Xcel Sports Complex

Pitzner Parkway & W Racine St
Jefferson, WI 53549

Structural Calculations

Pre-manufactured Metal Building
Foundations & Exterior Wall Panels

Prepared For

OpeningDesign
Madison, WI

07/08/2015

NTRIVE
INNOVATIVE ENGINEERING

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

Xcel Sports Complex

Pitzner Parkway & W Racine St
Jefferson, WI 53549

Structural Calculations

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Table of Contents

Xcel Sports Complex
Jefferson, WI

Design Criteria

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

JOB XCEL SPORTS COMPLEX NO. 20150104

SHEET NO. 101 OF

CALCULATED BY KZZ DATE 6/16/15

CHECKED BY DATE

DESCRIPTION GENERAL REQUIREMENT

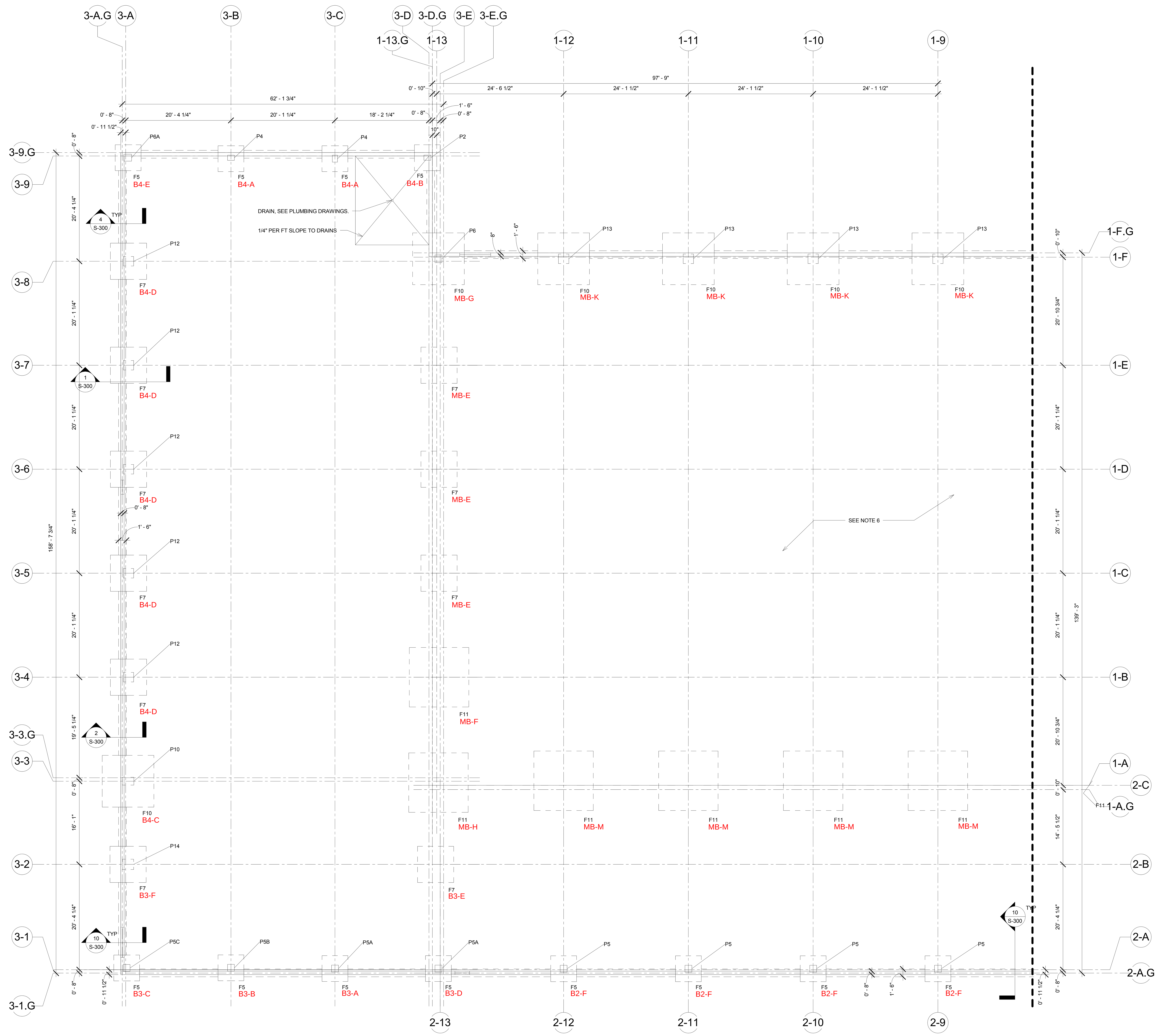
PURPOSE:
DESIGN BALCONY FRAMING AND ITS ATTACHMENT TO EXISTING BUILDING

MATERIALS:
STRUCTURAL STEEL:
WIDE FLANGES - ASTM A992
PLATES - ASTM A36 (Fy=36 ksi)
RECTANGULAR TUBES - ASTM A500C (Fy=50 ksi)

CODES. SPECS, REFERENCES, ETC.:
BUILDING CODE - 2011 WISCONSIN BUILDING CODE (REFERENCES 2009 IBC)
STEEL DESIGN - AISC 13TH EDITION ASD

STRUCTURAL LOADS:
WIND LOAD: PER ASCE 7-05 (COMPONENTS & CLADDING)
h_{mean}=31'-0"
$q_z=0.00256K_zK_{zt}K_dV^2I=0.00256*1.0*1.0*0.85*90^2*1.0=17.63$ PSF
Kz=1.0 (TABLE 6-3)
Kzt=1.0 (SECTION 6.5.7.2)
Kd=0.85 (TABLE 6-4)
V=90 MPH (FIGURE 6-1)
I=1.0 (TABLE 6-1)
$p=q_z(GCp \pm GCpi)=17.63$ PSF*$(-1.4 \pm 0.18)=-27.6$ PSF
GCp=-1.4 (FIGURE 6-11A)
GCpi=0.18

@ PARAPET:
q_z=17.63 PSF
$p=q_z(GCp^+ \pm GCp^-)=17.63$ PSF*(1.0+1.8)=49.4 PSF
GCp+=1.0 (FIGURE 6-11A)
GCP-=MAX(-1.4, -1.8)=-1.8 (FIGURES 6-11A, 6-14A)



FOUNDATION PLAN
1/8" = 1'-0"

SHEET NOTES:

1. SEE SHEET S-100 FOR GENERAL NOTES, ABBREVIATIONS AND SCHEDULES.
2. VERIFY ALL DIMENSIONS AND ELEVATIONS WITH EXISTING CONDITIONS, ARCHITECTURAL, PLUMBING AND MECHANICAL DRAWINGS.
3. FX INDICATES FOOTING. SEE FOOTING SCHEDULE ON SHEET S-100. PX INDICATES CONCRETE PIER. SEE PIER SCHEDULE ON SHEET S-100.
4. T/FOUNDATION WALL ELEVATION = +100'-0" UNLESS NOTED THUS [ ]
5. T/EXTERIOR FOOTING ELEVATION = +96'-6" UNLESS NOTED THUS ( ). T/INTERIOR FOOTING ELEVATION = +99'-0" UNLESS NOTED THUS ( ).
6. TYPICAL SLAB ON GRADE - 6" CONCRETE WITH 6X6 - W2.9XW2.9 WWR ON MIN 10 MIL POLYETHYLENE VAPOR RETARDER ON 6" MIN WELL COMPACTED GRANULAR FILL (PER GEOTECHNICAL REPORT, MAXIMUM PARTICLE SIZE OF 1" CONTAINING NO MORE THAN 5% PASSING 200 SIEVE AND FOLLOW RECOMMENDATIONS OF ACI 302.1 PART 4.1).
T/CONC ELEV=+100'-0".

Owner
4860 Highwood Circle
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WISCONSIN RYAN P. SCHULTZ A-11197-5 STOUGHTON, WI ARCHITECT

No.	Description	Date
1	PROGRESS SET	06/05/2015

Xcel
Sports Complex

FOUNDATION PLAN

Date | Issue Date

S-200

Scale | 1/8" = 1'-0"

NOT FOR CONSTRUCTION

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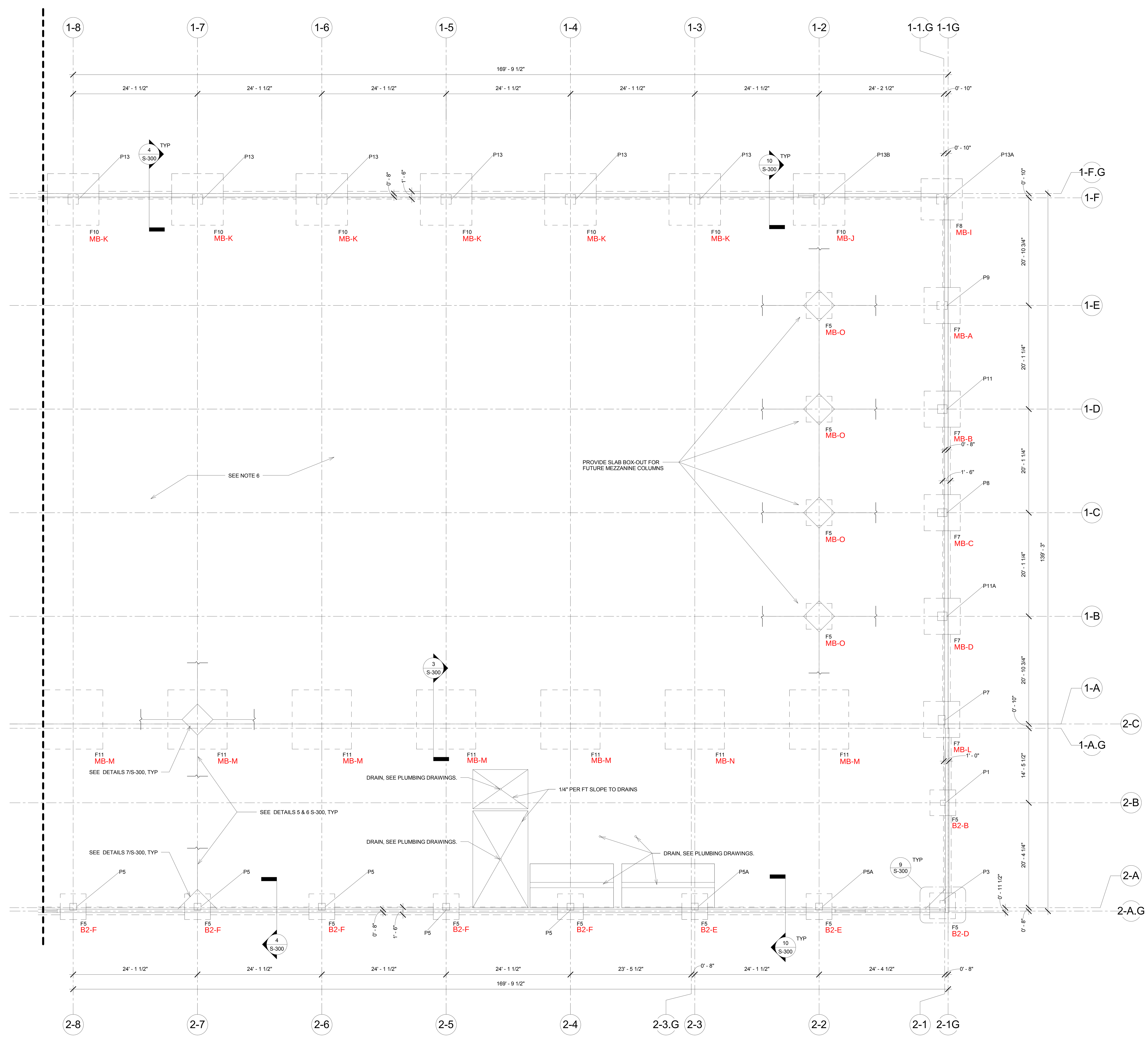

1 FOUNDATION PLAN CONT.
1/8" = 1'-0"

SHEET NOTES:

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WISCONSIN
RYAN P. SCHULTZ
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STOUGHTON, WI
ARCHITECT

No.	Description	Date
1	PROGRESS SET	06/05/2015

Xcel
Sports Complex

FOUNDATION PLAN CONT.

Date Issue Date

S-201

Scale 1/8" = 1'-0"

NOT FOR CONSTRUCTION

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Xcel Sports Complex
Jefferson, WI

Wall Sheathing Analysis

Ntrive Engineering

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JOB XCEL SPORTS COMPLEX NO. 20150104

SHEET NO. 201 OF

CALCULATED BY KZZ DATE 6/16/15

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DESCRIPTION PARAPET PANEL ANALYSIS

CHECK LIGHT GAGE CHANNELS SPANNING BETWEEN HORIZONTAL GIRTS @ WALL:

CHECK STRENGTH:

p=27.6 PSF

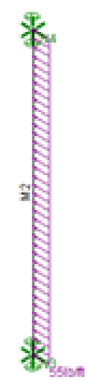
SPAN=4'-0"

w=27.6 PSF*2'=55 PLF

Member Cold Formed Steel Code Checks

Hot Rolled Steel | Cold Formed Steel | Wood | Aluminum | Concrete

	L...	Member	Shape	UC Max	Loc[in]	Shear ...	Loc[in]	D...	Pn/Om...	Tn/Om...	Mnyy/O...	Mnzz/O...	Cb	C...	C...	Eqn
1	1	M2	250S125-33	.496	24	.087	48	y	3.201	5.272	.075	.222	1.136	.6	.85	C5.2.1-2



Mact=WL^2/8=55*4^2/8=110 FT*LB

Mall=222 FT*LB (FROM RISA OUTPUT)

Mall > Mact, **OK**

CHECK DEFLECTION:

Δ_{ALL}=L/240=48/240=0.2"

Δ=0.06" (FROM RISA OUTPUT)

$\Delta < \Delta_{ALL}$, **OK**

PROVIDE 250S125-33 @ 24" OC W/ MAX SPAN=48"

CHECK PLYWOOD SPANNING BETWEEN VERTICAL LT GAGE GIRTS:

CHECK STRENGTH:

p=-27.6 PSF

SPAN=2'-0"

p_{ALLOW}=73 PSF (PER PLYWOOD DESIGN SPEC PS-1 LOAD TABLES)

SPAN ADJUSTMENT FACTOR=1.0

LOAD DURATION ADJUSTMENT FACTOR=1.6

MOISTURE ADJUSTMENT FACTOR=1.0

p'ALLOW=73*1.0*1.6*1.0=116.8 PSF > 27.6 PSF, **OK**

PROVIDE 32/16 PLYWOOD TO SPAN 2'-0"

CHECK DEFLECTION (L/240):

p_{ALLOW}=80 PSF (PER PLYWOOD DESIGN SPEC PS-1 LOAD TABLES)

SPAN ADJUSTMENT FACTOR=1.0

LOAD DURATION ADJUSTMENT FACTOR=1.0

MOISTURE ADJUSTMENT FACTOR=1.0

p'ALLOW=80*1.0*1.0*1.0=80 PSF > 27.6 PSF, **OK**

NTRIVE
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JOB XCEL SPORTS COMPLEX NO. 20150104

SHEET NO. 202 OF

CALCULATED BY KZZ DATE 6/16/15

CHECKED BY DATE

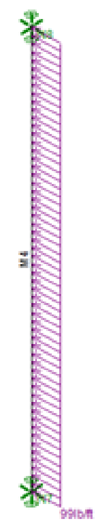
DESCRIPTION PARAPET PANEL ANALYSIS

CHECK LIGHT GAGE CHANNELS SPANNING BETWEEN HORIZONTAL GIRTS @ PARAPET:
CHECK STRENGTH:
p=49.4 PSF
SPAN=4'-0"
w=49.4 PSF*2'=99 PLF

Member Cold Formed Steel Code Checks

Hot Rolled Steel | Cold Formed Steel | Wood | Aluminum | Concrete

	L...	Member	Shape	UC Max	Loc[in]	Shear ...	Loc[in]	D.	Pn/Om...	Tn/Om...	Mnyy/O...	Mnzz/O...	Cb	C...	C...	Eqn
1	1	M4	250S125-33	.893	24	.157	0	y	3.201	5.272	.075	.222	1.136	.6	.85	C5.2.1-2



Mact=WL^2/8=99*4^2/8=198 FT*LB
Mall=222 FT*LB (FROM RISA OUTPUT)
Mall > Mact, **OK**

CHECK DEFLECTION:
Δ_{ALL}=L/240=48/240=0.2"
Δ=0.108" (FROM RISA OUTPUT)
$\Delta < \Delta_{ALL}$, **OK**
PROVIDE 250S125-33 @ 24" OC W/ MAX SPAN=48"

CHECK PLYWOOD SPANNING BETWEEN VERTICAL LT GAGE GIRTS:
CHECK STRENGTH:
p=-49.4 PSF
SPAN=2'-0"
p_{ALLOW}=73 PSF (PER PLYWOOD DESIGN SPEC PS-1 LOAD TABLES)
SPAN ADJUSTMENT FACTOR=1.0
LOAD DURATION ADJUSTMENT FACTOR=1.6
MOISTURE ADJUSTMENT FACTOR=1.0
p'ALLOW=73*1.0*1.6*1.0=116.8 PSF > 49.4 PSF, **OK**
PROVIDE 32/16 PLYWOOD TO SPAN 2'-0"

CHECK DEFLECTION (L/240):
p_{ALLOW}=80 PSF (PER PLYWOOD DESIGN SPEC PS-1 LOAD TABLES)
SPAN ADJUSTMENT FACTOR=1.0
LOAD DURATION ADJUSTMENT FACTOR=1.0
MOISTURE ADJUSTMENT FACTOR=1.0
p'ALLOW=80*1.0*1.0*1.0=80 PSF > 49.4 PSF, **OK**

Xcel Sports Complex
Jefferson, WI

Anchor Bolt Analysis

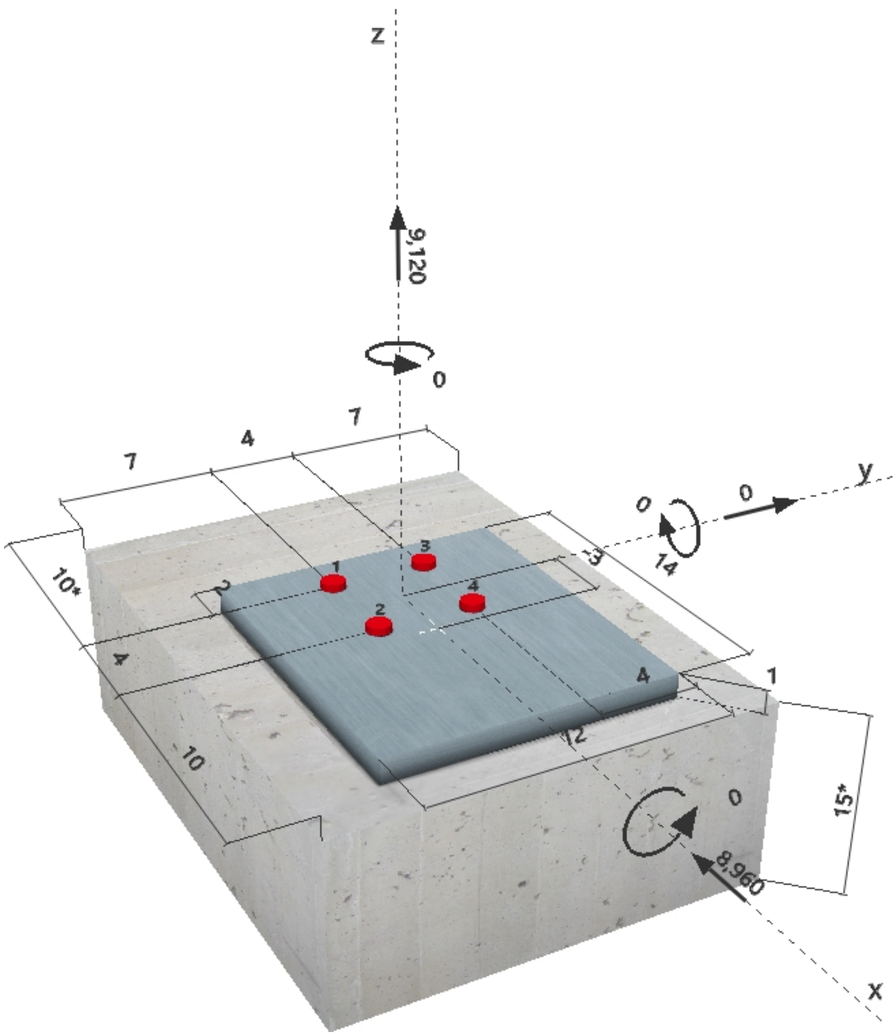
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-A, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 1.000 in.
Anchor plate:	l_x x l_y x t = 14.000 in. x 12.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 15.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

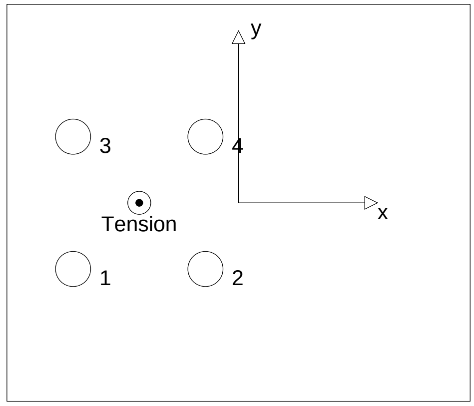
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2280	2240	-2240	0
2	2280	2240	-2240	0
3	2280	2240	-2240	0
4	2280	2240	-2240	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-3.000/0.000): 9120 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2280	26361	9	OK
Pullout Strength*	2280	36472	7	OK
Concrete Breakout Strength**	9120	22469	41	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

N_{sa} [lb]
35148

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
35148	0.750	26361	2280

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	1.16	4000

Calculations

N_p [lb]
37216

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
52102	0.700	36472	2280

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	7.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
432.00	400.00	1.000	1.000	0.910	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
32098	0.700	22469	9120

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2240	13708	17	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8960	44937	20	OK
Concrete edge failure in direction x-**	8960	11230	80	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

V_{sa} [lb]
21089

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
21089	0.650	13708	2240

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	7.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
432.00	400.00	1.000	1.000	0.910	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
64196	0.700	44937	8960

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
10.000	7.000	0.000	1.400	15.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
8.000	1.000	1.000	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
270.00	450.00	1.000	0.840	1.000	21220

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
14973	0.750	11230	8960

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.406	0.798	5/3	91	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

