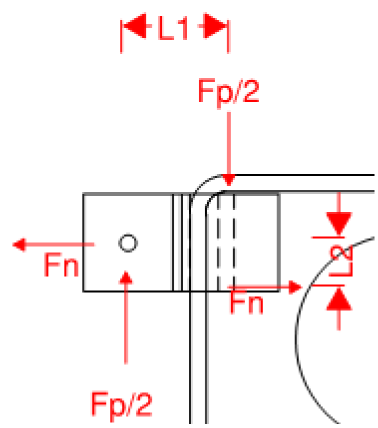
Force in N-S direction will cause resultant horizontal loads on angle

$\dfrac{F_p}{2} = 110.40\ \boldsymbol{lb}$

$L1 := 1.5\ \boldsymbol{in} + 1\ \boldsymbol{in}$

$L2 := 1.5\ \boldsymbol{in}$

$Fn := \dfrac{F_p}{2} \cdot \dfrac{L1}{L2} = 184.00\ \boldsymbol{lb}$



Tension in N-S is less than previously designed angle, just check additional shear to vertical leg

Vertical Angle Leg Bending:

$V_{angle} := Fn = 184.00\ \boldsymbol{lb}$

$M_{val} := V_{angle} \cdot 3.5\ \boldsymbol{in} = 644.00\ \boldsymbol{lb \cdot in}$

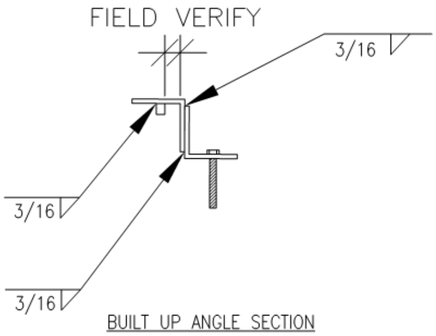
$t_{a\_reqd1} := \sqrt{\dfrac{4 \cdot M_{val}}{\phi_b \cdot F_{ya} \cdot b_a}} = 0.16\ \boldsymbol{in}$ <0.25" ok

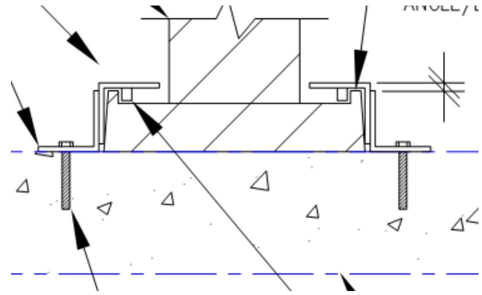
Additional Forces to anchor from shear

$T_{add} := \dfrac{3.5\ \boldsymbol{in} \cdot Fn}{1.5\ \boldsymbol{in}} = 429.33\ \boldsymbol{lb}$

Add tension to anchor force in y direction

Check weld strength:





Second angle will cover the top of the base frame to resist uplift.

Weld block of steel to underside of top angle to provide resistance to sliding in forward-back direction (block will contact lip of frame if sliding occurs)

$$t_w := \frac{3}{16}\ \mathbf{in} \qquad l_w := 3\ \mathbf{in}$$

$$A_{we} := \frac{t_w}{\sqrt{2}} \cdot l_w = 0.40\ \mathbf{in}^2$$

$$R_{n\_weld} := 0.6 \cdot 70\ ksi \cdot A_{we} = 16705.40\ \mathbf{lb}$$

$$phiRn := 0.75 \cdot R_{n\_weld} = 12529.05\ \mathbf{lb}$$

$$DCR_{weld} := \frac{\sqrt{\left(\frac{F_p}{2}\right)^2 + Fn^2}}{phiRn} = 0.02 \qquad \text{<1 OK}$$

Attachment to Concrete Slab: Check using strength design load case 0.9D +/- Ω_0 E

Seismic Force front to back of unit (Fp in Y Direction):

$$M_{ot\Omega} := F_p \cdot z' \cdot \Omega_0 = 1943.04\ \mathbf{lb \cdot ft}$$

$$V_{1\Omega} := \frac{F_p \cdot \Omega_0}{n} = 110.40\ \mathbf{lb}$$

$$T_{1\Omega} := \frac{\left(M_{ot\Omega} + \left(F_{pv} \cdot e_y\right)\right)}{S_x} + \frac{F_{pv}}{n} - \frac{0.9 \cdot W_p}{n} + \Omega_0 \cdot T_{add} = 1650.65\ \mathbf{lb}$$

Seismic Force Across Unit (Fp in X Direction):

$$V_{2\Omega} := \frac{F_p \cdot \Omega_0}{n} = 110.40\ \mathbf{lb}$$

$$T_{2\Omega} := \frac{\left(M_{ot\Omega} + \left(F_{pv} \cdot e_x\right)\right)}{S_y} + \frac{F_{pv}}{n} - \frac{0.9 \cdot W_p}{n} + V_{2\Omega} \cdot \frac{a1}{a2} = 1064.39\ \mathbf{lb}$$

Seismic Force At an Angle to the Unit:

$$V_{3x\Omega} := \frac{F_x(\theta) \cdot \Omega_0}{n} = 82.04\ \mathbf{lb}$$

$$V_{3y\Omega} := \frac{F_y(\theta) \cdot \Omega_0}{n} = 73.87\ \mathbf{lb}$$

$$T_{3\Omega} := \frac{\left(F_y(\theta) \cdot z' \cdot \Omega_0\right) + \left(F_{pv} \cdot e_y\right)}{S_x} + \frac{\left(F_x(\theta) \cdot z' \cdot \Omega_0\right) + \left(F_{pv} \cdot e_x\right)}{S_y} + \frac{F_{pv}}{n} - \frac{.9 \cdot W_p}{n} + V_{3x\Omega} \cdot \frac{a1}{a2} = 1352.25\ \mathbf{lb}$$

Worst case tension:

$$N := \max\left(T_{1\Omega}, T_{2\Omega}, T_{3\Omega}\right) = 1650.65\ \mathbf{lb}$$

Use 1/2" dia threaded rod anchor with epoxy.
See appendix for anchor calculations for the governing case.

Conclusions:

Restrain the drill press base plate per the steel angles and anchors shown on the attached drawings.

The anchors to concrete should be installed per the following specifications:

Anchor size	1/2 inch diameter
Rod type	ASTM A F1554 Gr. 55
Epoxy Type	Hilti HIT-HY 200
ICC Evaluation Report	ESR-3187
Anchor embedment into concrete	3 inches
Hole depth in concrete	3 inches
Hole diameter in concrete	9/16 inch
Hole diameter in steel	5/8 inch
Hole drilling	Hammer drill with carbide tip
Special inspection	Required
Installation torque	30 ft-lbs
Pull test	All anchors to 2500 pounds
Additional requirements	Locate anchors to avoid (E) slab reinforcing & utilities

RAISED LIP AROUND EQUIPMENT BASE

GAP BETWEEN LIP AND PLATE FOR STEEL BLOCK TO FIT INTO

BUILDING 31 DRILL PRESS ANCHORAGE DETAILS

Room 104

DRAWN BY	S. DE LEON	DATE 4/01/20
CHECKED BY	Y. YIN	4/02/20
APPROVED BY	T. HART	4/04/20
CAD FILE PATH		
SCALE	NOT TO SCALE	
DRAWING NO.		SHEET SK-1
PROJECT NO.	W0205883	1 OF 3