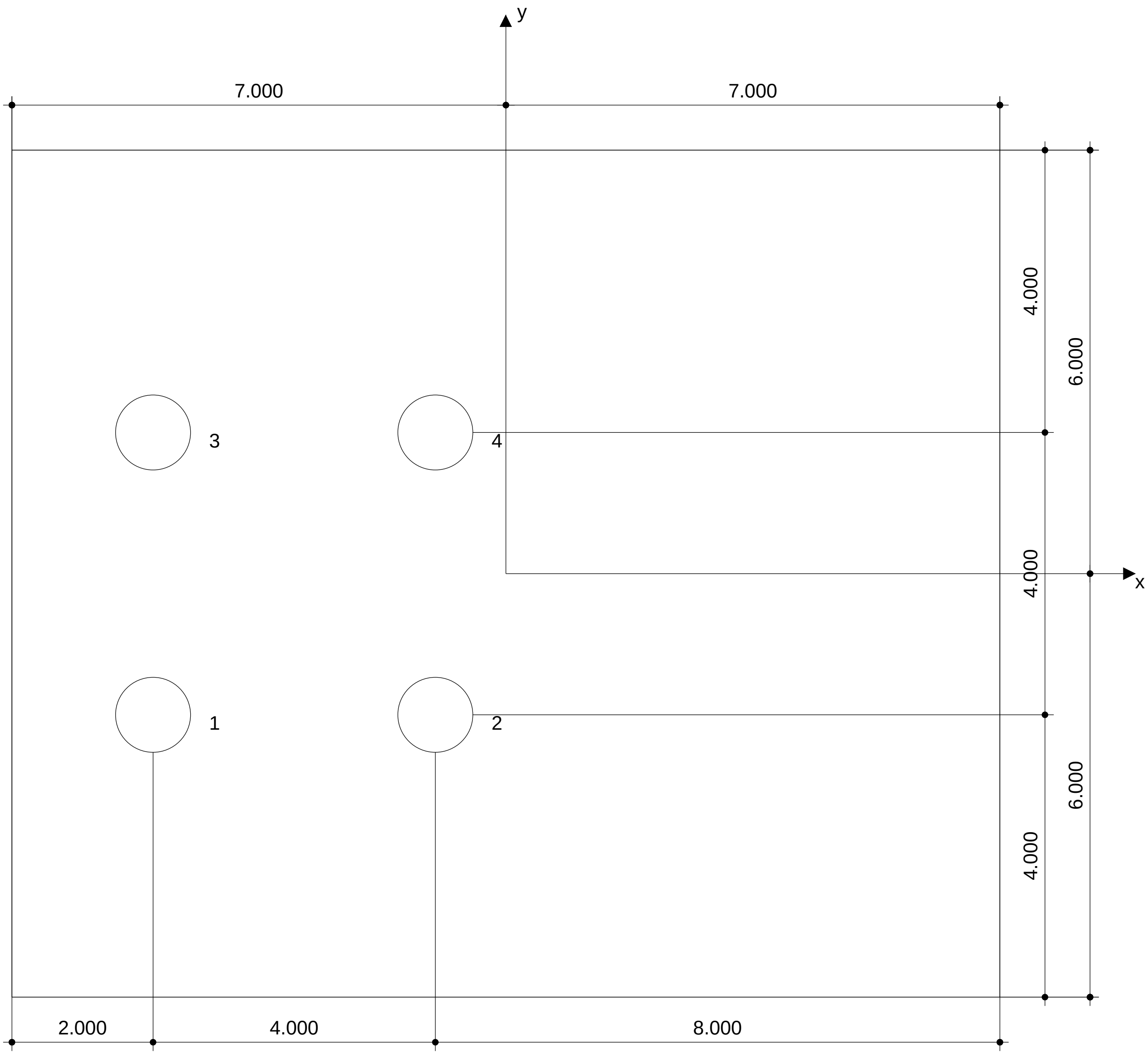
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 1.000 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 12.000 in.
Minimum thickness of the base material: 14.172 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-5.000	-2.000	10.000	14.000	7.000	11.000
2	-1.000	-2.000	14.000	10.000	7.000	11.000
3	-5.000	2.000	10.000	14.000	11.000	7.000
4	-1.000	2.000	14.000	10.000	11.000	7.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

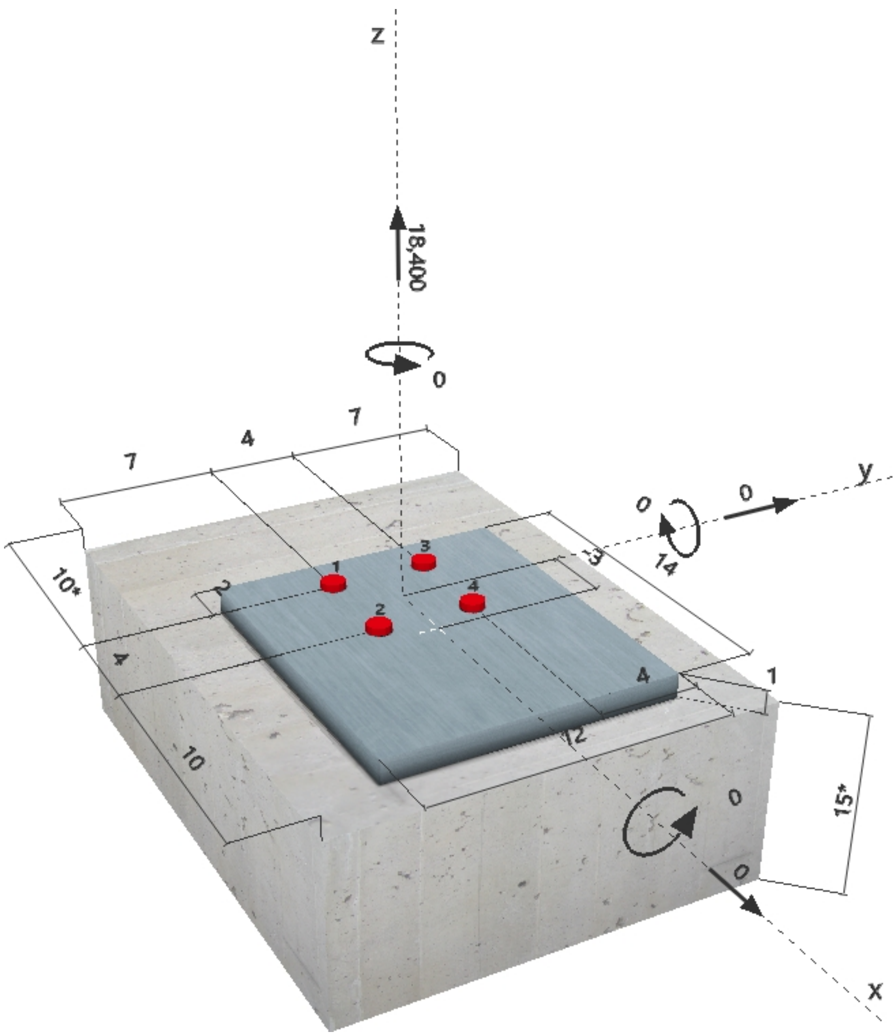
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-A, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 1.000 in.
Anchor plate:	l_x x l_y x t = 14.000 in. x 12.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 15.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

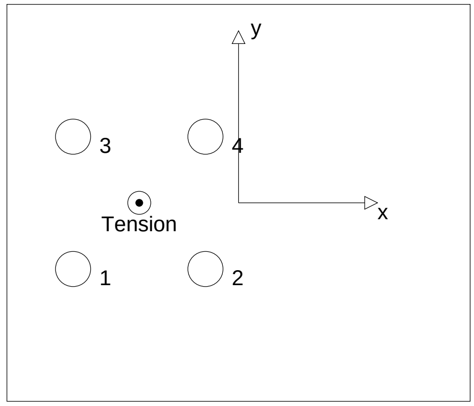
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	4600	0	0	0
2	4600	0	0	0
3	4600	0	0	0
4	4600	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-3.000/0.000): 18400 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	4600	26361	18	OK
Pullout Strength*	4600	36472	13	OK
Concrete Breakout Strength**	18400	22469	82	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\ A_{se,N}\ f_{uta}$ ACI 318-08 Eq. (D-3)

$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

N_{sa} [lb]
35148

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
35148	0.750	26361	4600

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\ N_p$ ACI 318-08 Eq. (D-14)

$N_p = 8\ A_{brg}\ f'_c$ ACI 318-08 Eq. (D-15)

$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	1.16	4000

Calculations

N_p [lb]
37216

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
52102	0.700	36472	4600

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	7.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
432.00	400.00	1.000	1.000	0.910	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
32098	0.700	22469	18400

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

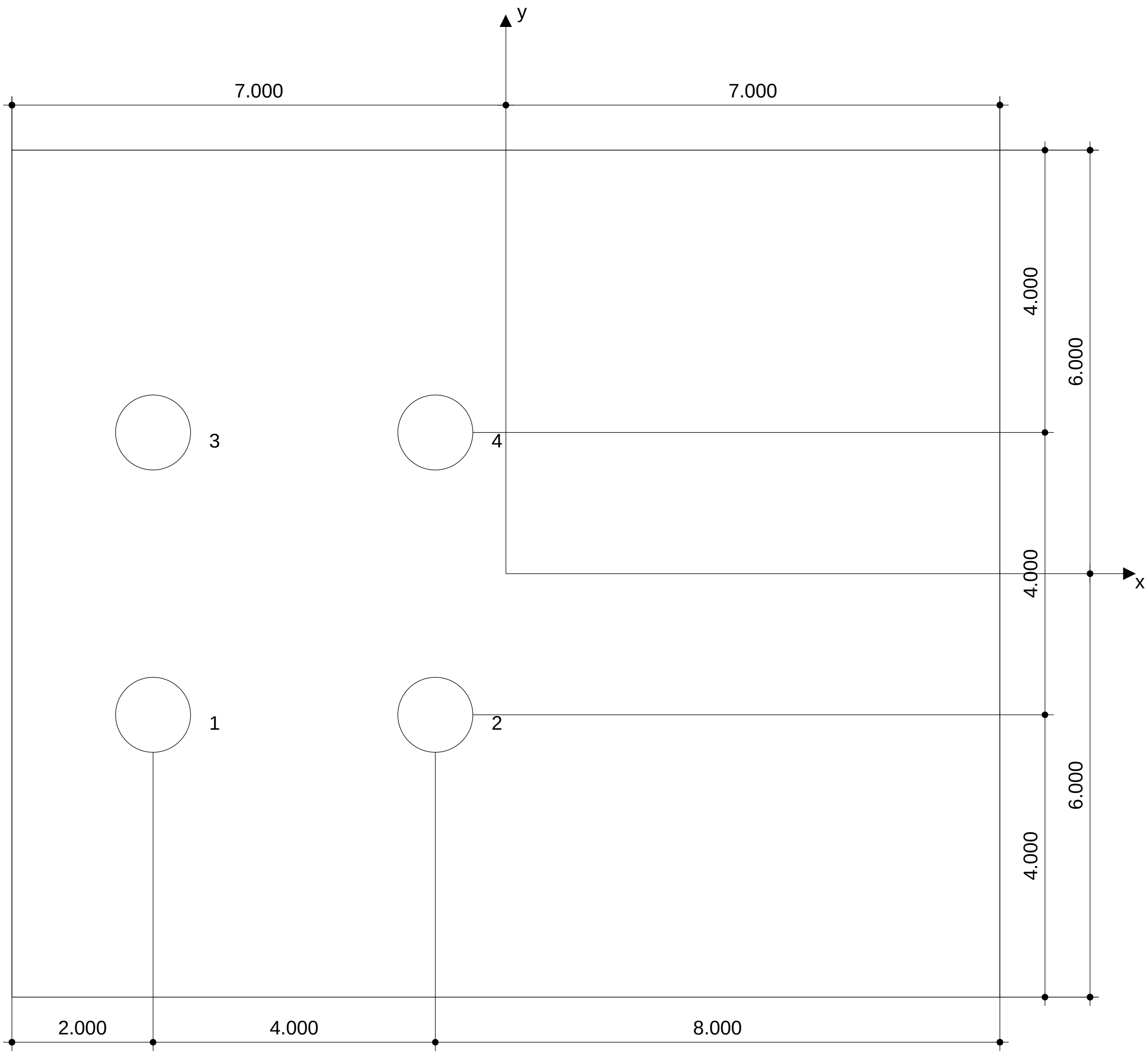
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 1.000 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 12.000 in.
Minimum thickness of the base material: 14.172 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-5.000	-2.000	10.000	14.000	7.000	11.000
2	-1.000	-2.000	14.000	10.000	7.000	11.000
3	-5.000	2.000	10.000	14.000	11.000	7.000
4	-1.000	2.000	14.000	10.000	11.000	7.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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- 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.

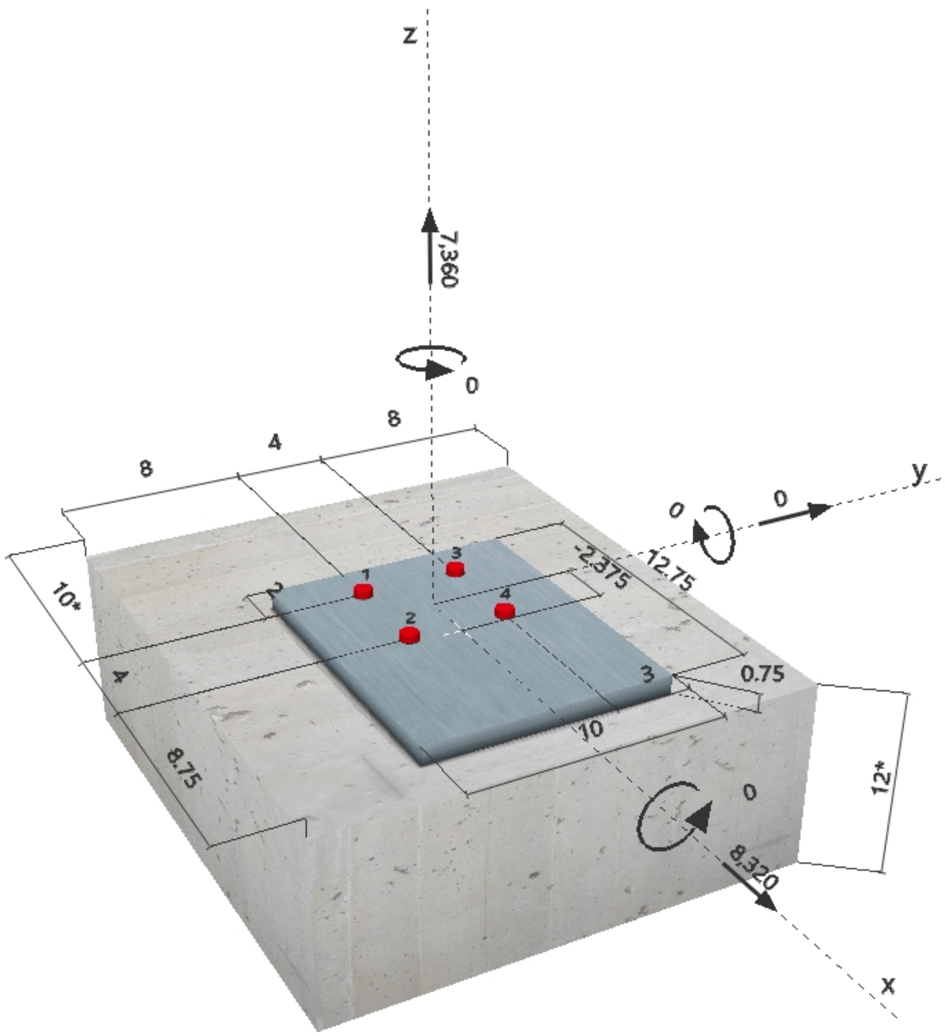
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-B, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 10.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

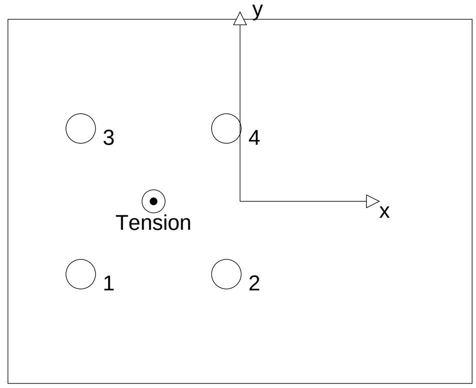
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1840	2080	2080	0
2	1840	2080	2080	0
3	1840	2080	2080	0
4	1840	2080	2080	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 7360 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1840	14529	13	OK
Pullout Strength*	1840	20509	9	OK
Concrete Breakout Strength**	7360	24445	31	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)

$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	1840

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)

$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)

$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	1840

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
455.00	400.00	1.000	1.000	0.940	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
34921	0.700	24445	7360

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2080	7555	28	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8320	48890	18	OK
Concrete edge failure in direction x+**	8320	10355	81	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	2080

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
455.00	400.00	1.000	1.000	0.940	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
69843	0.700	48890	8320

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	8.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
240.00	288.00	1.000	0.900	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
13807	0.750	10355	8320

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.301	0.803	5/3	83	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

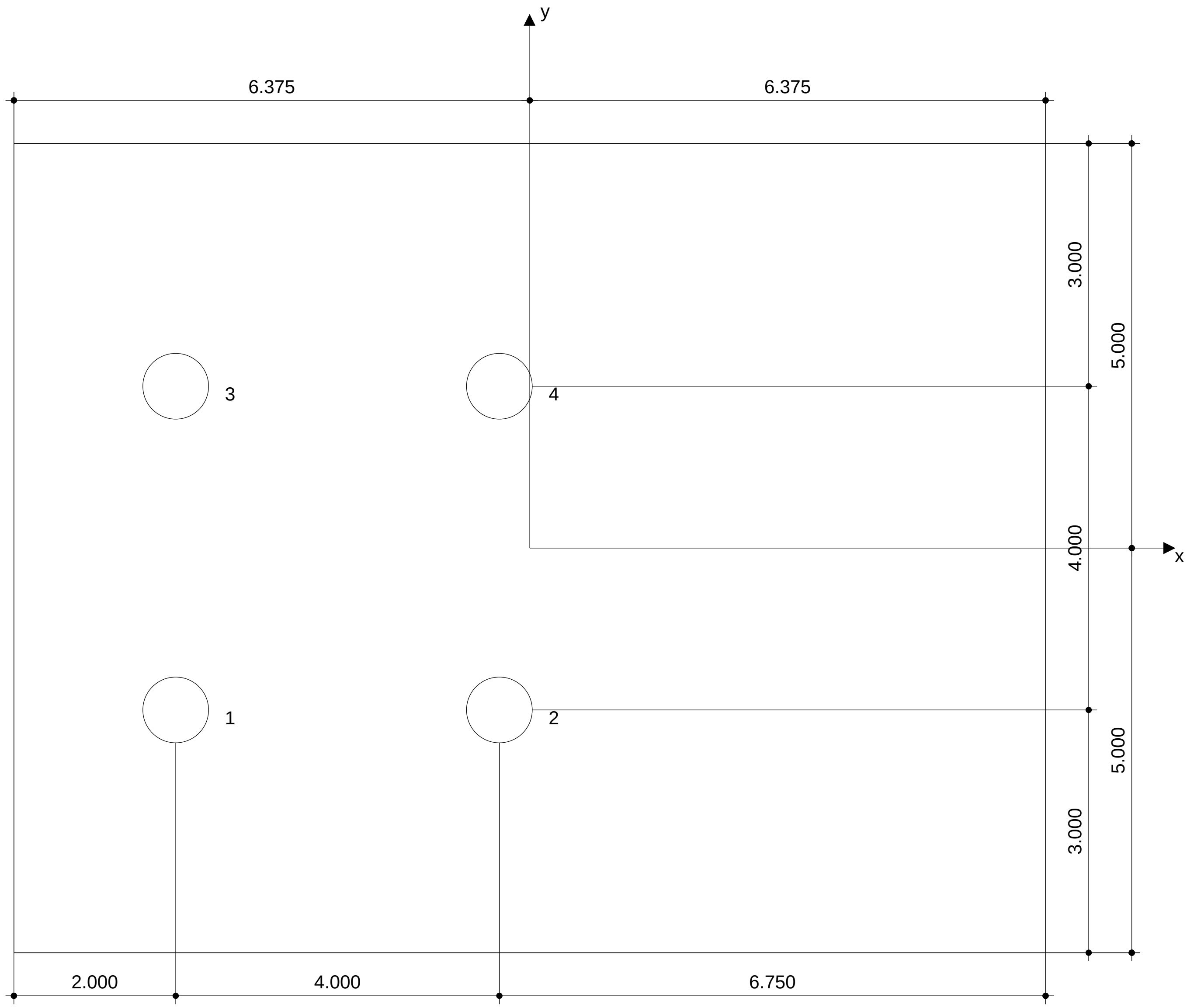
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	8.000	12.000
2	-0.375	-2.000	14.000	8.750	8.000	12.000
3	-4.375	2.000	10.000	12.750	12.000	8.000
4	-0.375	2.000	14.000	8.750	12.000	8.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

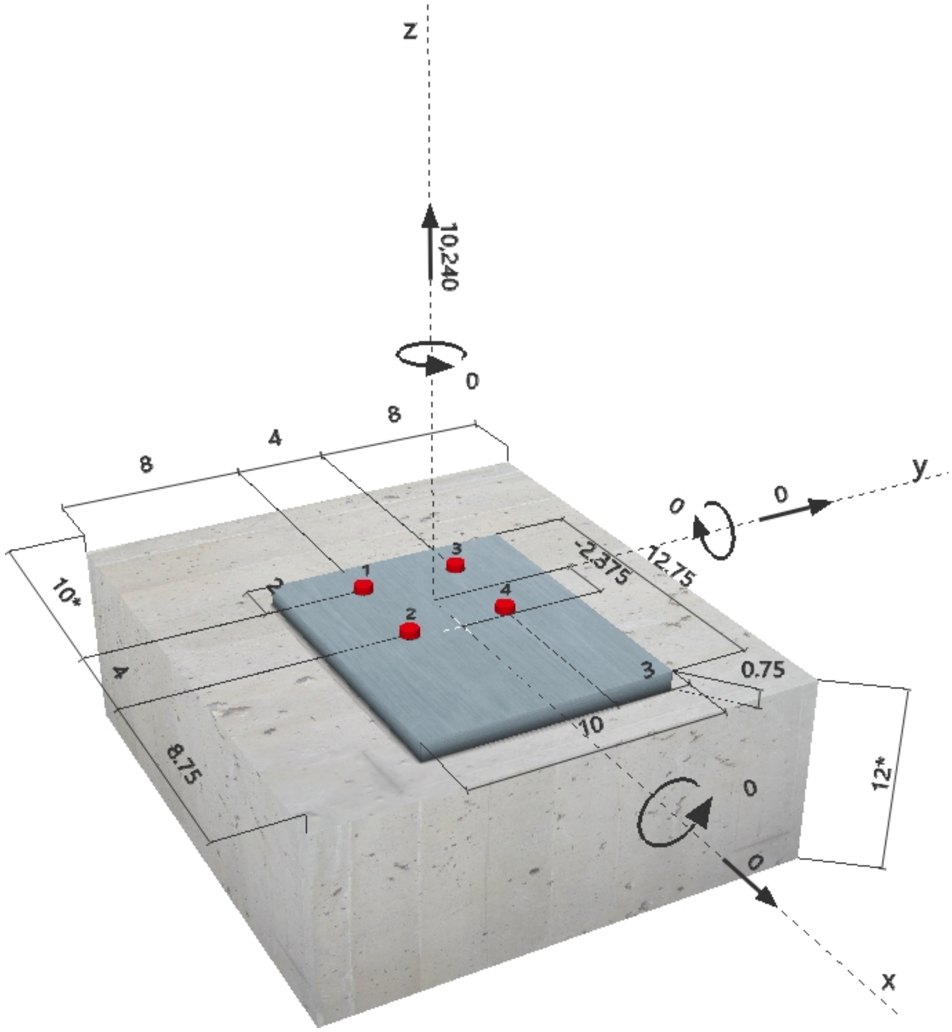
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-B, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 10.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