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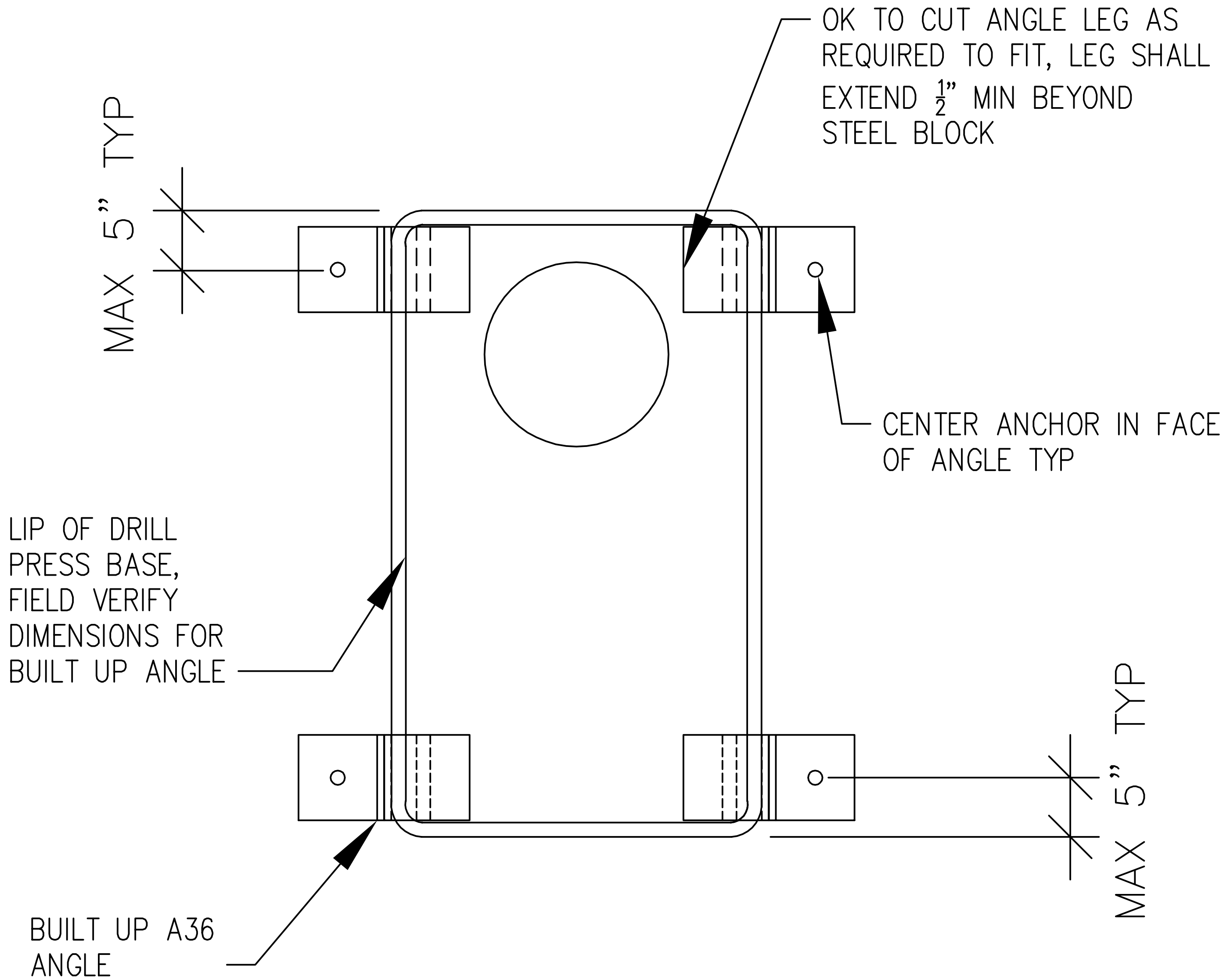
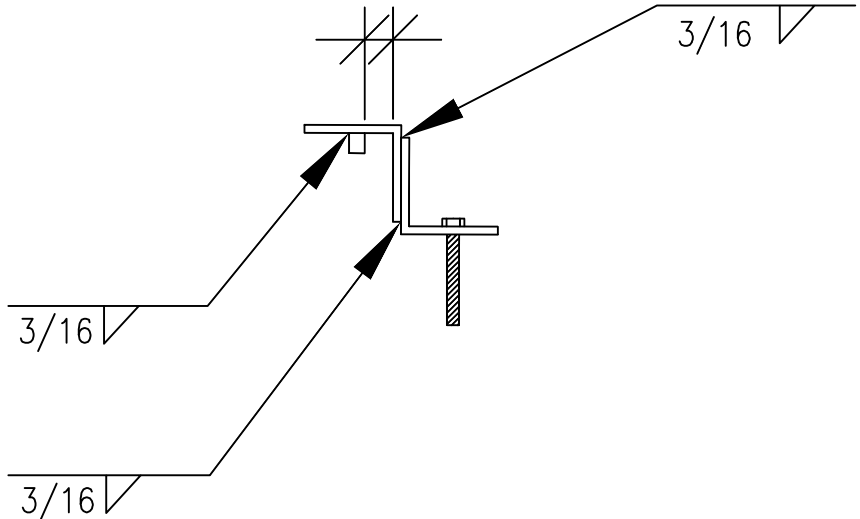
FACILITIES DIVISION

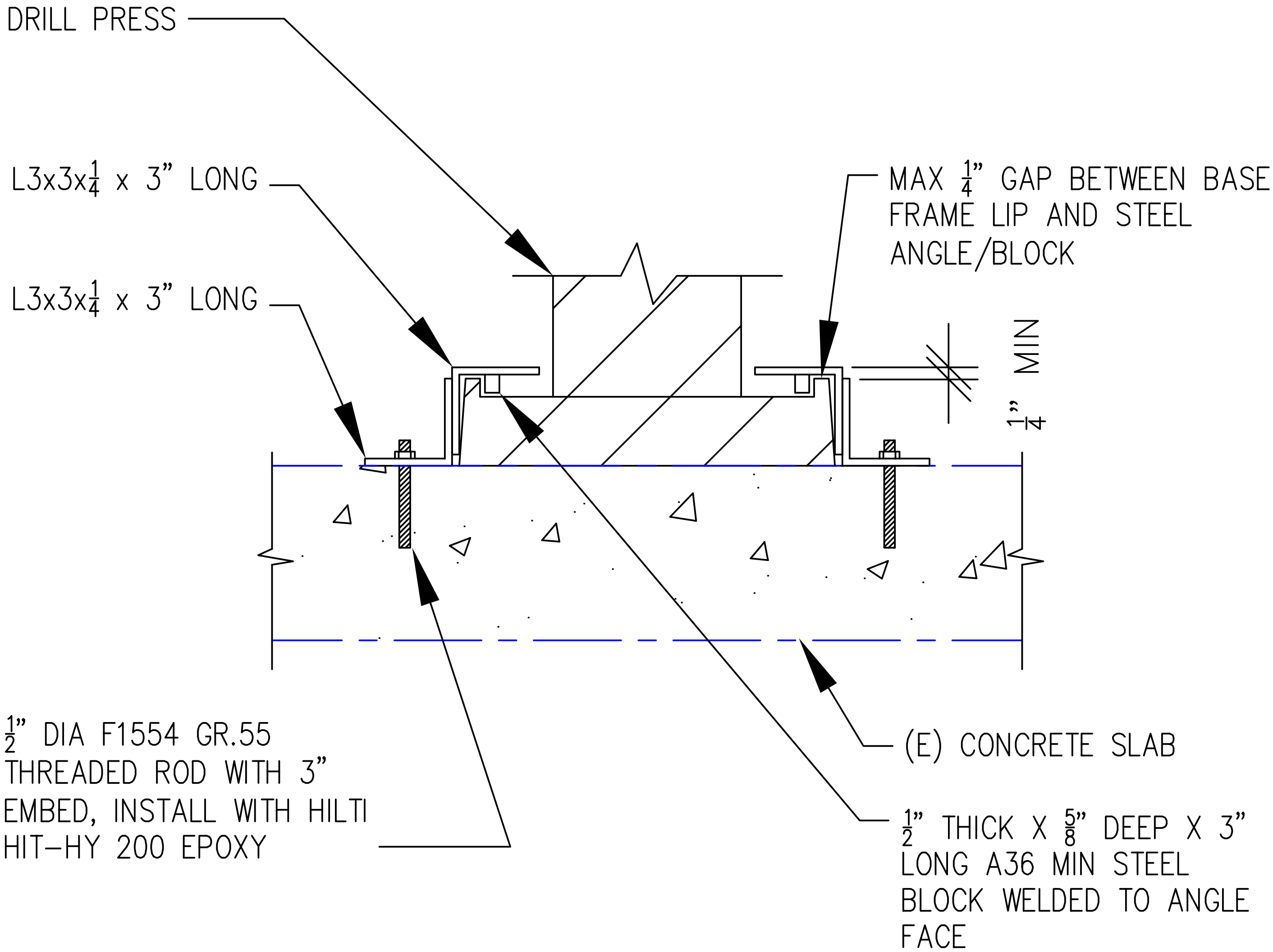


BASE FRAME PLAN VIEW

BUILDING 31 DRILL PRESS ANCHORAGE DETAILS	ROOM 104	DRAWN BY S. DE LEON	DATE 4/01/20
		CHECKED BY Y. YIN	4/02/20
		APPROVED BY T.HART	4/03/20
		CAD FILE PATH	
		SCALE NOT TO SCALE	
UNIVERSITY OF CALIFORNIA LAWRENCE BERKELEY NATIONAL LABORATORY FACILITIES DIVISION		DRAWING NO.	SHEET SK-2
		PROJECT NO. W0205883	2 of 3