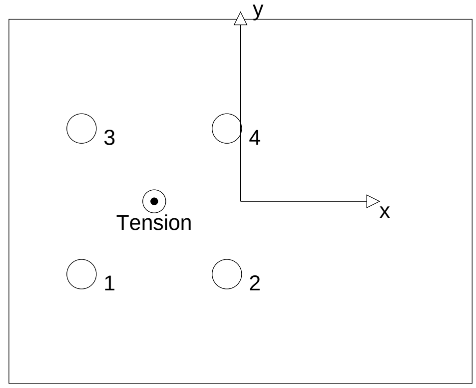
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	2560	0	0	0
2	2560	0	0	0
3	2560	0	0	0
4	2560	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 10240 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2560	14529	18	OK
Pullout Strength*	2560	20509	13	OK
Concrete Breakout Strength**	10240	24445	42	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	2560

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	2560

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
455.00	400.00	1.000	1.000	0.940	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
34921	0.700	24445	10240

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

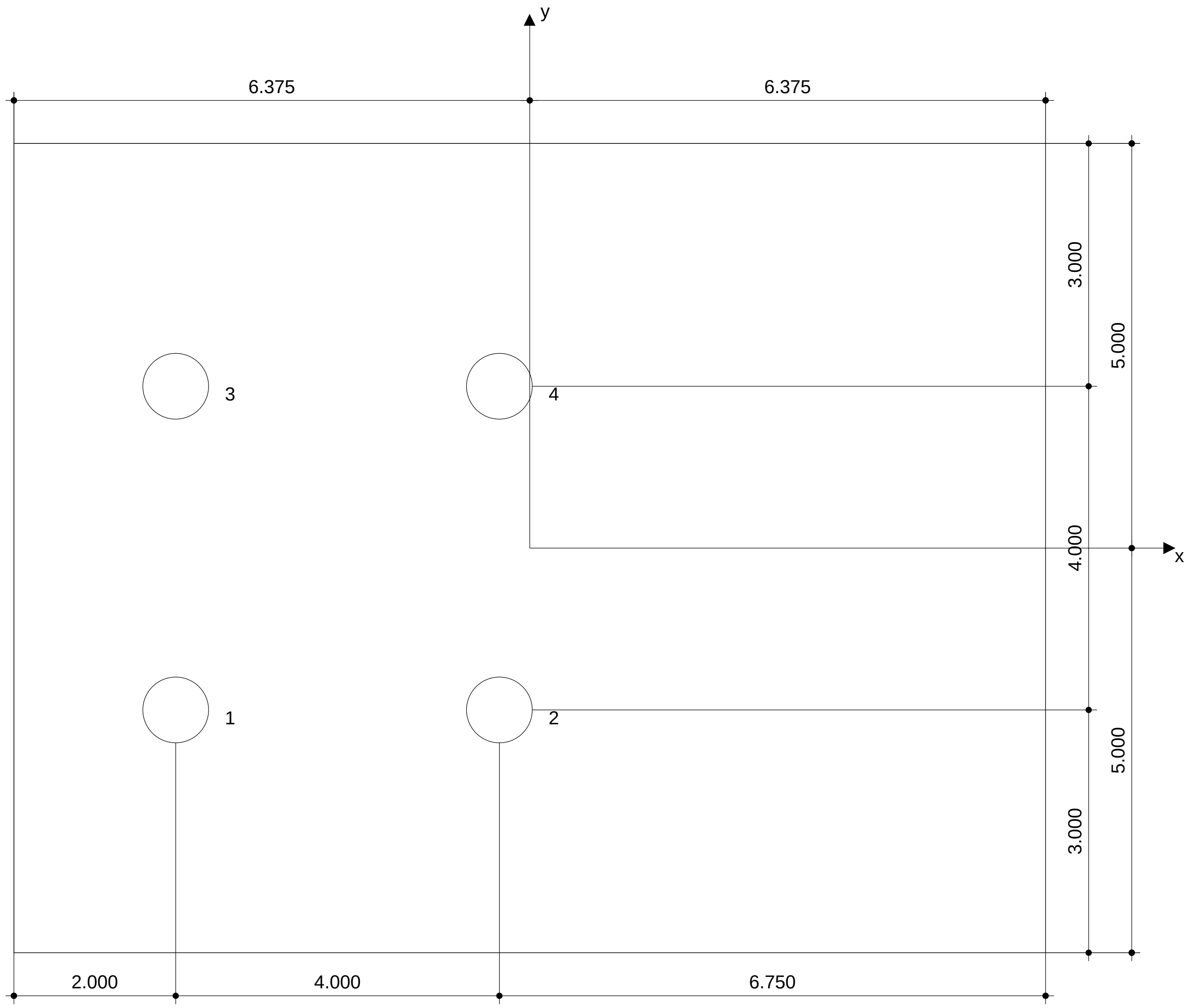
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	8.000	12.000
2	-0.375	-2.000	14.000	8.750	8.000	12.000
3	-4.375	2.000	10.000	12.750	12.000	8.000
4	-0.375	2.000	14.000	8.750	12.000	8.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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- 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.

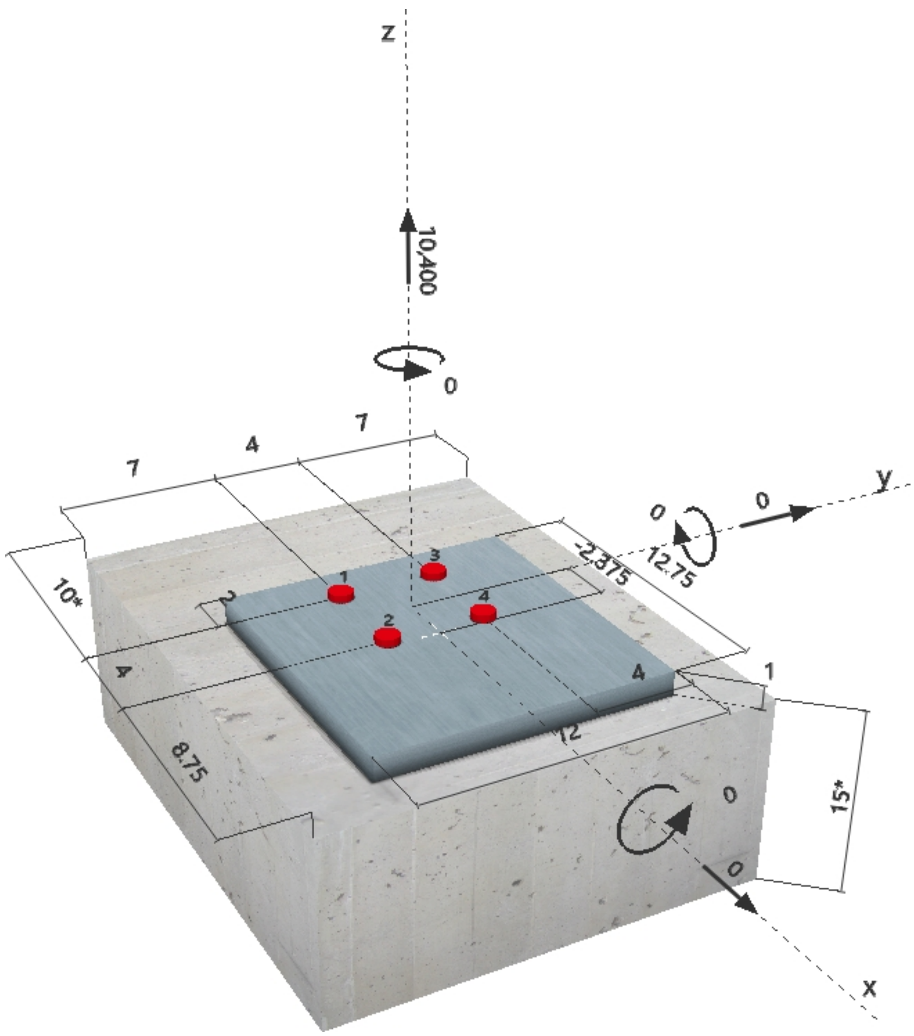
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-C, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 1.000 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 12.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 15.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

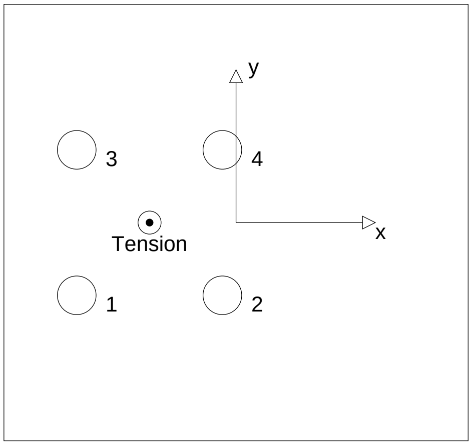
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2600	0	0	0
2	2600	0	0	0
3	2600	0	0	0
4	2600	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 10400 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2600	26361	10	OK
Pullout Strength*	2600	36472	8	OK
Concrete Breakout Strength**	10400	21298	49	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

N_{sa} [lb]
35148

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
35148	0.750	26361	2600

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	1.16	4000

Calculations

N_p [lb]
37216

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
52102	0.700	36472	2600

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e'_N}{3\, h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f'_c}\, h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	7.000	1.250

c_{ac} [in.]	k_c	λ	f'_c [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
409.50	400.00	1.000	1.000	0.910	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
30426	0.700	21298	10400

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

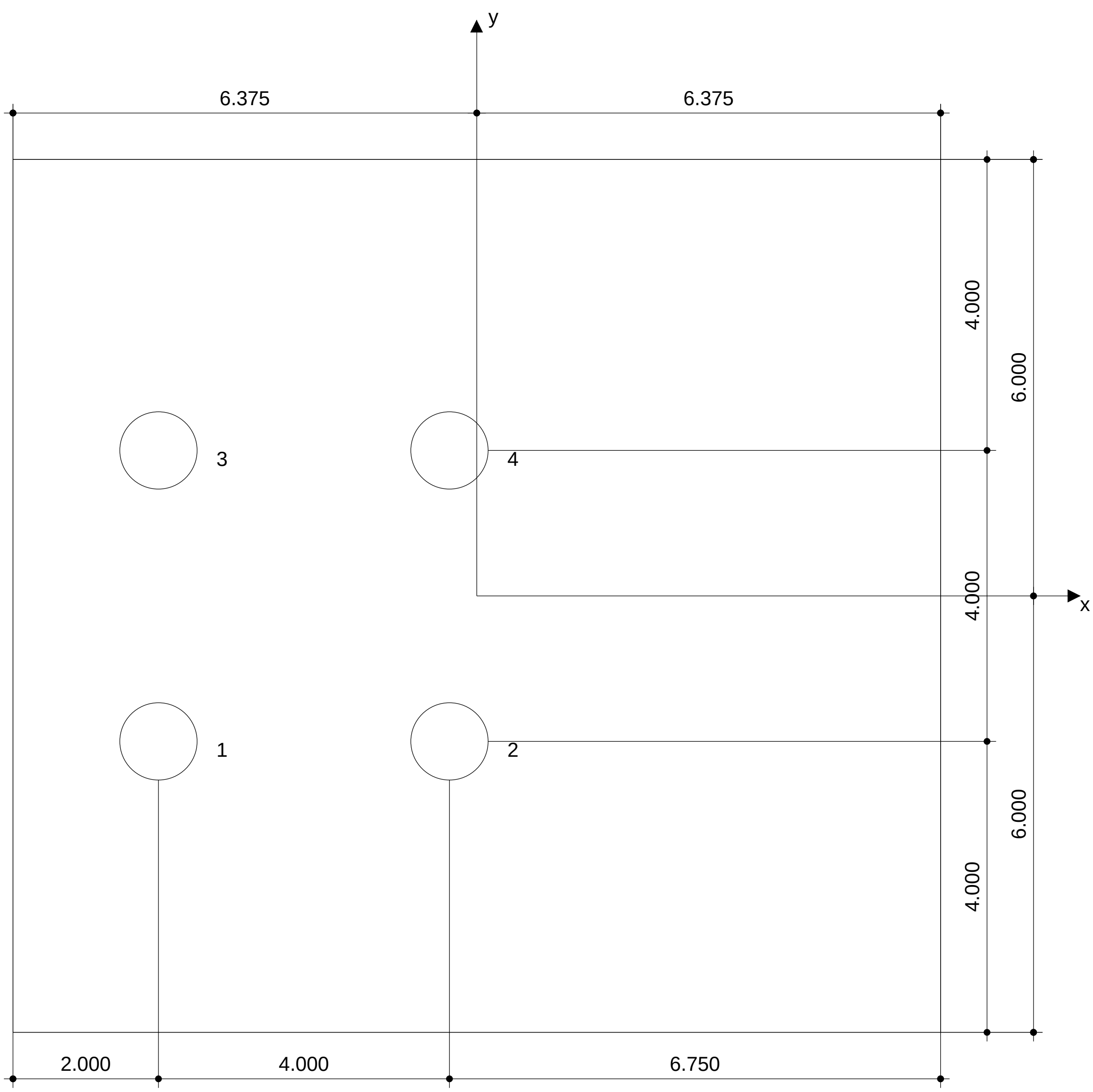
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 1.000 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 12.000 in.
Minimum thickness of the base material: 14.172 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	7.000	11.000
2	-0.375	-2.000	14.000	8.750	7.000	11.000
3	-4.375	2.000	10.000	12.750	11.000	7.000
4	-0.375	2.000	14.000	8.750	11.000	7.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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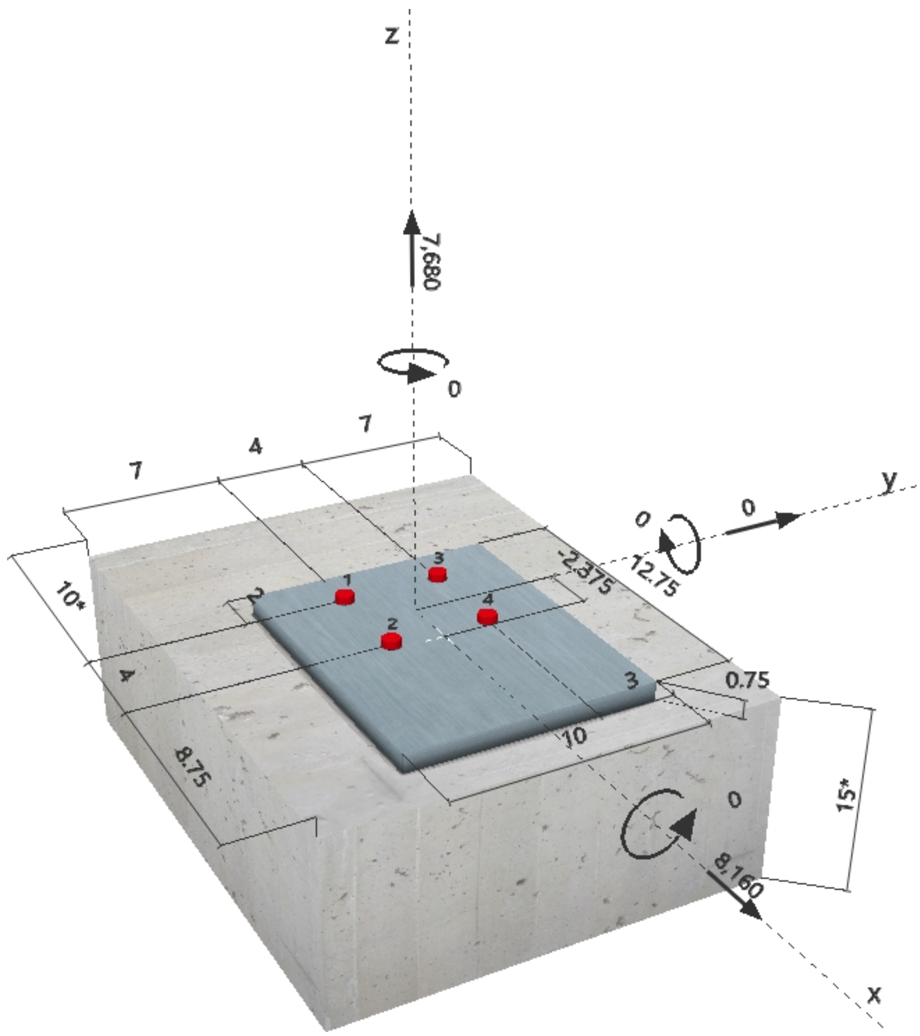
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-C, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 10.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 15.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

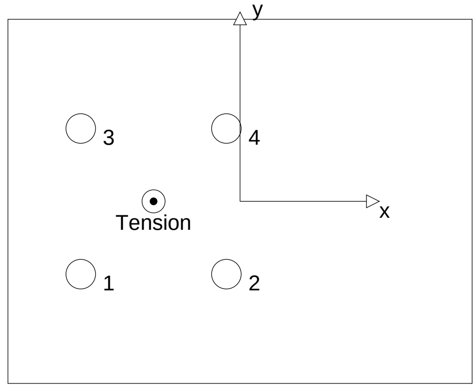
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1920	2040	2040	0
2	1920	2040	2040	0
3	1920	2040	2040	0
4	1920	2040	2040	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 7680 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	**Capacity ϕN_n [lb]**	**Utilization $\beta_N = N_{ua}/\phi N_n$**	**Status**
Steel Strength*	1920	14529	14	OK
Pullout Strength*	1920	20509	10	OK
Concrete Breakout Strength**	7680	21298	37	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	1920

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	1920

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	7.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
409.50	400.00	1.000	1.000	0.910	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
30426	0.700	21298	7680

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2040	7555	28	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8160	42597	20	OK
Concrete edge failure in direction x+**	8160	9314	88	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	2040

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	7.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
409.50	400.00	1.000	1.000	0.910	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
60853	0.700	42597	8160

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.750	7.000	0.000	1.400	15.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
236.25	344.53	1.000	0.860	1.000	15041

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
12418	0.750	9314	8160

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.361	0.876	5/3	99	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

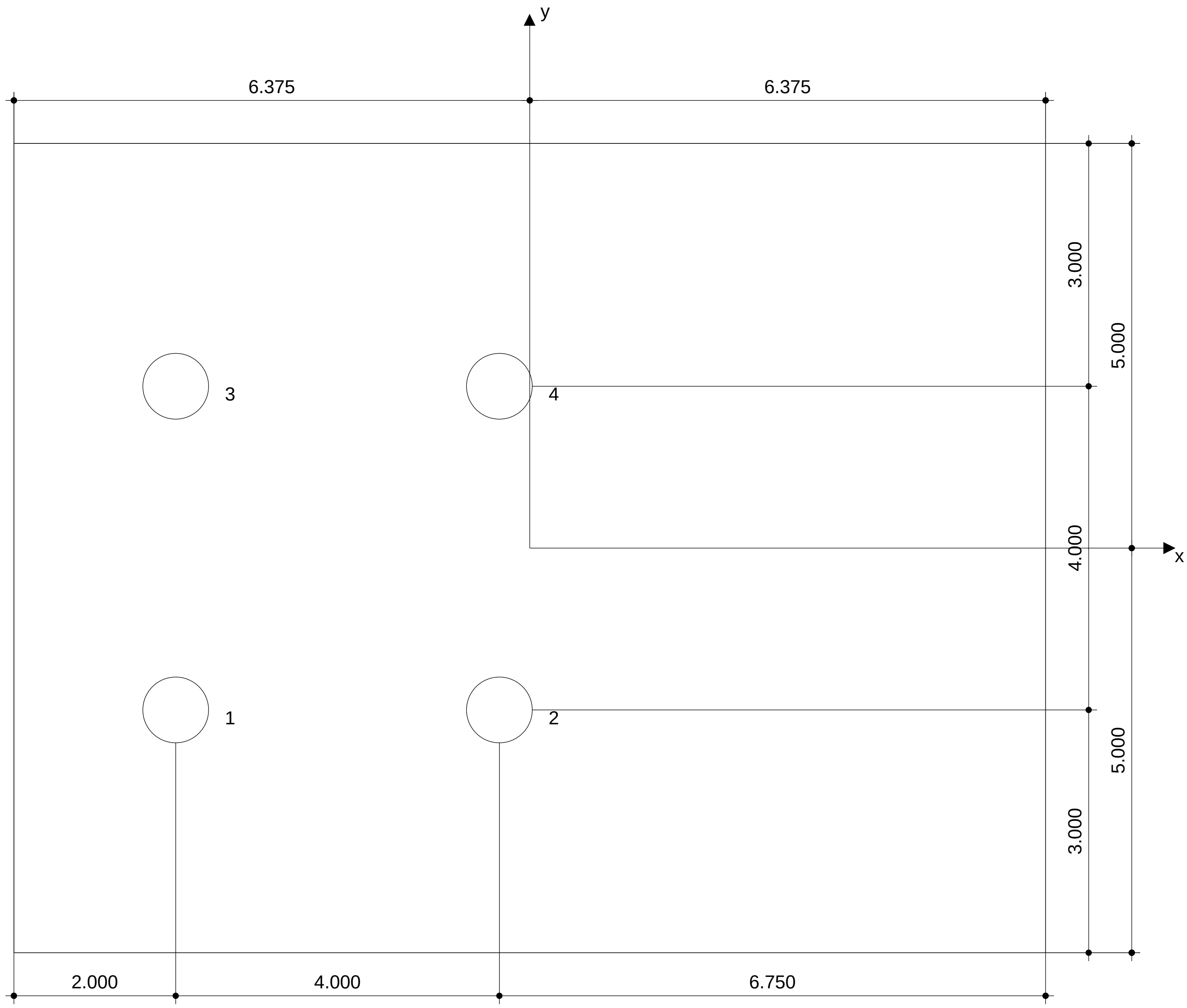
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 12.000 in.
Minimum thickness of the base material: 14.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	7.000	11.000
2	-0.375	-2.000	14.000	8.750	7.000	11.000
3	-4.375	2.000	10.000	12.750	11.000	7.000
4	-0.375	2.000	14.000	8.750	11.000	7.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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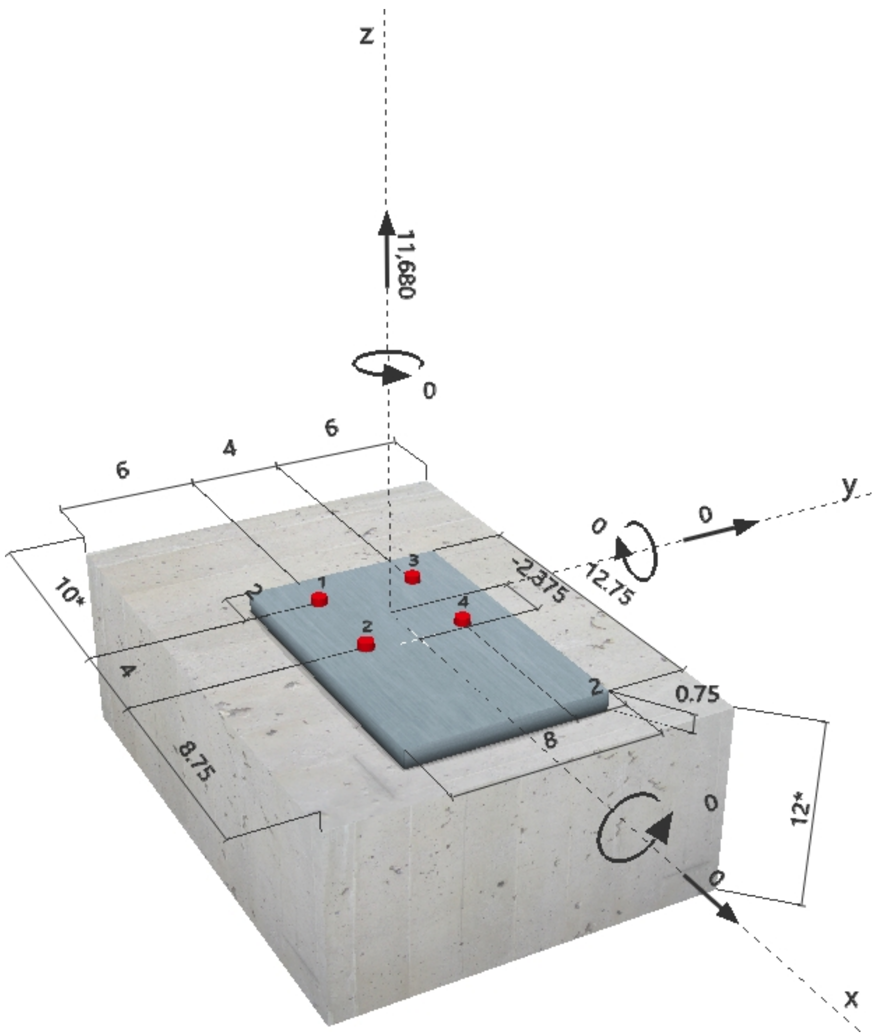
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-D, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 8.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

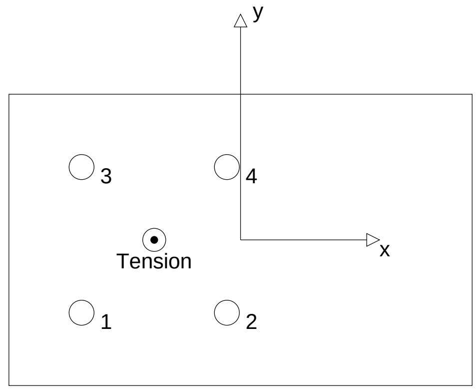
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	2920	0	0	0
2	2920	0	0	0
3	2920	0	0	0
4	2920	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 11680 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2920	9831	30	OK
Pullout Strength*	2920	14237	21	OK
Concrete Breakout Strength**	11680	18307	64	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	2920

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	2920

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	6.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
364.00	400.00	1.000	1.000	0.880	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
26153	0.700	18307	11680

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

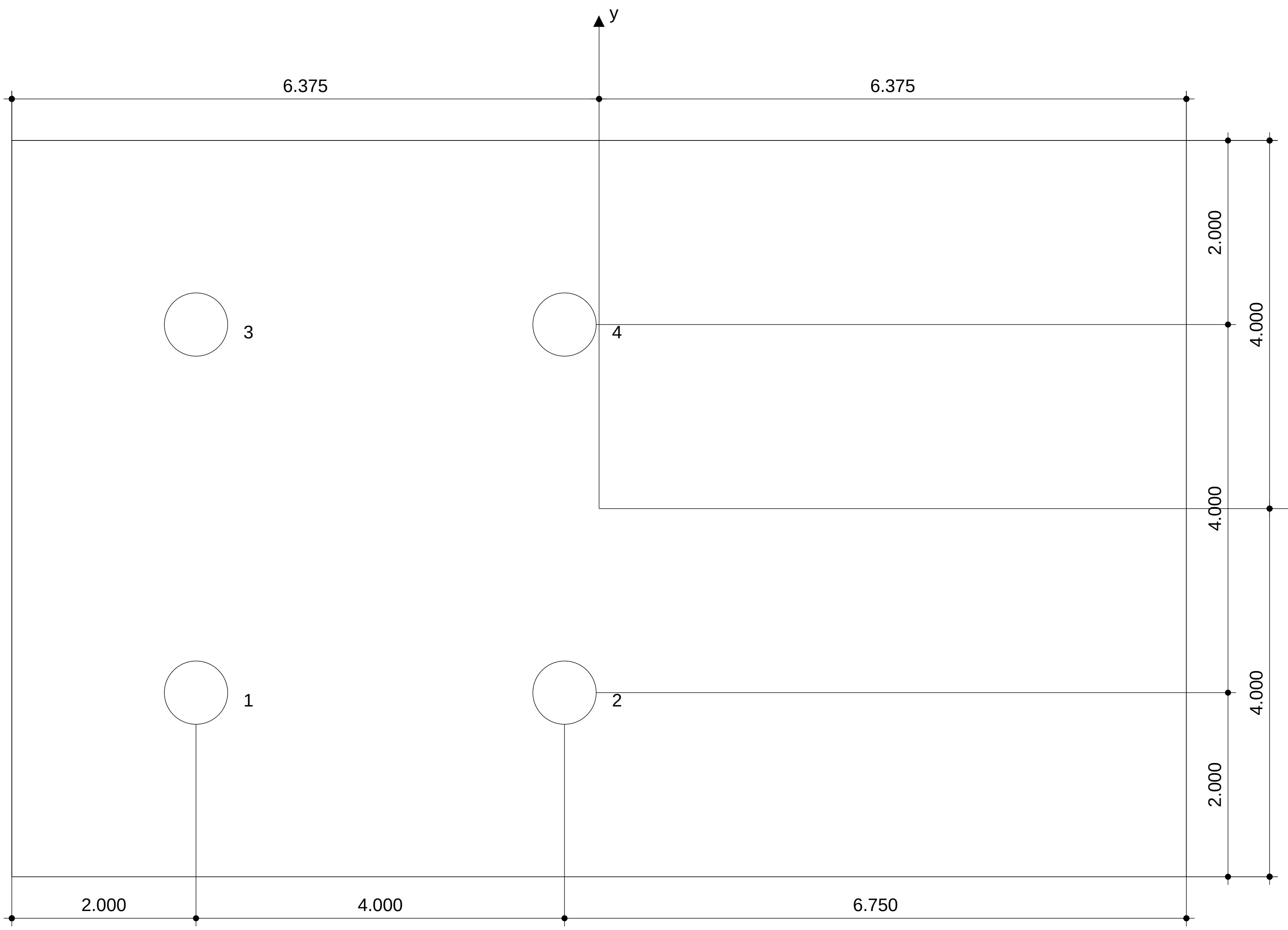
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 10.922 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	6.000	10.000
2	-0.375	-2.000	14.000	8.750	6.000	10.000
3	-4.375	2.000	10.000	12.750	10.000	6.000
4	-0.375	2.000	14.000	8.750	10.000	6.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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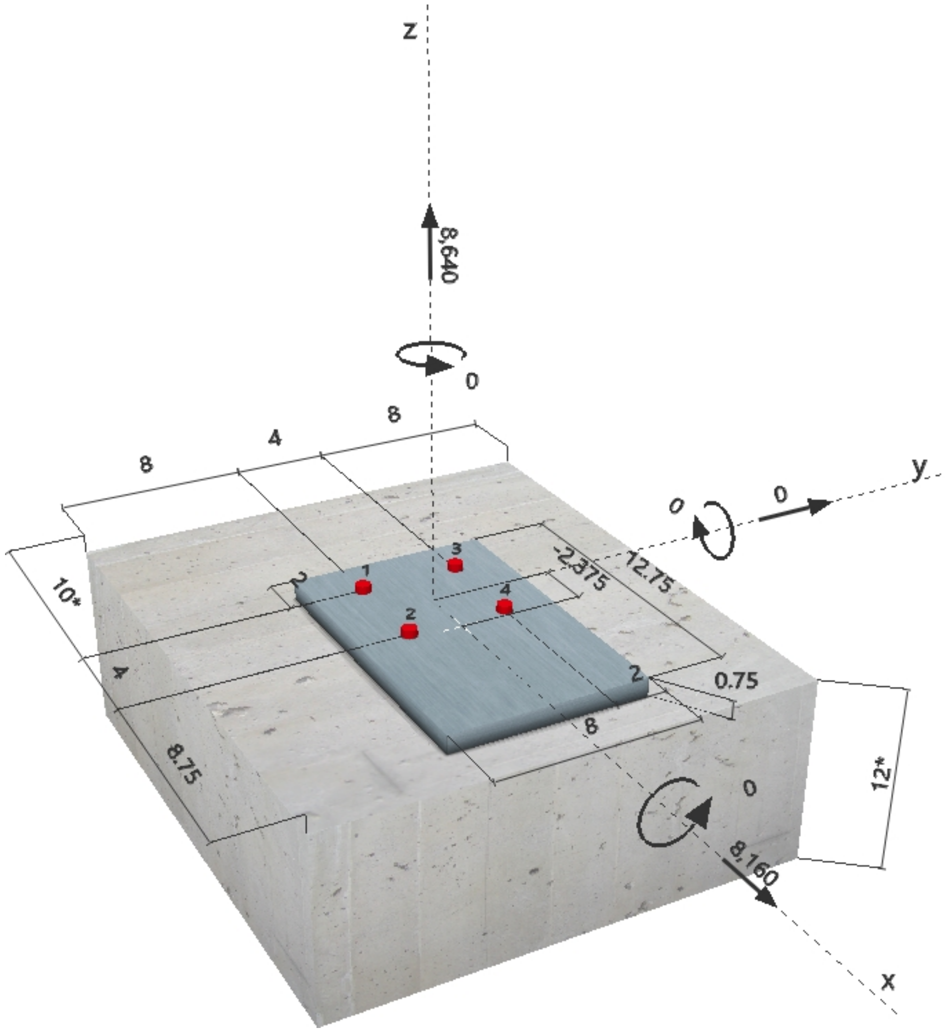
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-D, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 8.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

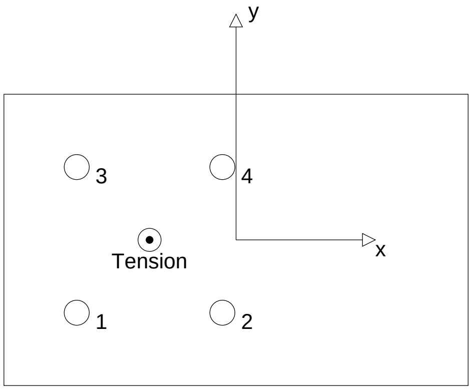
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	2160	2040	2040	0
2	2160	2040	2040	0
3	2160	2040	2040	0
4	2160	2040	2040	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 8640 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2160	9831	22	OK
Pullout Strength*	2160	14237	16	OK
Concrete Breakout Strength**	8640	24445	36	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	2160

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	2160

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
455.00	400.00	1.000	1.000	0.940	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
34921	0.700	24445	8640

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2040	5112	40	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8160	48890	17	OK
Concrete edge failure in direction x+**	8160	9453	87	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	2040

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
455.00	400.00	1.000	1.000	0.940	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
69843	0.700	48890	8160

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	8.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
240.00	288.00	1.000	0.900	1.000	12004

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
12604	0.750	9453	8160

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.353	0.863	5/3	96	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

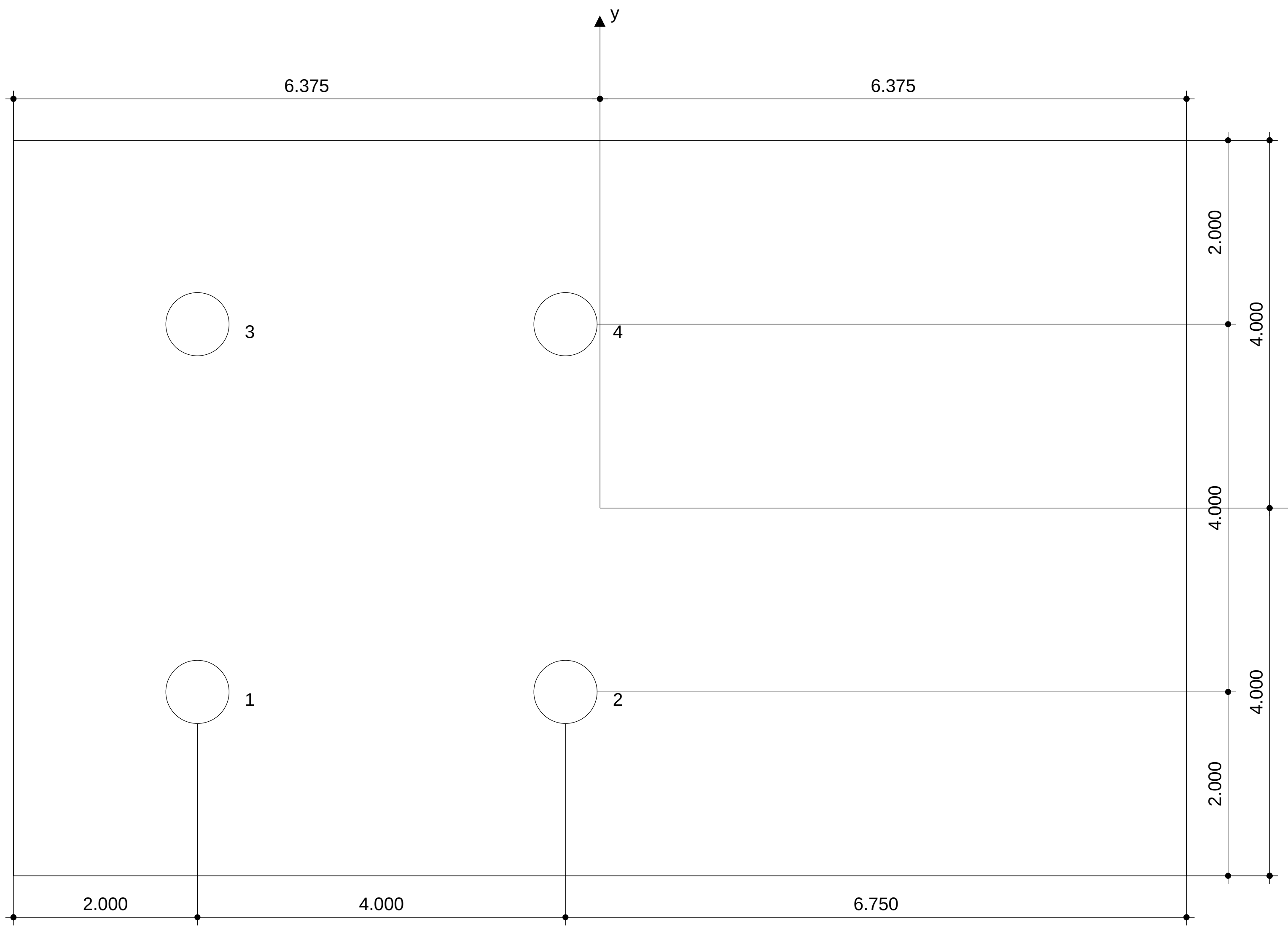
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	8.000	12.000
2	-0.375	-2.000	14.000	8.750	8.000	12.000
3	-4.375	2.000	10.000	12.750	12.000	8.000
4	-0.375	2.000	14.000	8.750	12.000	8.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

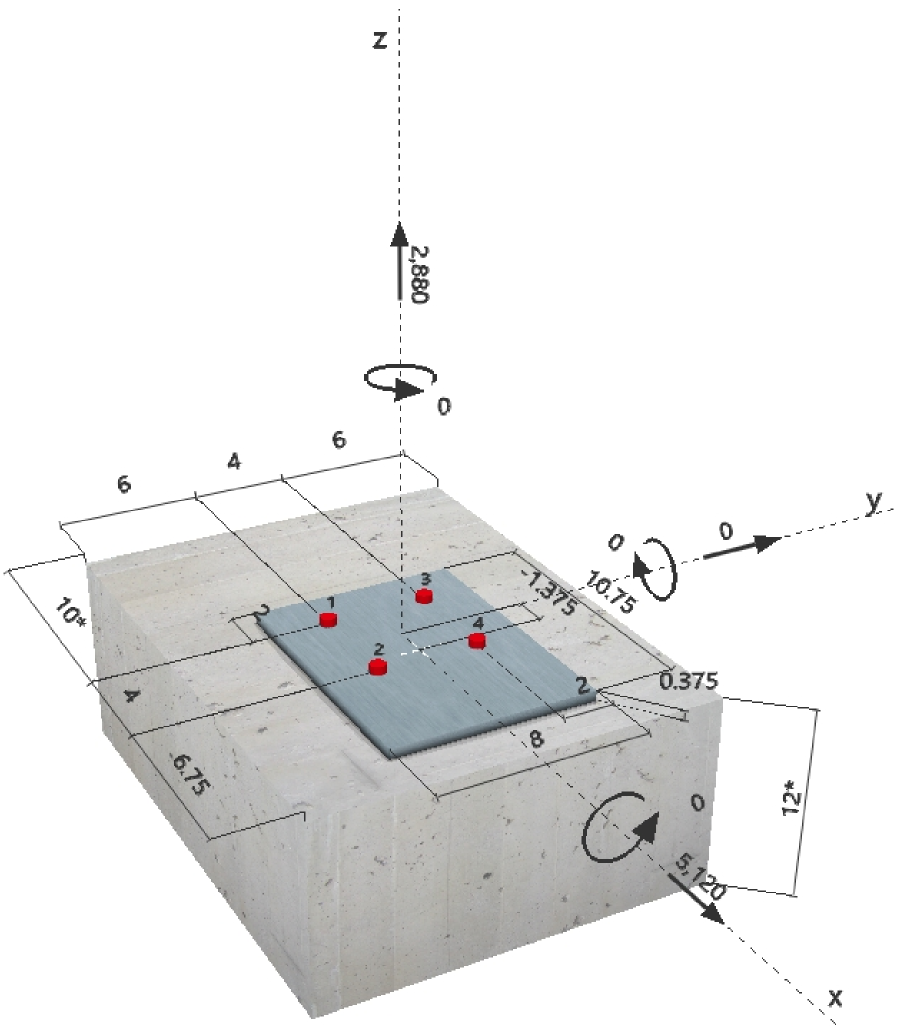
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-G

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 10.750 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

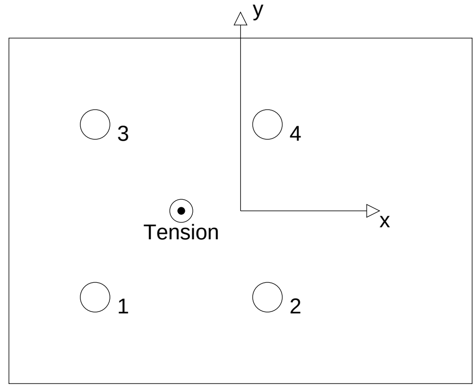
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	720	1280	1280	0
2	720	1280	1280	0
3	720	1280	1280	0
4	720	1280	1280	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-1.375/0.000): 2880 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	720	9831	8	OK
Pullout Strength*	720	14237	6	OK
Concrete Breakout Strength**	2880	16698	18	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	720

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	720

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	6.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
332.00	400.00	1.000	1.000	0.880	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
23854	0.700	16698	2880

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1280	5112	26	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	5120	33397	16	OK
Concrete edge failure in direction x+**	5120	6775	76	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	1280

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
332.00	400.00	1.000	1.000	0.880	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
47710	0.700	33397	5120

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ — ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ — ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ — ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
6.750	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
162.00	205.03	1.000	0.878	1.000	9303

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
9033	0.750	6775	5120

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.172	0.756	5/3	69	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