BUILT UP ANGLE SECTION



BUILDING 31 ROOM 104
DRILL PRESS
ANCHORAGE DETAILS

DRAWN BY	S. DE LEON	DATE 4/01/20
CHECKED BY	Y. YIN	4/02/20
APPROVED BY	T.HART	4/03/20
CAD FILE PATH		
SCALE	NOT TO SCALE	
DRAWING NO.		SHEET SK-3
PROJECT NO.	W0205883	3 of 3

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FACILITIES DIVISION

Company:		Page:	1
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Mar 26, 2020	Date:	4/1/2020
Fastening point:			

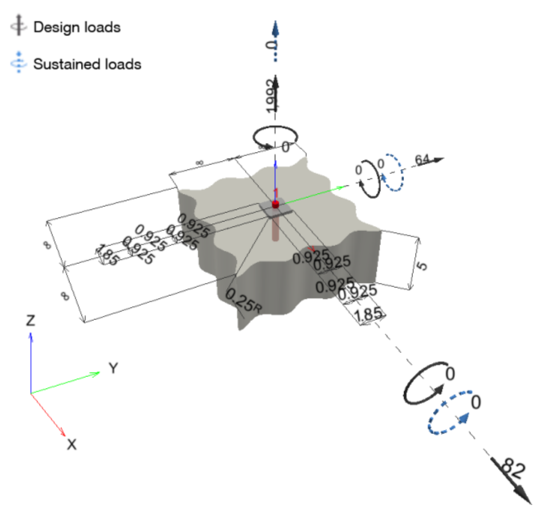
Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 + HAS-E-55 (ASTM F1554 Gr.55) 1/2**
Item number:	2197990 HAS-E-55 1/2"x4-1/2" (element) / 2022793 HIT-HY 200-R (adhesive)
Effective embedment depth:	$h_{ef,opti}$ = 2.874 in. ($h_{ef,limit}$ = 3.750 in.)
Material:	ASTM A 1554 Grade 55
Evaluation Service Report:	ESR-3187
Issued I Valid:	4/1/2019 | 3/1/2020
Proof:	Design Method ACI 318-14 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.250 in.
Anchor plate^R :	l_x x l_y x t = 1.850 in. x 1.850 in. x 0.250 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 5.000 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: 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))

R - The anchor calculation is based on a rigid anchor plate assumption.

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



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Company:		Page:	2
Address:		Specifier:	
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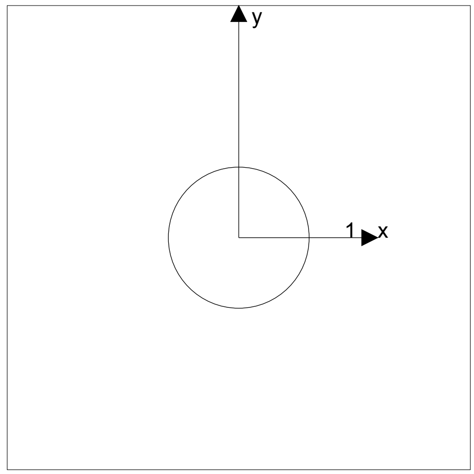
Design:	Concrete - Mar 26, 2020	Date:	4/1/2020
Fastening point:			

1.1 Design results

Case	Description		Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	N=1650 OK	$N = 1{,}992$; $V_x = 82$; $V_y = 64$; $M_x = 0$; $M_y = 0$; $M_z = 0$; $N_{sus} = 0$; $M_{x,sus} = 0$; $M_{y,sus} = 0$;	yes	99

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	1,992	104	82	64

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(0.000/0.000): 1,992 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1,992	7,984	25	OK
Bond Strength**	1,992	2,468	81	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	1,992	2,013	99	OK

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

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-3187

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

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.14	75,000

Calculations

N_{sa} [lb]
10,645

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
10,645	0.750	7,984	1,992

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Company:		Page:	4
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Mar 26, 2020	Date:	4/1/2020
Fastening point:			

3.2 Bond Strength

$N_a = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ — ACI 318-14 Eq. (17.4.5.1a)

$\phi\ N_a \geq N_{ua}$ — 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)