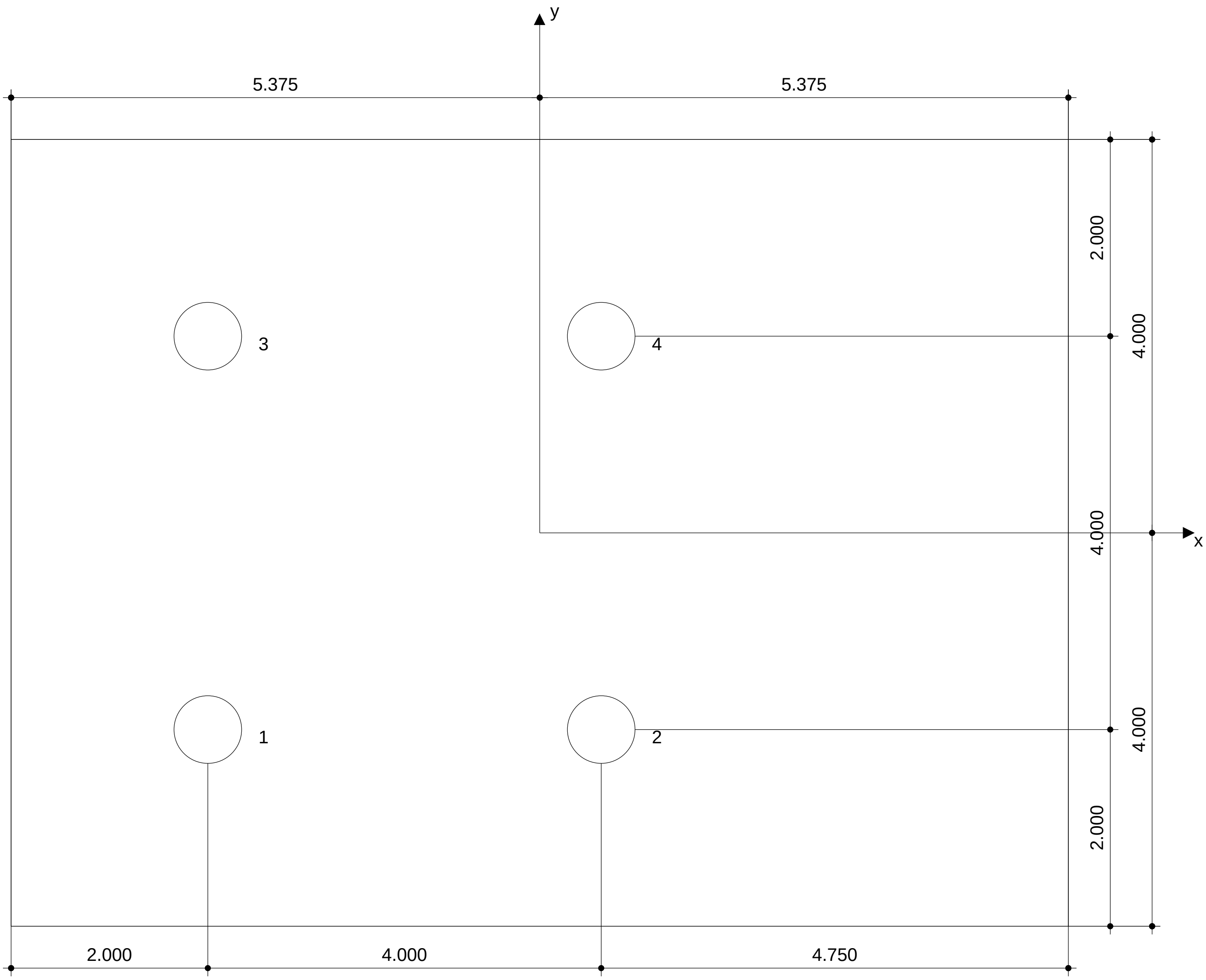
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-3.375	-2.000	10.000	10.750	6.000	10.000
2	0.625	-2.000	14.000	6.750	6.000	10.000
3	-3.375	2.000	10.000	10.750	10.000	6.000
4	0.625	2.000	14.000	6.750	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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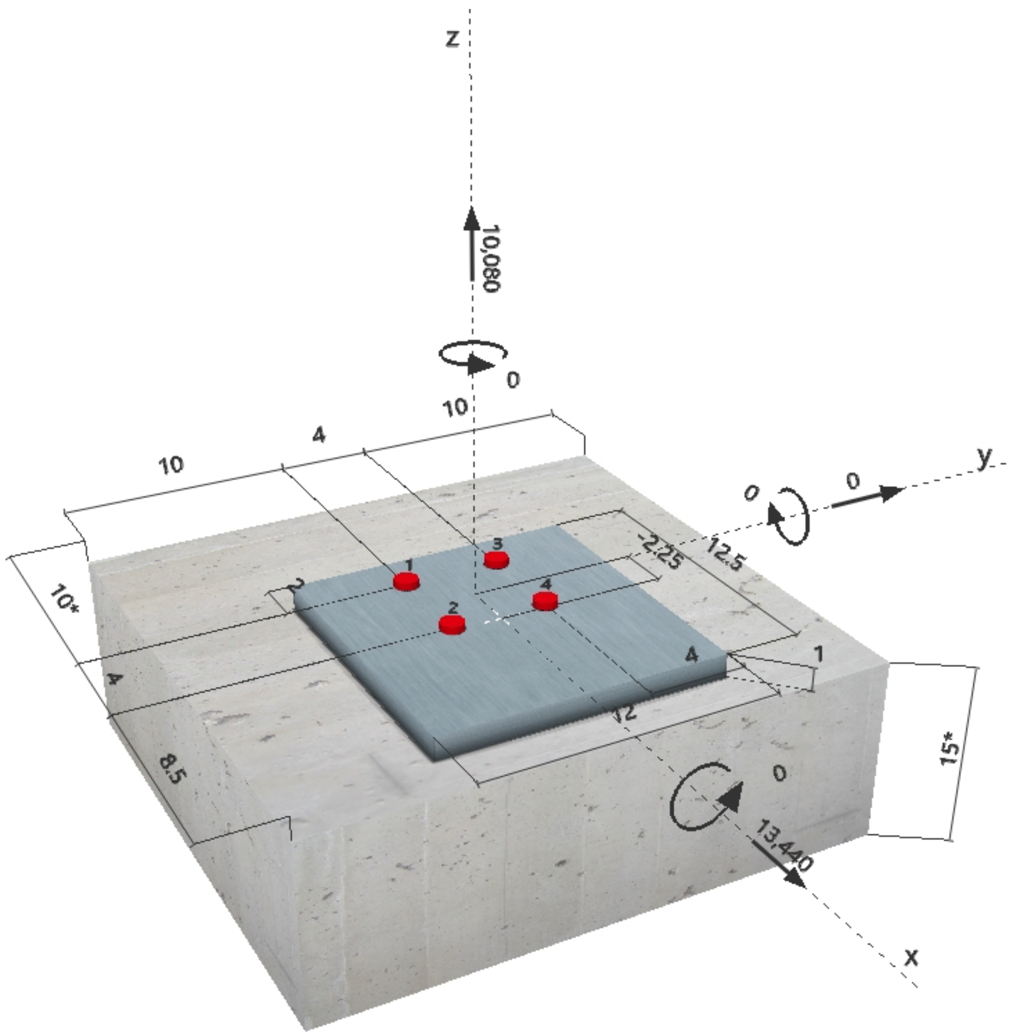
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-I, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 1.000 in.
Anchor plate:	l_x x l_y x t = 12.500 in. x 12.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 15.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

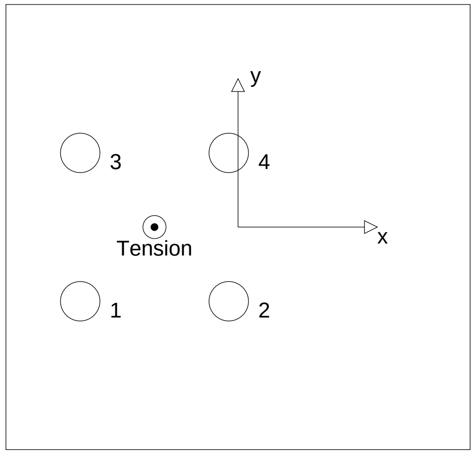
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2520	3360	3360	0
2	2520	3360	3360	0
3	2520	3360	3360	0
4	2520	3360	3360	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.250/0.000): 10080 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2520	26361	10	OK
Pullout Strength*	2520	36472	7	OK
Concrete Breakout Strength**	10080	29475	35	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\ A_{se,N}\ f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

N_{sa} [lb]
35148

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
35148	0.750	26361	2520

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\ N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\ A_{brg}\ f'_c$ ACI 318-08 Eq. (D-15)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	1.16	4000

Calculations

N_p [lb]
37216

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
52102	0.700	36472	2520

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.500	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
540.00	400.00	1.000	1.000	0.955	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
42107	0.700	29475	10080

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	3360	13708	25	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	13440	58949	23	OK
Concrete edge failure in direction x+**	13440	15370	88	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

V_{sa} [lb]
21089

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
21089	0.650	13708	3360

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
540.00	400.00	1.000	1.000	0.955	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
84213	0.700	58949	13440

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.500	10.000	0.000	1.400	15.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
8.000	1.000	1.000	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
306.00	325.13	1.000	0.935	1.000	16629

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
20494	0.750	15370	13440

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.342	0.874	5/3	97	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

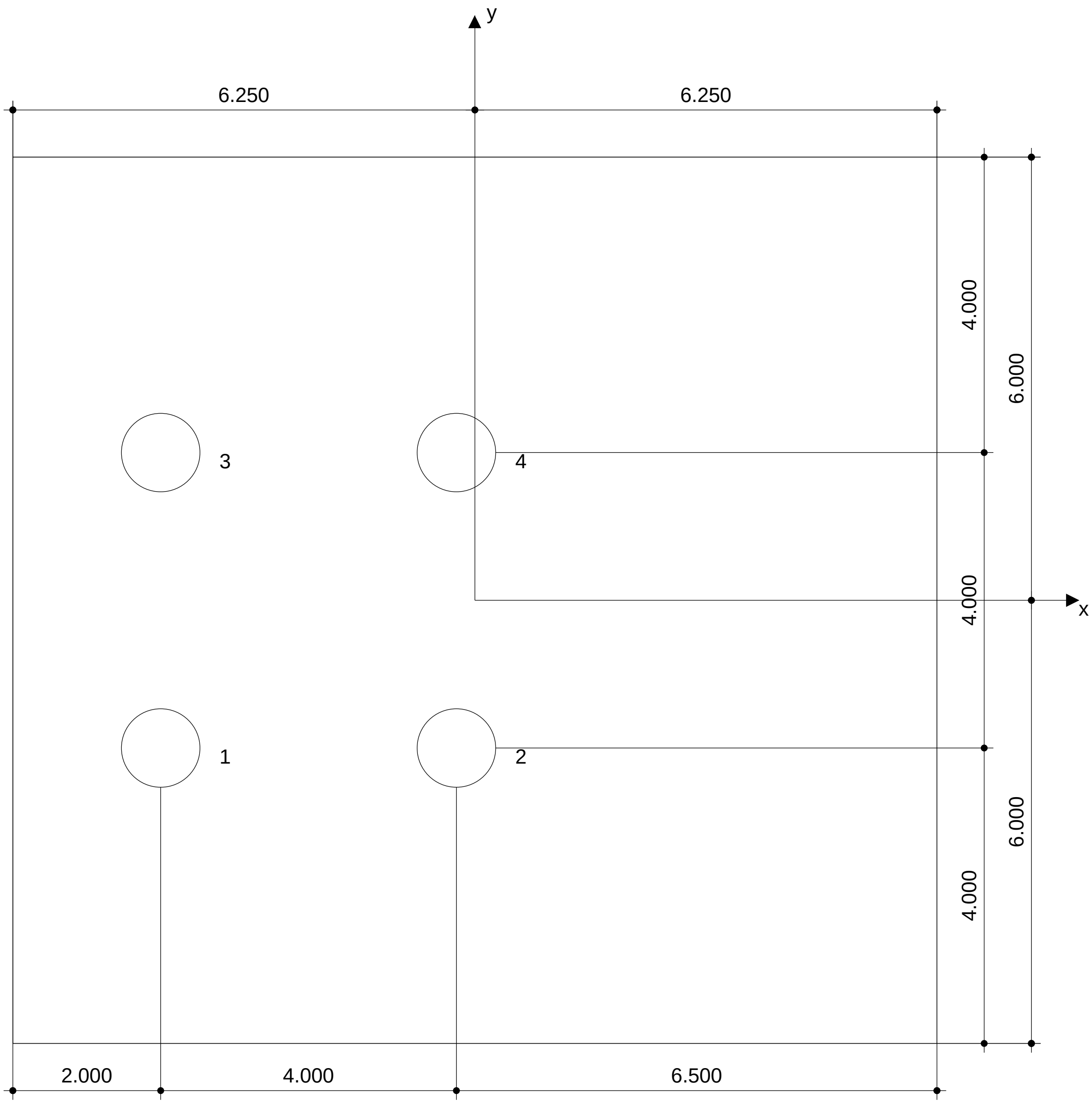
Fastening meets the design criteria!

Company: NTrive
Specifier: KZZ
Address:
Phone I Fax: |
E-Mail:

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 1.000 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 12.000 in.
Minimum thickness of the base material: 14.172 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.250	-2.000	10.000	12.500	10.000	14.000
2	-0.250	-2.000	14.000	8.500	10.000	14.000
3	-4.250	2.000	10.000	12.500	14.000	10.000
4	-0.250	2.000	14.000	8.500	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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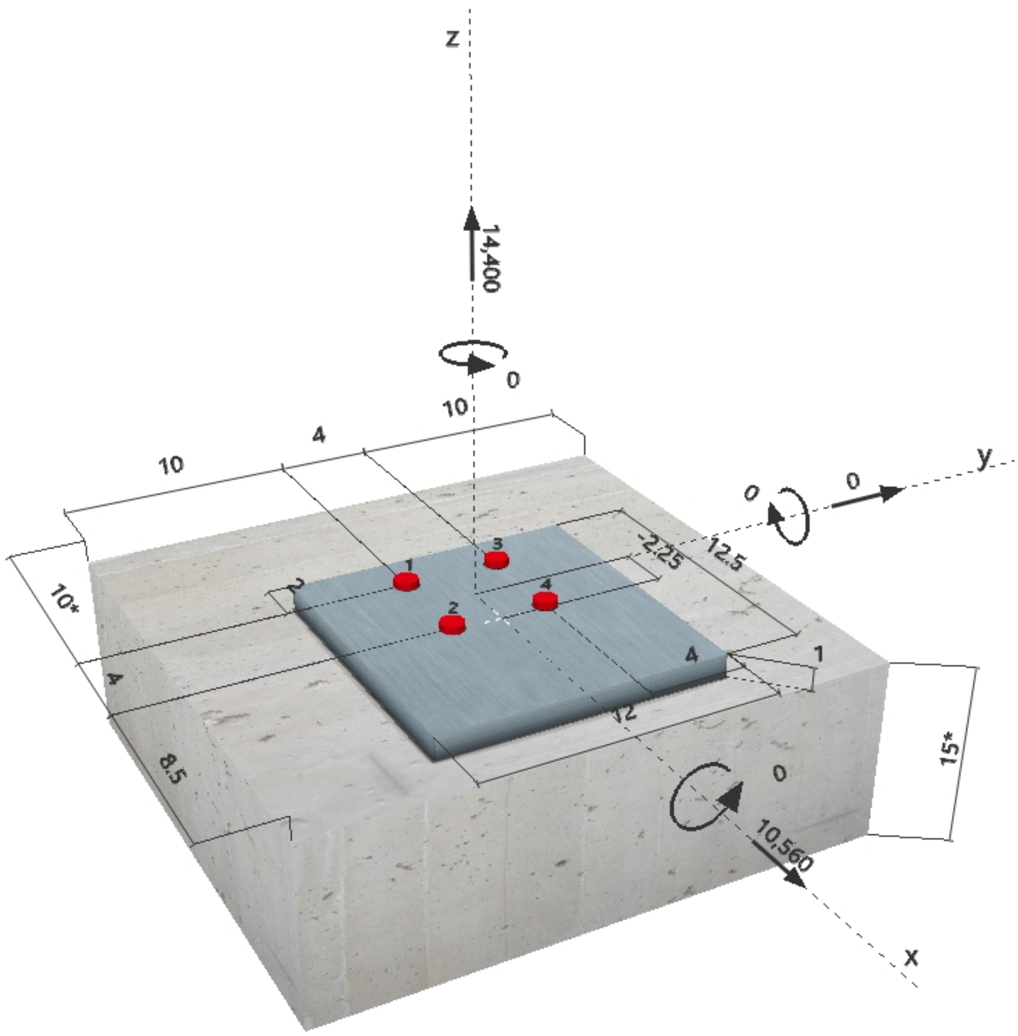
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-I, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 12.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 1.000 in.
Anchor plate:	l_x x l_y x t = 12.500 in. x 12.000 in. x 1.000 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 15.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

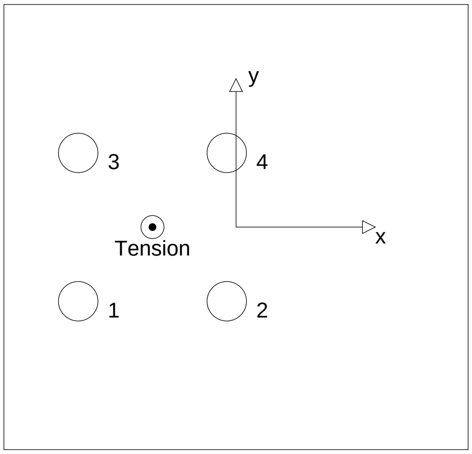
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	3600	2640	2640	0
2	3600	2640	2640	0
3	3600	2640	2640	0
4	3600	2640	2640	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.250/0.000): 14400 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3600	26361	14	OK
Pullout Strength*	3600	36472	10	OK
Concrete Breakout Strength**	14400	29475	49	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

N_{sa} [lb]
35148

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
35148	0.750	26361	3600

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	1.16	4000

Calculations

N_p [lb]
37216

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
52102	0.700	36472	3600

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e'_N}{3\, h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f'_c}\, h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.500	1.250

c_{ac} [in.]	k_c	λ	f'_c [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
540.00	400.00	1.000	1.000	0.955	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
42107	0.700	29475	14400

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2640	13708	20	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	10560	58949	18	OK
Concrete edge failure in direction x+**	10560	15370	69	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

V_{sa} [lb]
21089

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
21089	0.650	13708	2640

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
540.00	400.00	1.000	1.000	0.955	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
84213	0.700	58949	10560

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.500	10.000	0.000	1.400	15.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
8.000	1.000	1.000	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
306.00	325.13	1.000	0.935	1.000	16629

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
20494	0.750	15370	10560

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.489	0.687	5/3	84	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

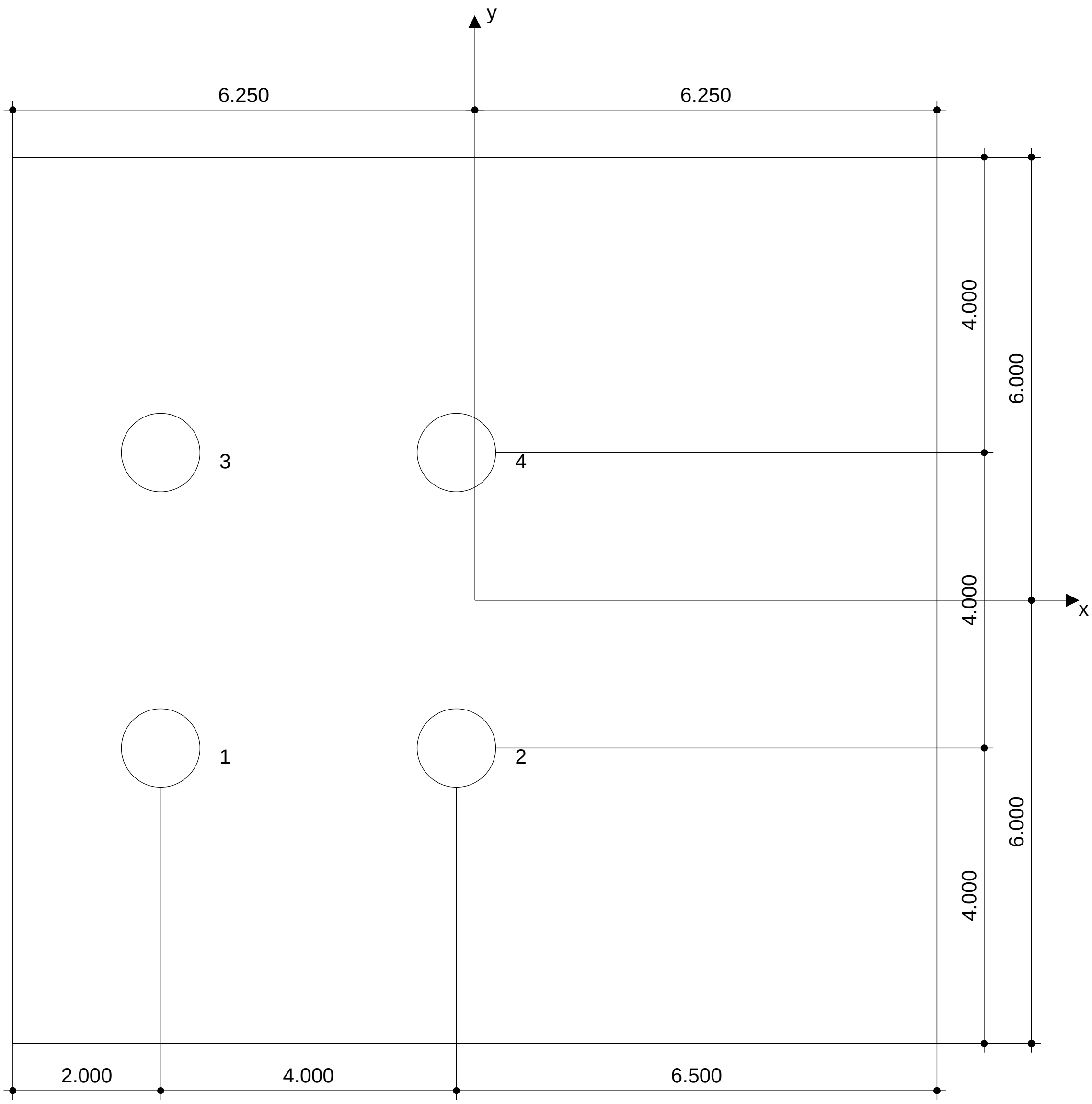
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 1.000 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 12.000 in.
Minimum thickness of the base material: 14.172 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.250	-2.000	10.000	12.500	10.000	14.000
2	-0.250	-2.000	14.000	8.500	10.000	14.000
3	-4.250	2.000	10.000	12.500	14.000	10.000
4	-0.250	2.000	14.000	8.500	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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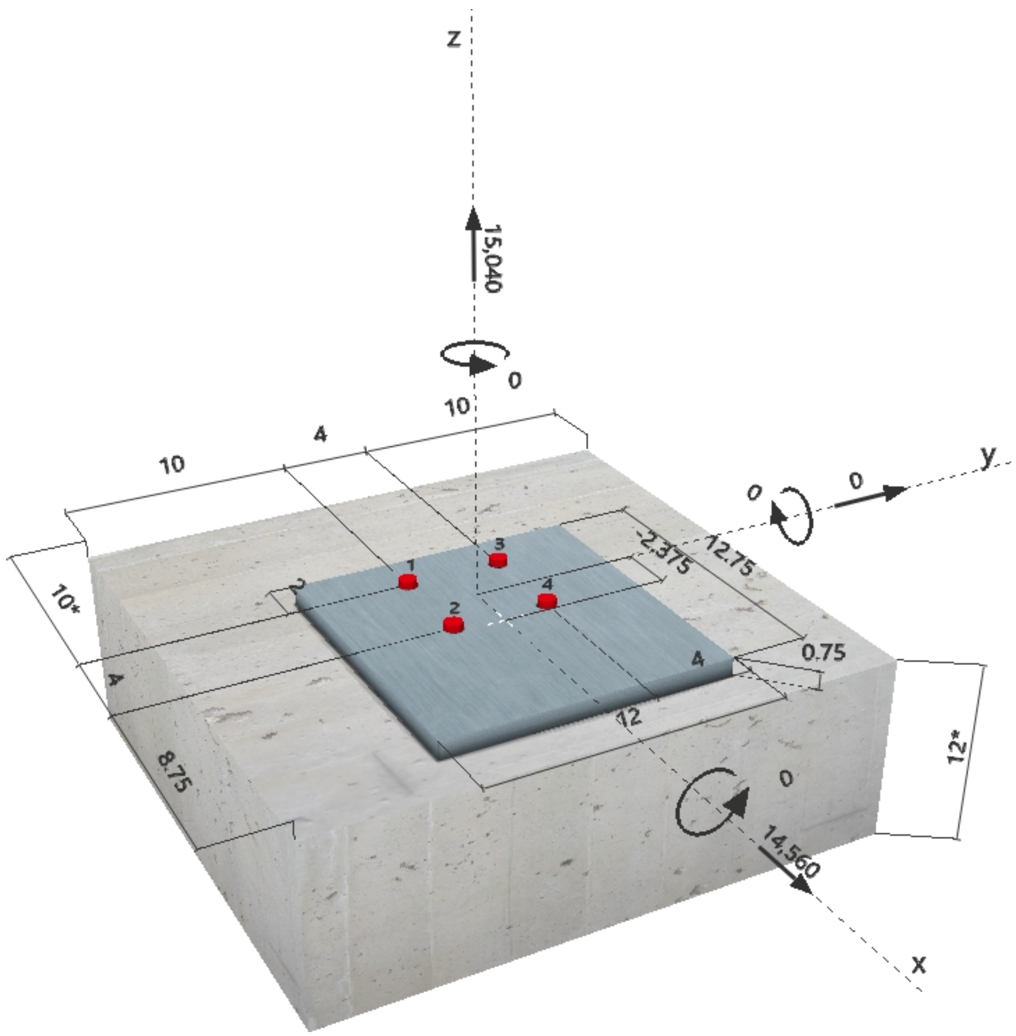
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-J, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 12.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

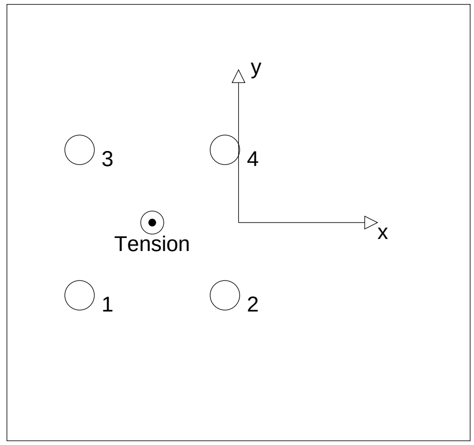
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	3760	3640	3640	0
2	3760	3640	3640	0
3	3760	3640	3640	0
4	3760	3640	3640	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 15040 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3760	14529	26	OK
Pullout Strength*	3760	20509	19	OK
Concrete Breakout Strength**	15040	30036	51	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	3760

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	3760

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.750	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
42908	0.700	30036	15040

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	3640	7555	49	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	14560	60072	25	OK
Concrete edge failure in direction x+**	14560	13117	112	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	3640

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
85818	0.700	60072	14560

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	14560

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.501	1.110	1.000	135	not recommended

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

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

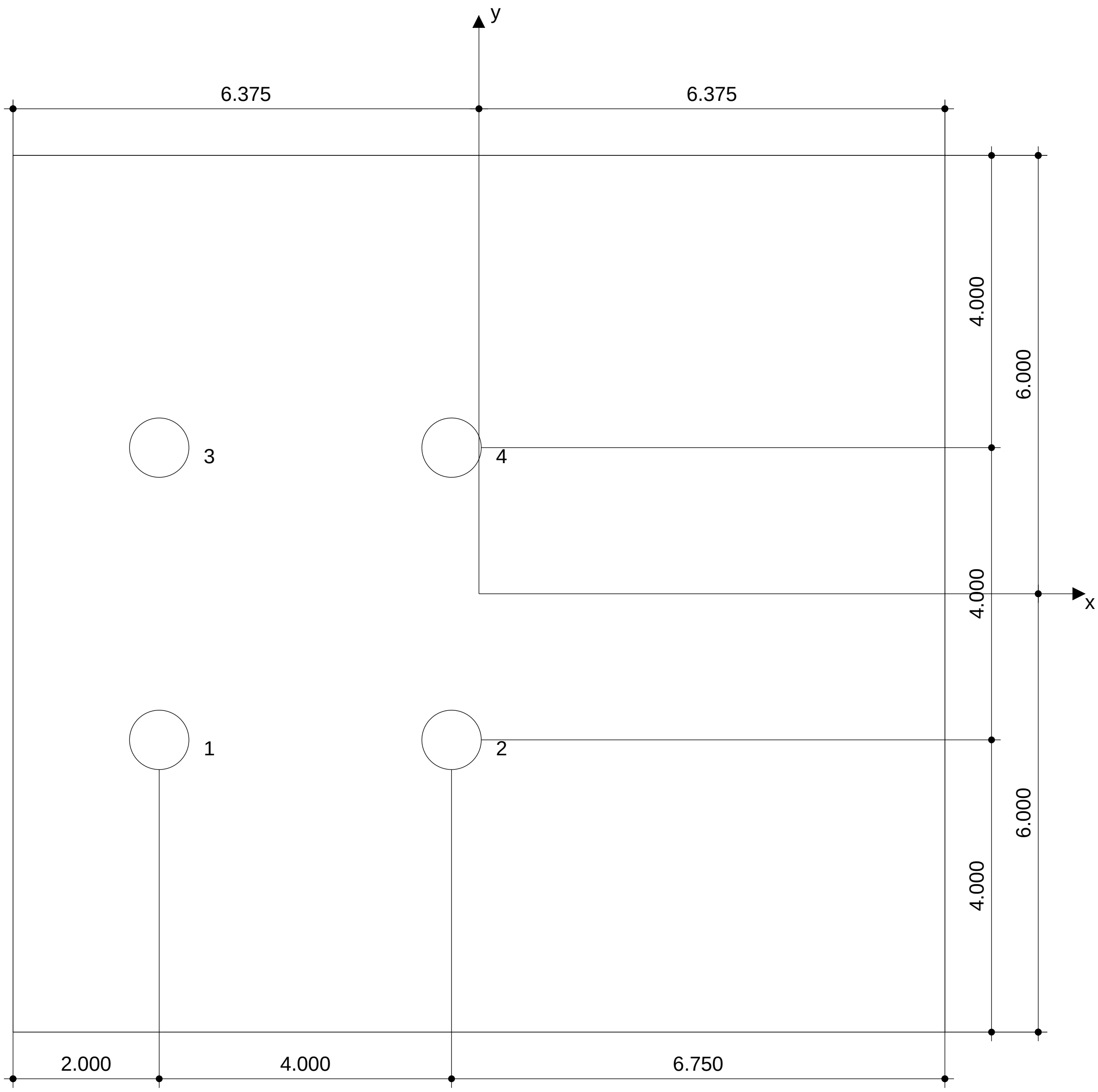
SEE CALCULATIONS
PAGE 548

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	10.000	14.000
2	-0.375	-2.000	14.000	8.750	10.000	14.000
3	-4.375	2.000	10.000	12.750	14.000	10.000
4	-0.375	2.000	14.000	8.750	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

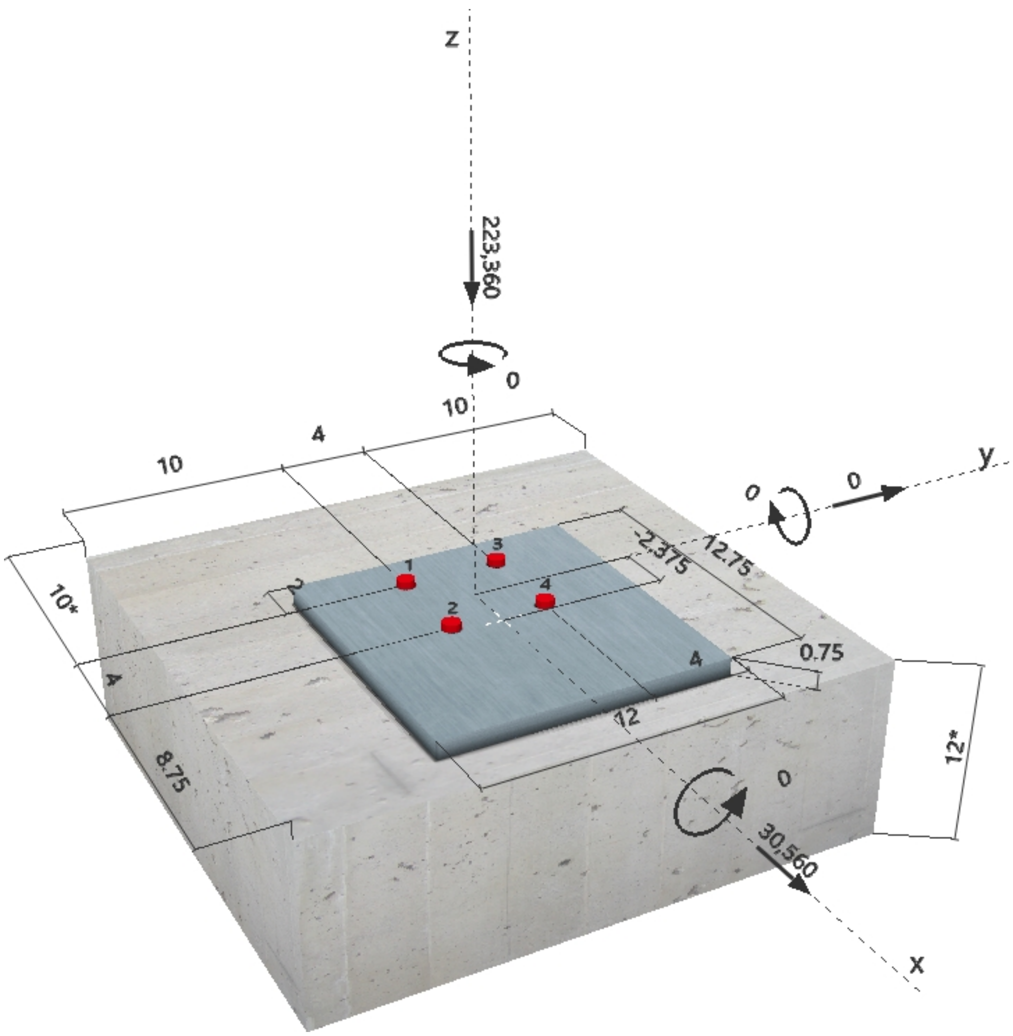
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-J, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 12.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

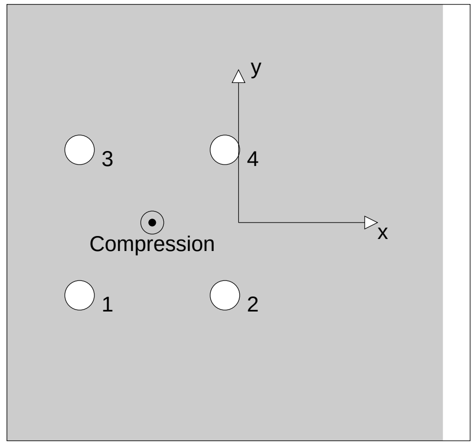
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	7640	7640	0
2	0	7640	7640	0
3	0	7640	7640	0
4	0	7640	7640	0

max. concrete compressive strain: 0.71 [‰]
max. concrete compressive stress: 3102 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-2.375/0.000): 223360 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	7640	7555	102	not recommended
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	30560	60072	51	OK
Concrete edge failure in direction x+**	30560	13117	233	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	7640

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
85818	0.700	60072	30560

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-26)

$$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-28)

$$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$$ ACI 318-08 Eq. (D-29)

$$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\, c_{a1}^{1.5}$$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	30560

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

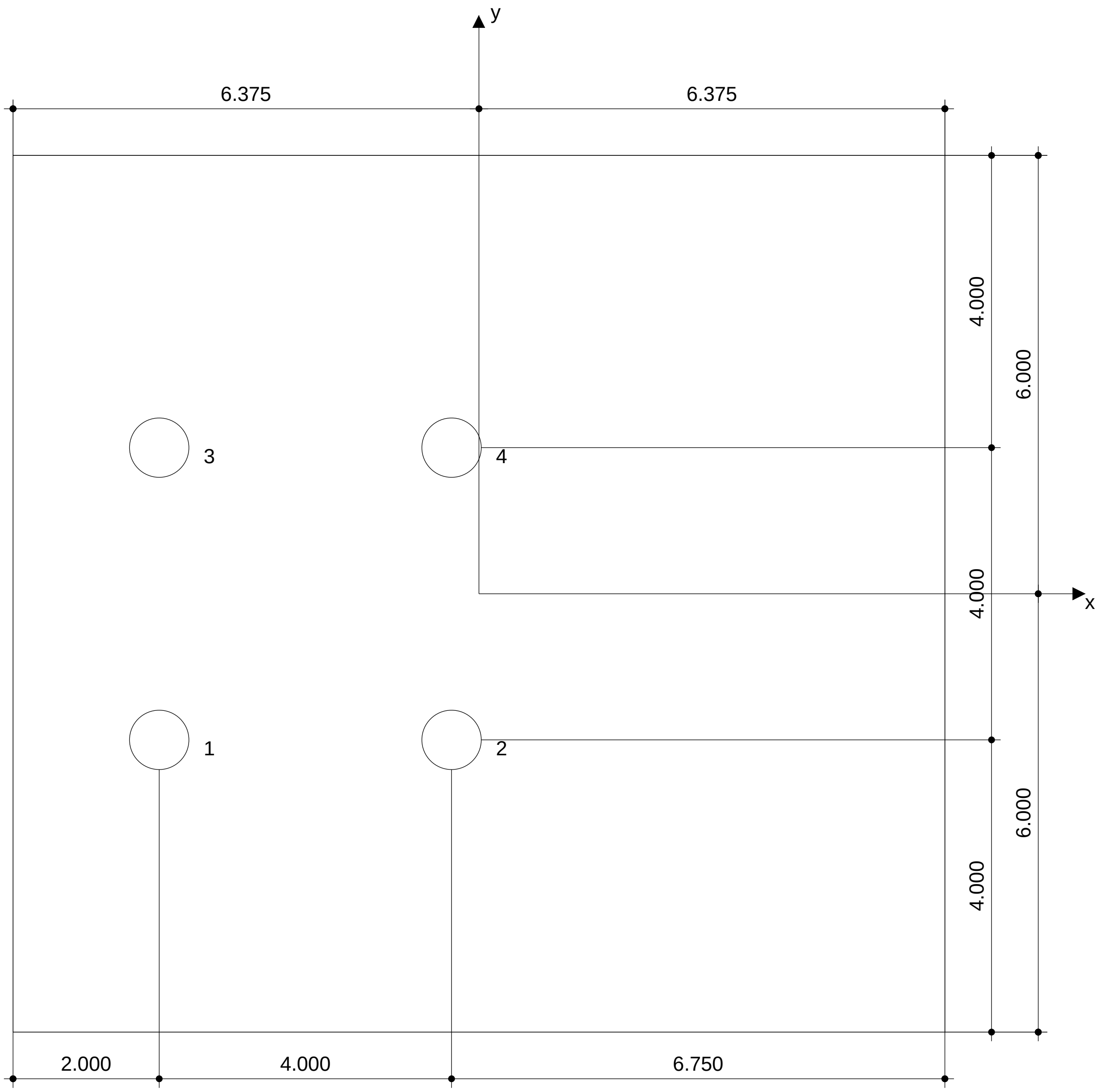
SEE CALCULATIONS
PAGE 547

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	10.000	14.000
2	-0.375	-2.000	14.000	8.750	10.000	14.000
3	-4.375	2.000	10.000	12.750	14.000	10.000
4	-0.375	2.000	14.000	8.750	14.000	10.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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- 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.

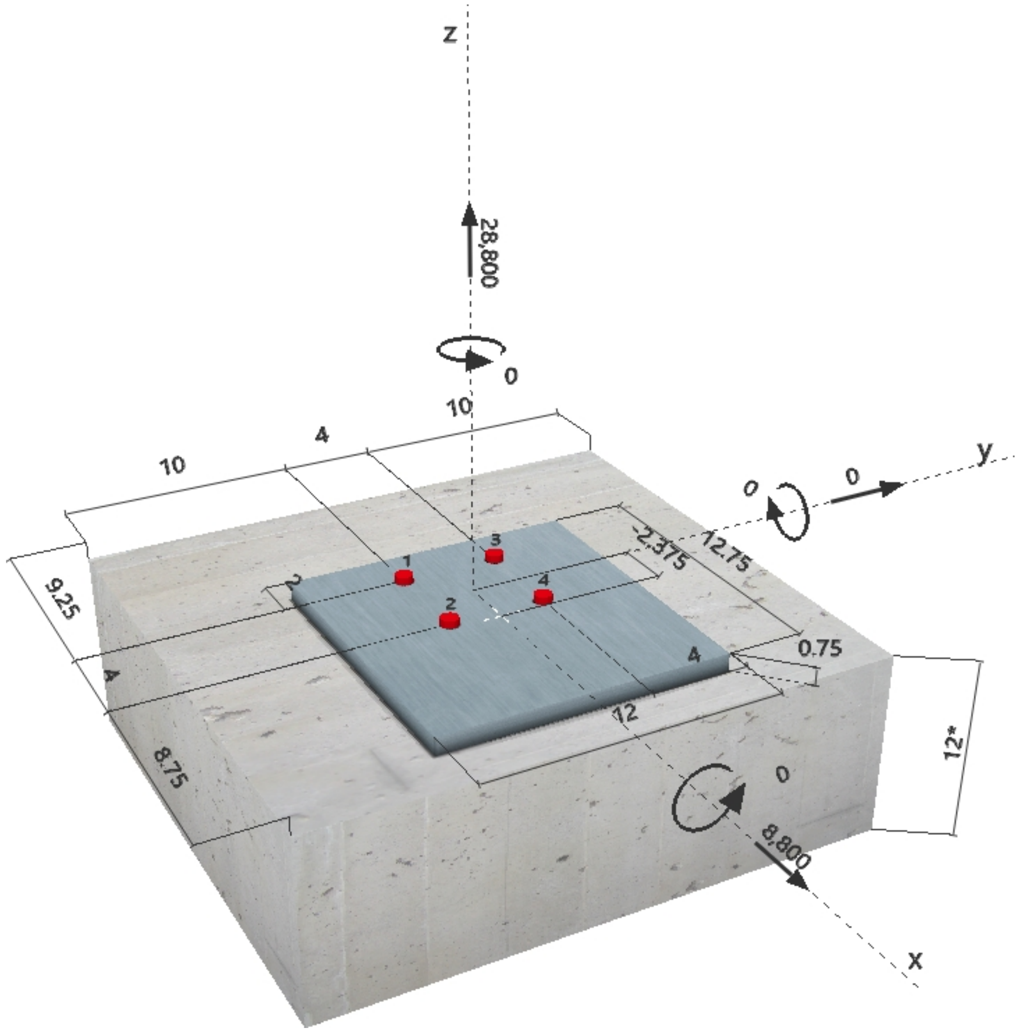
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

Specifier's comments: MB-J, LC3

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.750 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 12.000 in. x 0.750 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

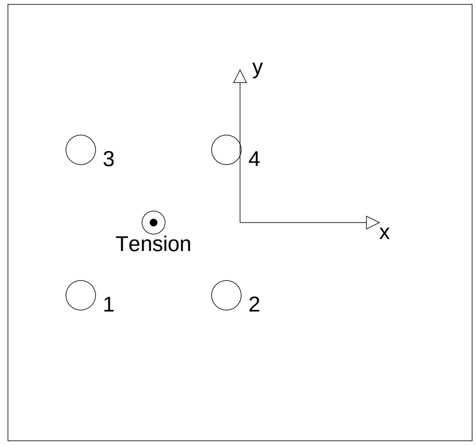
Anchor	Tension force	Shear force	Shear force x	Shear force y
1	7201	2200	2200	0
2	7199	2200	2200	0
3	7201	2200	2200	0
4	7199	2200	2200	0

max. concrete compressive strain: - [‰]

max. concrete compressive stress: - [psi]

resulting tension force in (x/y)=(-2.375/0.000): 28800 [lb]

resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	7201	14529	50	OK
Pullout Strength*	7201	20509	36	OK
Concrete Breakout Strength**	28800	29045	100	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)

$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	7201

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)

$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)

$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	7201

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.750	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
528.00	400.00	1.000	1.000	0.963	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
41494	0.700	29045	28800

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2200	7555	30	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8800	58092	16	OK
Concrete edge failure in direction x+**	8800	13117	68	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	2200

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
528.00	400.00	1.000	1.000	0.963	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
82989	0.700	58092	8800

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	8800

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.992	0.671	1.000	139	not recommended