$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ — 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)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \alpha_{N,seis} \cdot \pi \cdot d_a \cdot h_{ef}$ — 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]
2,220	0.500	2.874	∞	1.000	1,135

c_{ac} [in.]	λ_a	$\alpha_{N,seis}$
5.632	1.000	0.990

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
7.071	200.00	200.00	1.000

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	5,062

Results

N_a [lb]	ϕ_{bond}	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ N_a$ [lb]	N_{ua} [lb]
5,062	0.650	0.750	1.000	2,468	1,992

3.3 Concrete Breakout Failure

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N} \; \psi_{c,N} \; \psi_{cp,N} \; N_b$	ACI 318-14 Eq. (17.4.2.1a)
$\phi \; N_{cb} \geq N_{ua}$	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)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	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

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
2.874	∞	1.000	5.632	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
74.03	74.03	1.000	1.000	4,129

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \; N_{cb}$ [lb]	N_{ua} [lb]
4,129	0.650	0.750	1.000	2,013	1,992

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Company:		Page:	6
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Mar 26, 2020	Date:	4/1/2020
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	104	2,905	4	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	104	5,780	2	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-3187
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.14	75,000	0.700

Calculations

$V_{sa,eq}$ [lb]
4,469

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi\ V_{sa,eq}$ [lb]	V_{ua} [lb]
4,469	0.650	2,905	104

4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \ \psi_{c,N} \ \psi_{cp,N} \ N_b \right]$	ACI 318-14 Eq. (17.5.3.1a)
$\phi \ V_{cp} \geq V_{ua}$	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)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0$	ACI 318-14 Eq. (17.4.2.5b)
$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0$	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.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2	2.874	∞	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
5.632	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
74.03	74.03	1.000	1.000	4,129

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi \ V_{cp}$ [lb]	V_{ua} [lb]
8,257	0.700	1.000	1.000	5,780	104

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.990	0.036	1.000	86	OK

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

Company:		Page:	8
Address:		Specifier:	
Phone I Fax:	|	E-Mail:	
Design:	Concrete - Mar 26, 2020	Date:	4/1/2020
Fastening point:			

6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2018, 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 anchor 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/
- 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).
- Section 17.2.3.4.3 (b) / Section 17.2.3.5.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.2.3.4.3 (c) / Section 17.2.3.5.3 (b) waive the ductility requirements and require the anchors to be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.2.3.4.3 (d) / Section 17.2.3.5.3 (c) waive the ductility requirements and require the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by ω_0.
- 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.

Fastening meets the design criteria!

7 Installation data

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

Anchor type and diameter: HIT-HY 200 + HAS-E-55 (ASTM F1554 Gr.55) 1/2

Item number: 2197990 HAS-E-55 1/2"x4-1/2" (element) / 2022793 HIT-HY 200-R (adhesive)

Installation torque: 360 in.lb

Hole diameter in the base material: 0.563 in.

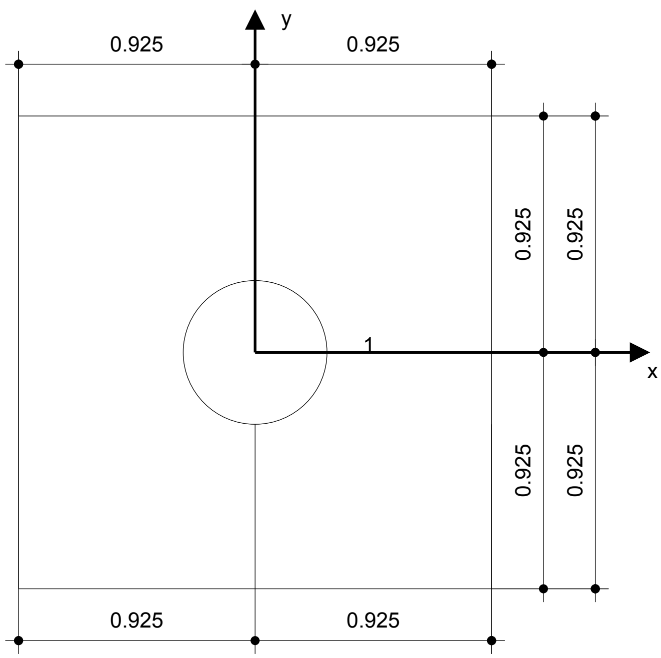
Hole depth in the base material: 2.874 in.

Minimum thickness of the base material: 4.124 in.

1/2 Hilti HAS Carbon steel threaded rod with Hilti HIT-HY 200 Safe Set System

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	0.000	0.000	-	-	-	-

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.
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