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

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

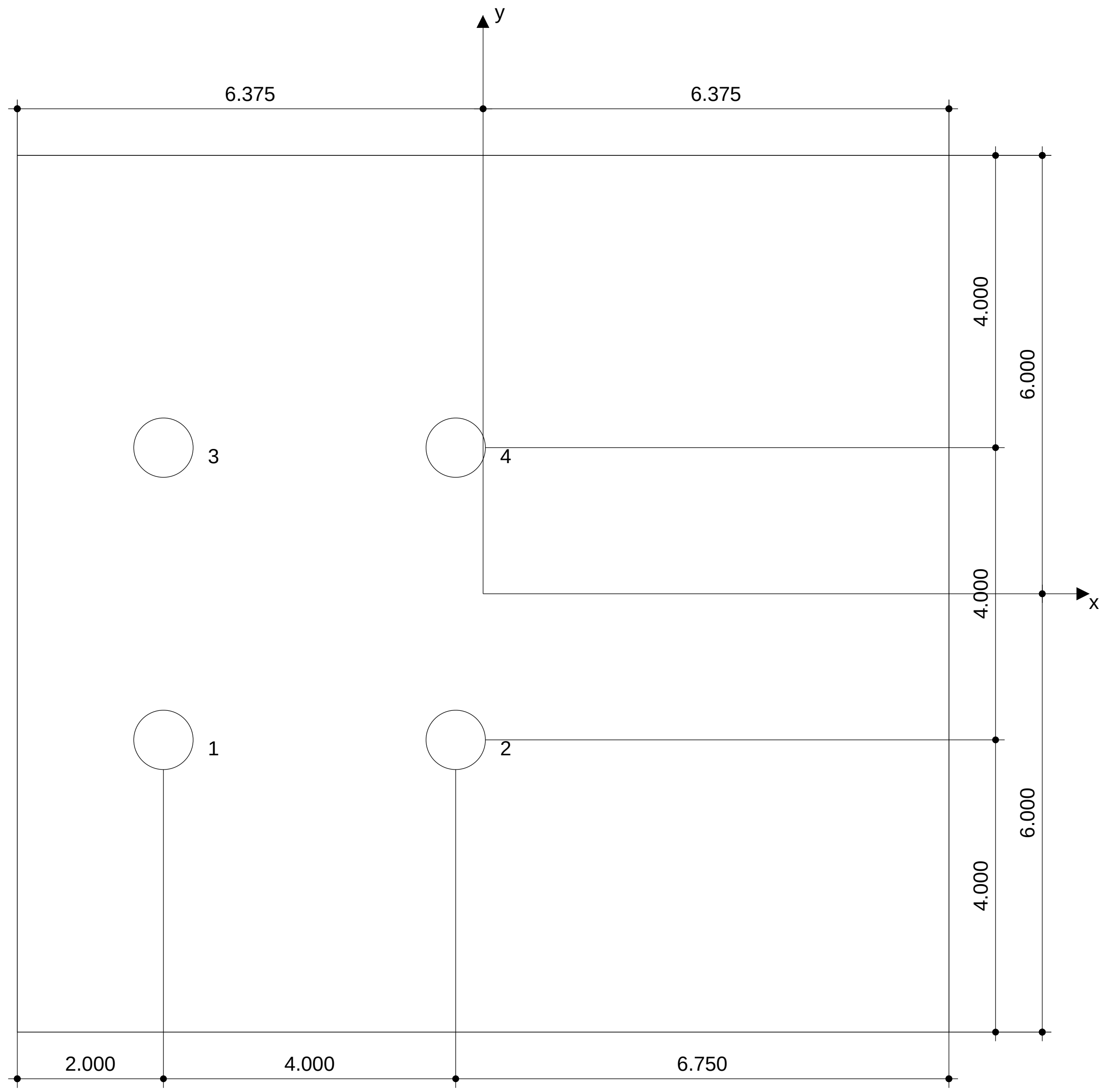
SEE CALCULATIONS
PAGE 547

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.750 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	9.250	12.750	10.000	14.000
2	-0.375	-2.000	13.250	8.750	10.000	14.000
3	-4.375	2.000	9.250	12.750	14.000	10.000
4	-0.375	2.000	13.250	8.750	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150104.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	7/6/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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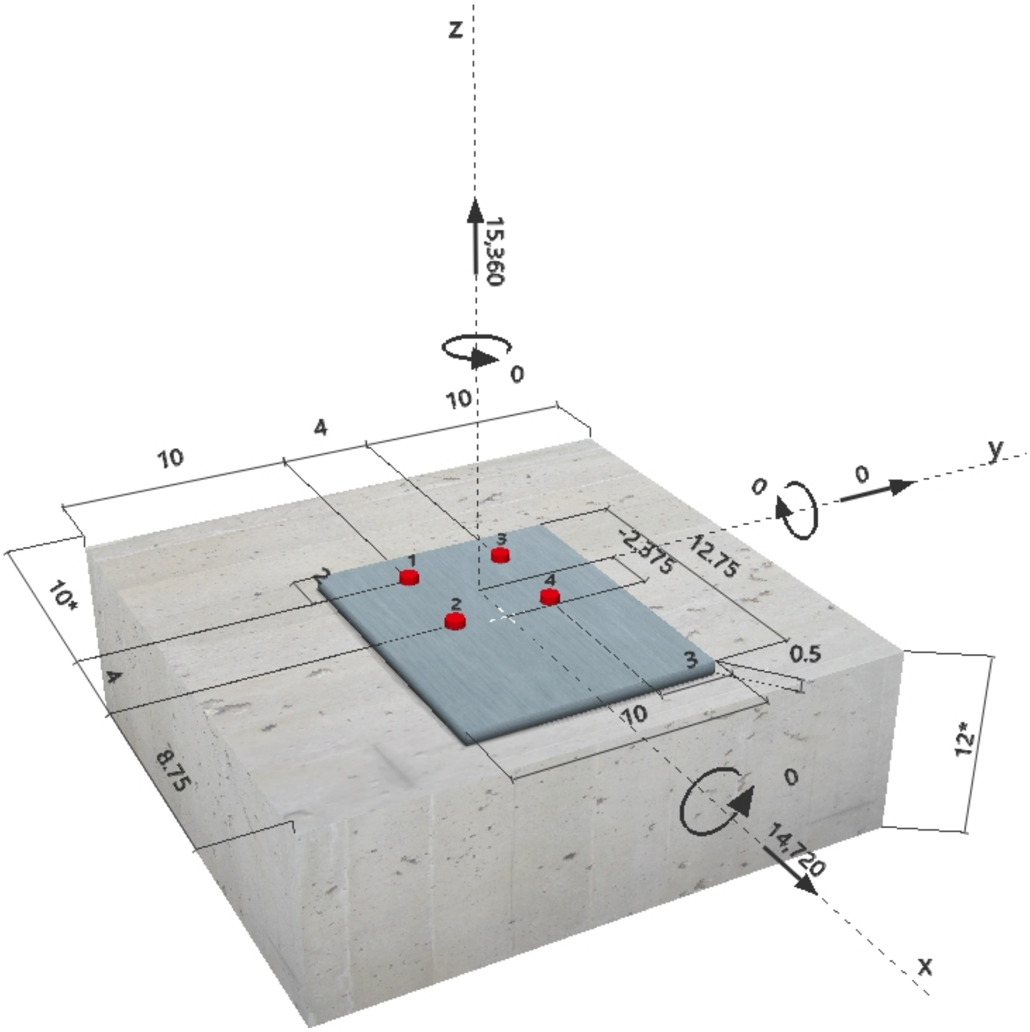
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-K, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 10.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

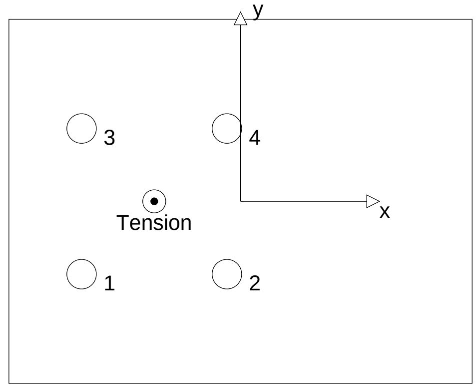
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	3840	3680	3680	0
2	3840	3680	3680	0
3	3840	3680	3680	0
4	3840	3680	3680	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 15360 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3840	14529	27	OK
Pullout Strength*	3840	20509	19	OK
Concrete Breakout Strength**	15360	30036	52	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	3840

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	3840

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e'_N}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f'_c}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.750	1.250

c_{ac} [in.]	k_c	λ	f'_c [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
42908	0.700	30036	15360

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	3680	7555	49	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	14720	60072	25	OK
Concrete edge failure in direction x+**	14720	13117	113	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	3680

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
85818	0.700	60072	14720

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	14720

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.511	1.122	1.000	137	not recommended

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

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

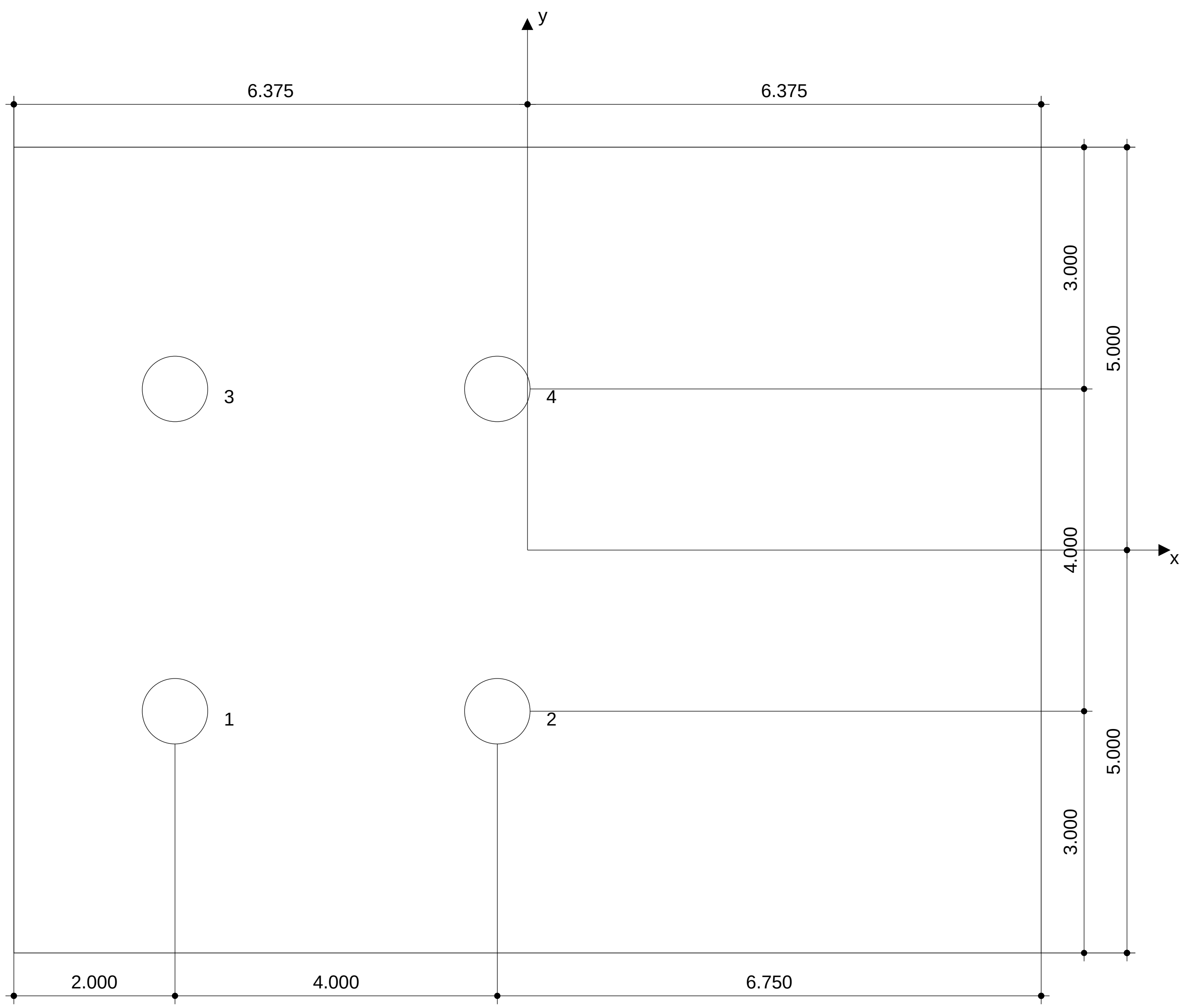
SEE CALCULATIONS
PAGE 548

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	10.000	14.000
2	-0.375	-2.000	14.000	8.750	10.000	14.000
3	-4.375	2.000	10.000	12.750	14.000	10.000
4	-0.375	2.000	14.000	8.750	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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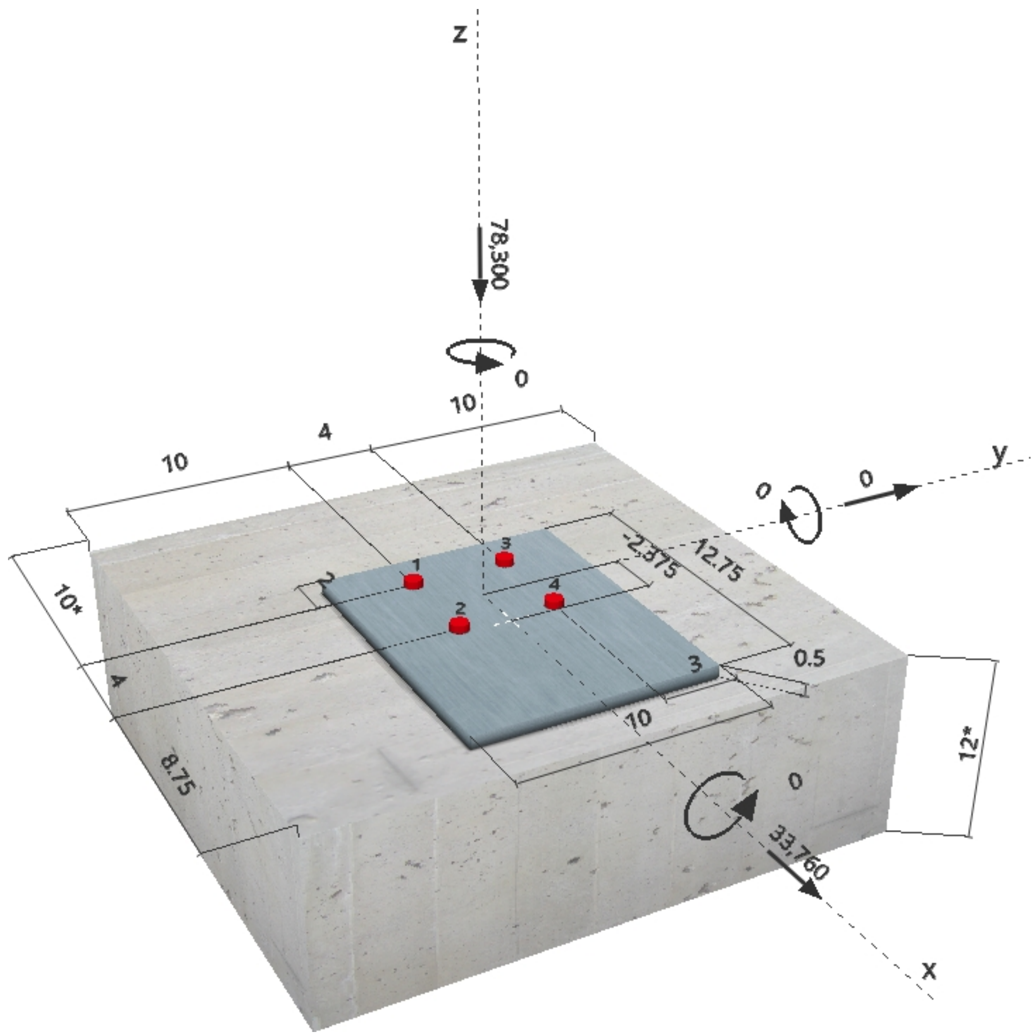
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-K, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 10.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

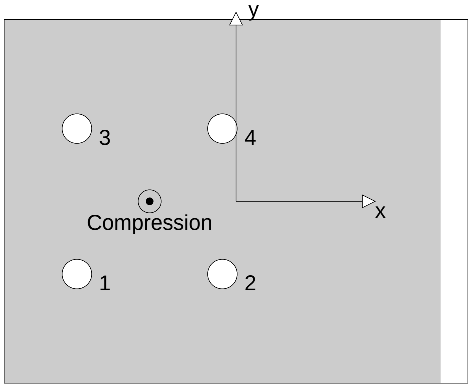
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	8440	8440	0
2	0	8440	8440	0
3	0	8440	8440	0
4	0	8440	8440	0

max. concrete compressive strain: 0.30 [‰]
max. concrete compressive stress: 1305 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-2.375/0.000): 78300 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	8440	7555	112	not recommended
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	33760	60072	57	OK
Concrete edge failure in direction x+**	33760	13117	258	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	8440

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
85818	0.700	60072	33760

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	33760

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

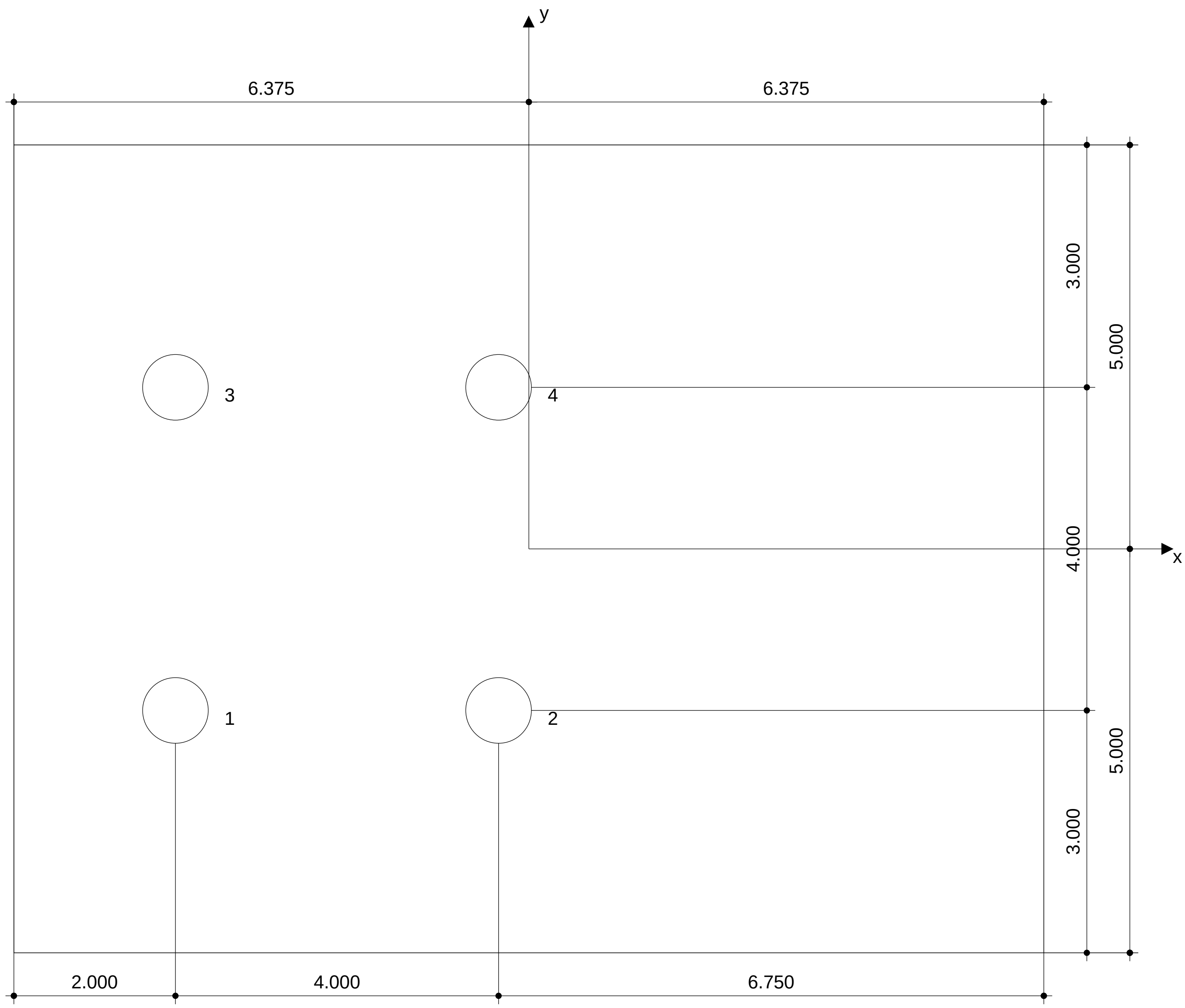
SEE CALCULATIONS
PAGE 547

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	10.000	14.000
2	-0.375	-2.000	14.000	8.750	10.000	14.000
3	-4.375	2.000	10.000	12.750	14.000	10.000
4	-0.375	2.000	14.000	8.750	14.000	10.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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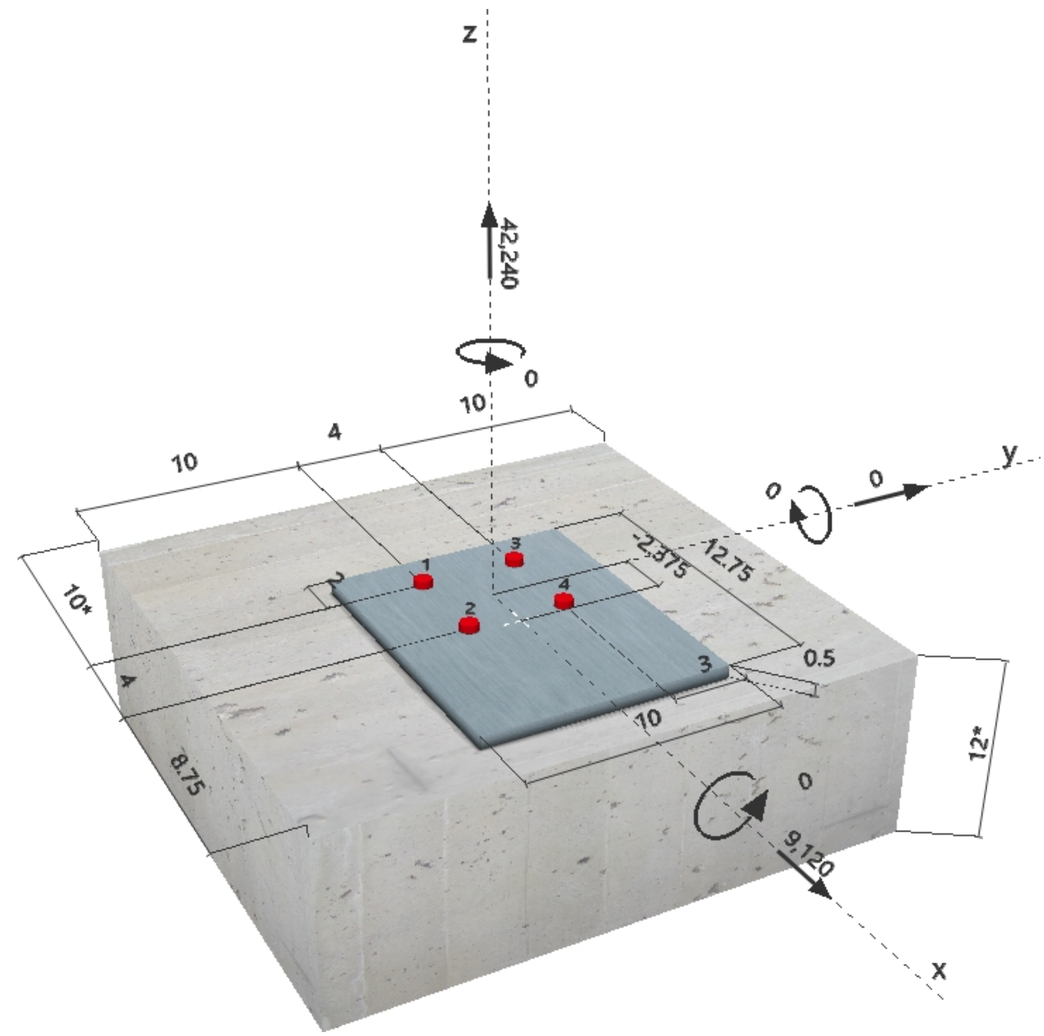
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-K, LC3

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 12.750 in. x 10.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

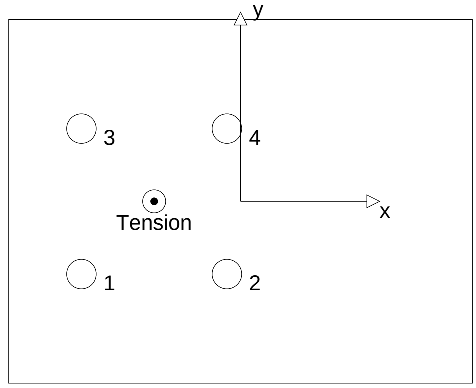
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	10561	2280	2280	0
2	10559	2280	2280	0
3	10561	2280	2280	0
4	10559	2280	2280	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.375/0.000): 42240 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	10561	14529	73	OK
Pullout Strength*	10561	20509	52	OK
Concrete Breakout Strength**	42240	30036	141	not recommended
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)

$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	10561

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)

$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)

$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	10561

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N^{'}}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c^{'}}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	8.750	1.250

c_{ac} [in.]	k_c	λ	$f_c^{'}$ [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
42908	0.700	30036	42240

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2280	7555	31	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	9120	60072	16	OK
Concrete edge failure in direction x+**	9120	13117	70	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	2280

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	8.750

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
546.00	400.00	1.000	1.000	0.963	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
85818	0.700	60072	9120

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-26)

$$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$$ ACI 318-08 Eq. (D-28)

$$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$$ ACI 318-08 Eq. (D-29)

$$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\ c_{a1}^{1.5}$$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	9120

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
1.406	0.695	1.000	176	not recommended

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

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

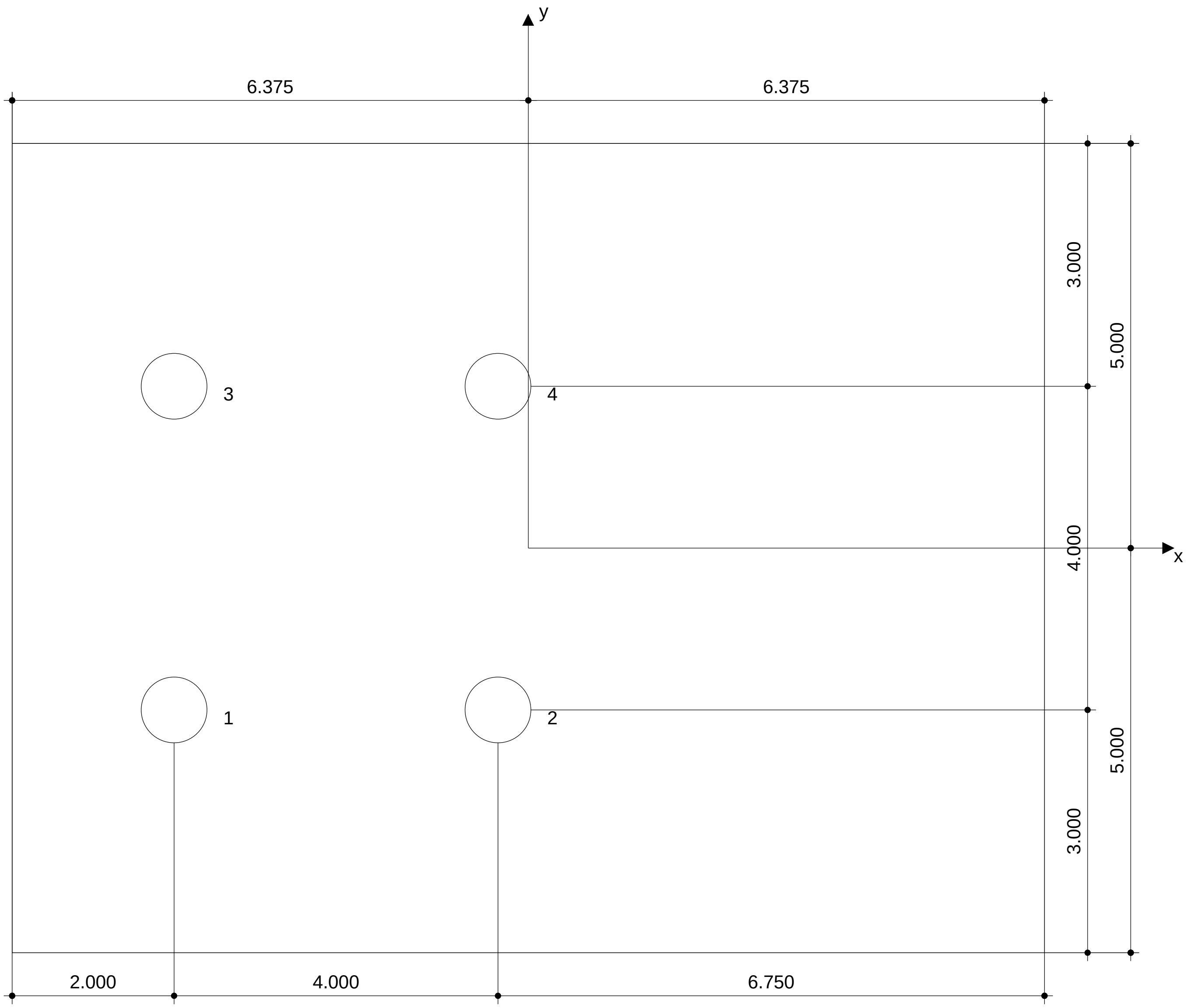
SEE CALCULATIONS
PAGE 548

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.375	-2.000	10.000	12.750	10.000	14.000
2	-0.375	-2.000	14.000	8.750	10.000	14.000
3	-4.375	2.000	10.000	12.750	14.000	10.000
4	-0.375	2.000	14.000	8.750	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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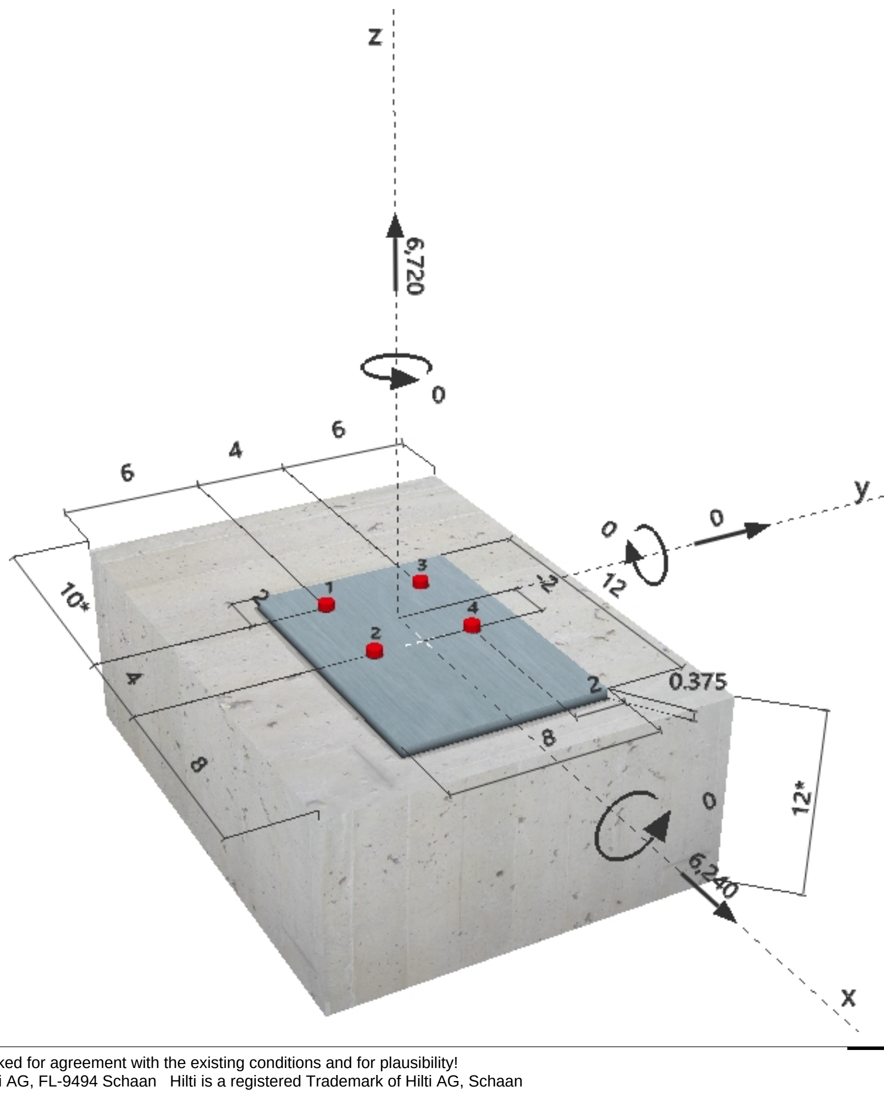
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-L, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 12.000 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

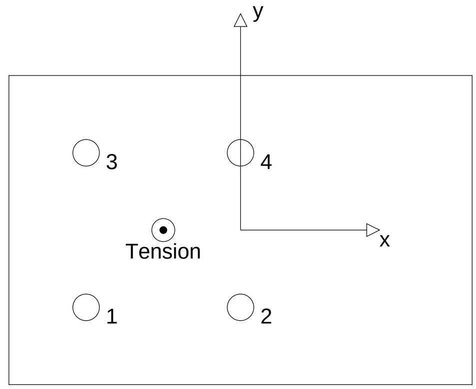
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1680	1560	1560	0
2	1680	1560	1560	0
3	1680	1560	1560	0
4	1680	1560	1560	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.000/0.000): 6720 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1680	9831	18	OK
Pullout Strength*	1680	14237	12	OK
Concrete Breakout Strength**	6720	17704	38	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1680

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1680

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	6.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
352.00	400.00	1.000	1.000	0.880	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
25292	0.700	17704	6720

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1560	5112	31	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	6240	35409	18	OK
Concrete edge failure in direction x+**	6240	7142	88	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	1560

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
352.00	400.00	1.000	1.000	0.880	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
50584	0.700	35409	6240

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
192.00	288.00	1.000	0.850	1.000	12004

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
9523	0.750	7142	6240

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.380	0.874	5/3	100	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

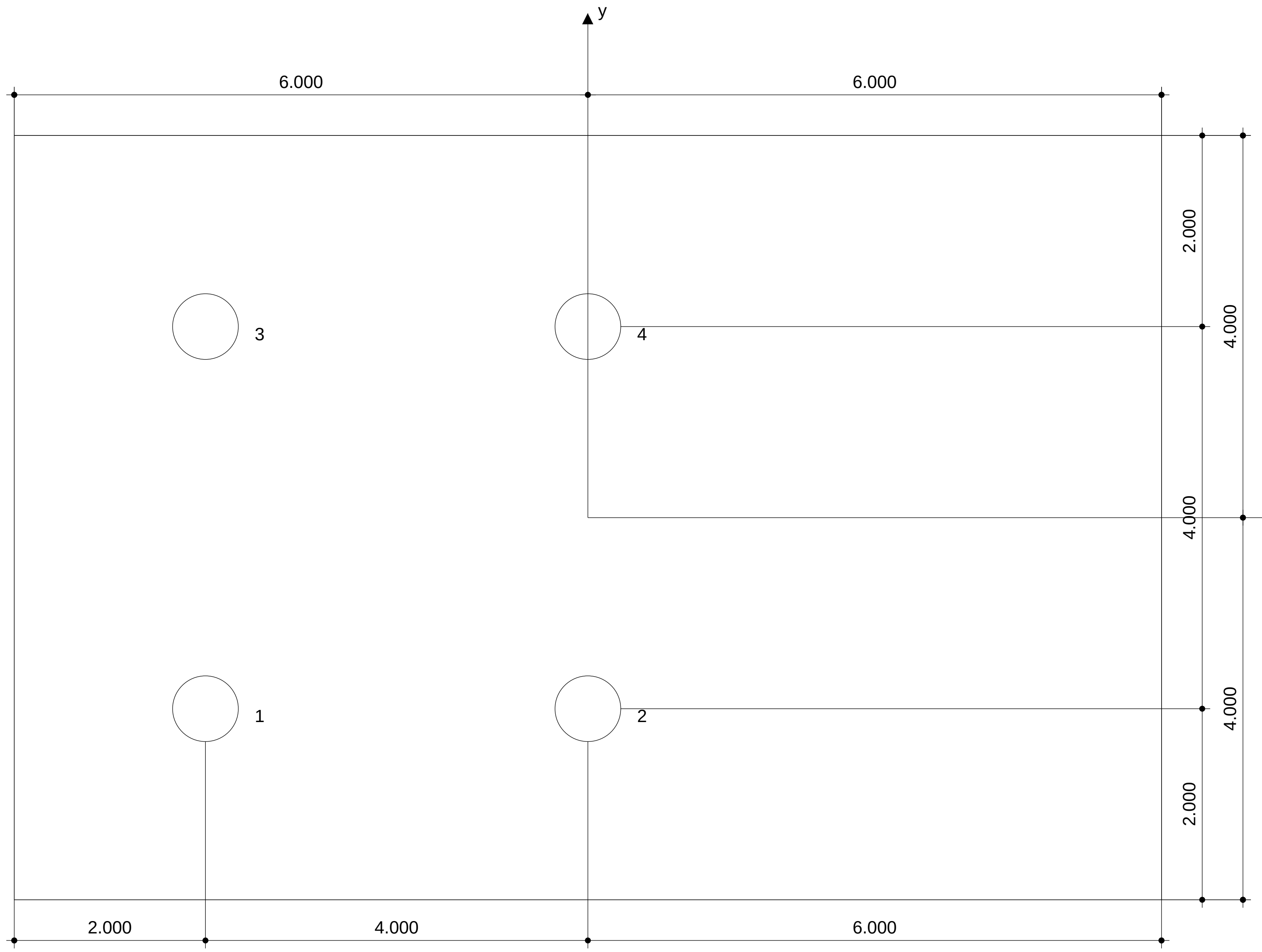
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.000	-2.000	10.000	12.000	6.000	10.000
2	0.000	-2.000	14.000	8.000	6.000	10.000
3	-4.000	2.000	10.000	12.000	10.000	6.000
4	0.000	2.000	14.000	8.000	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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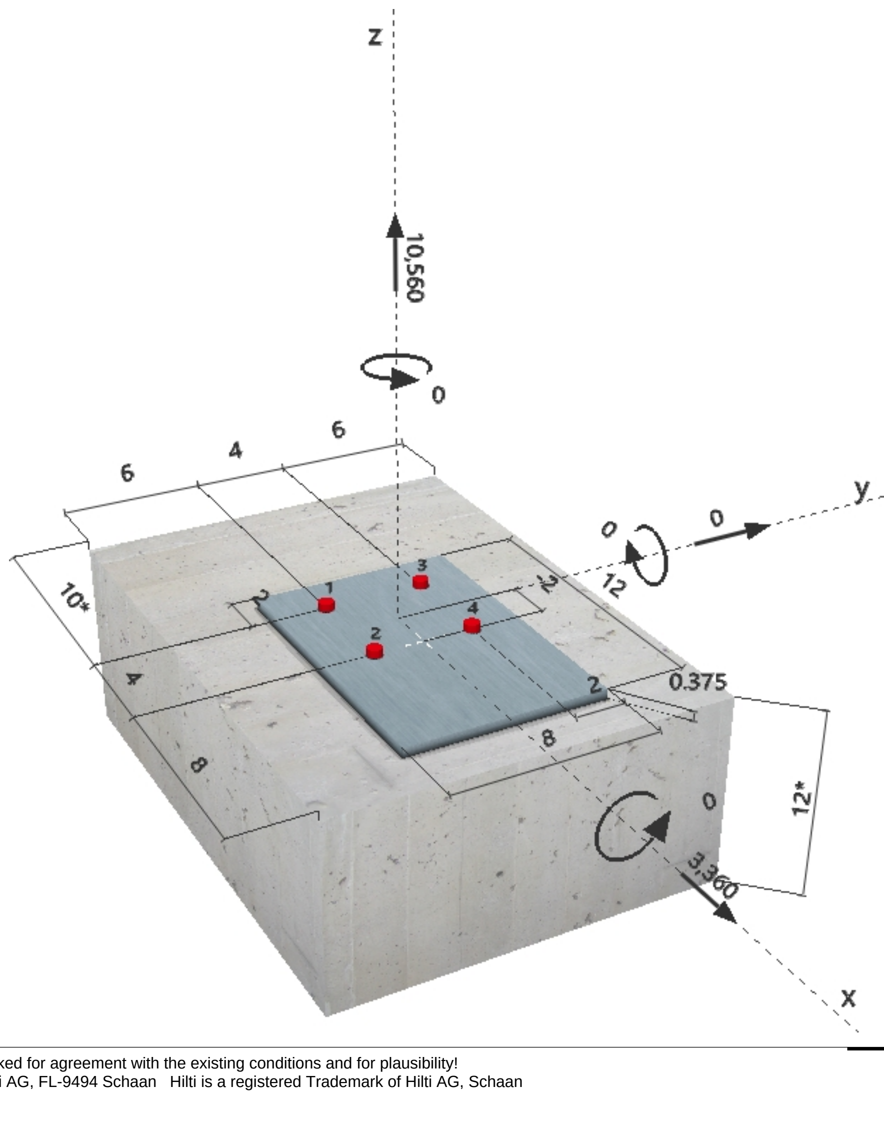
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: MB-L, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 12.000 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

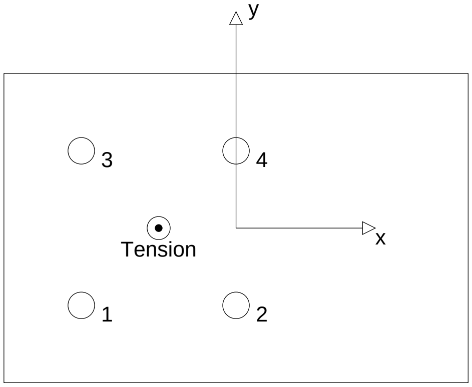
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2640	840	840	0
2	2640	840	840	0
3	2640	840	840	0
4	2640	840	840	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-2.000/0.000): 10560 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2640	9831	27	OK
Pullout Strength*	2640	14237	19	OK
Concrete Breakout Strength**	10560	17704	60	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	2640

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	2640

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	6.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
352.00	400.00	1.000	1.000	0.880	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
25292	0.700	17704	10560

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	840	5112	17	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	3360	35409	10	OK
Concrete edge failure in direction x+**	3360	7142	48	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	840

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX} \left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
352.00	400.00	1.000	1.000	0.880	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
50584	0.700	35409	3360

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
192.00	288.00	1.000	0.850	1.000	12004

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
9523	0.750	7142	3360

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.596	0.470	5/3	71	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

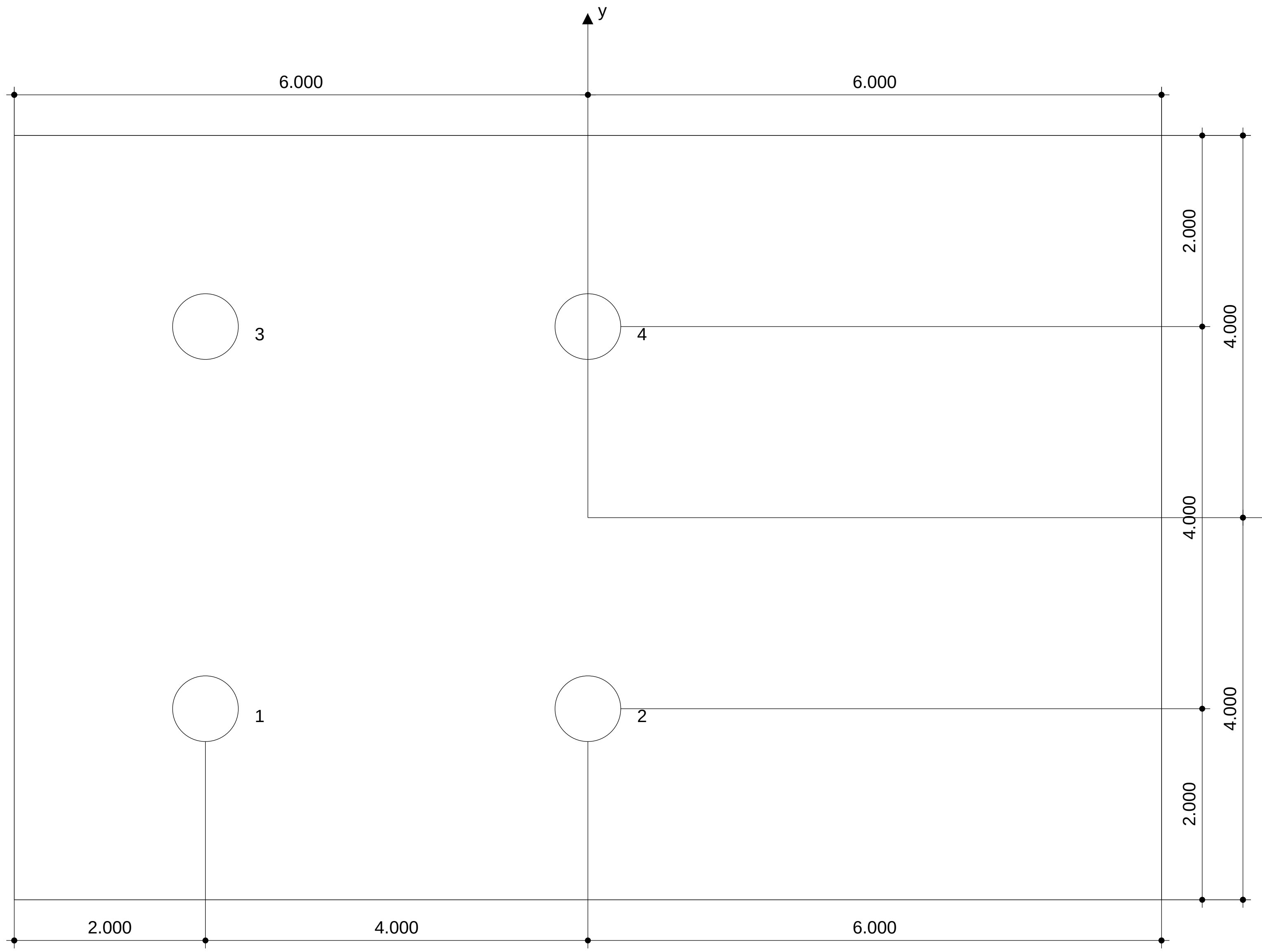
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.000	-2.000	10.000	12.000	6.000	10.000
2	0.000	-2.000	14.000	8.000	6.000	10.000
3	-4.000	2.000	10.000	12.000	10.000	6.000
4	0.000	2.000	14.000	8.000	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

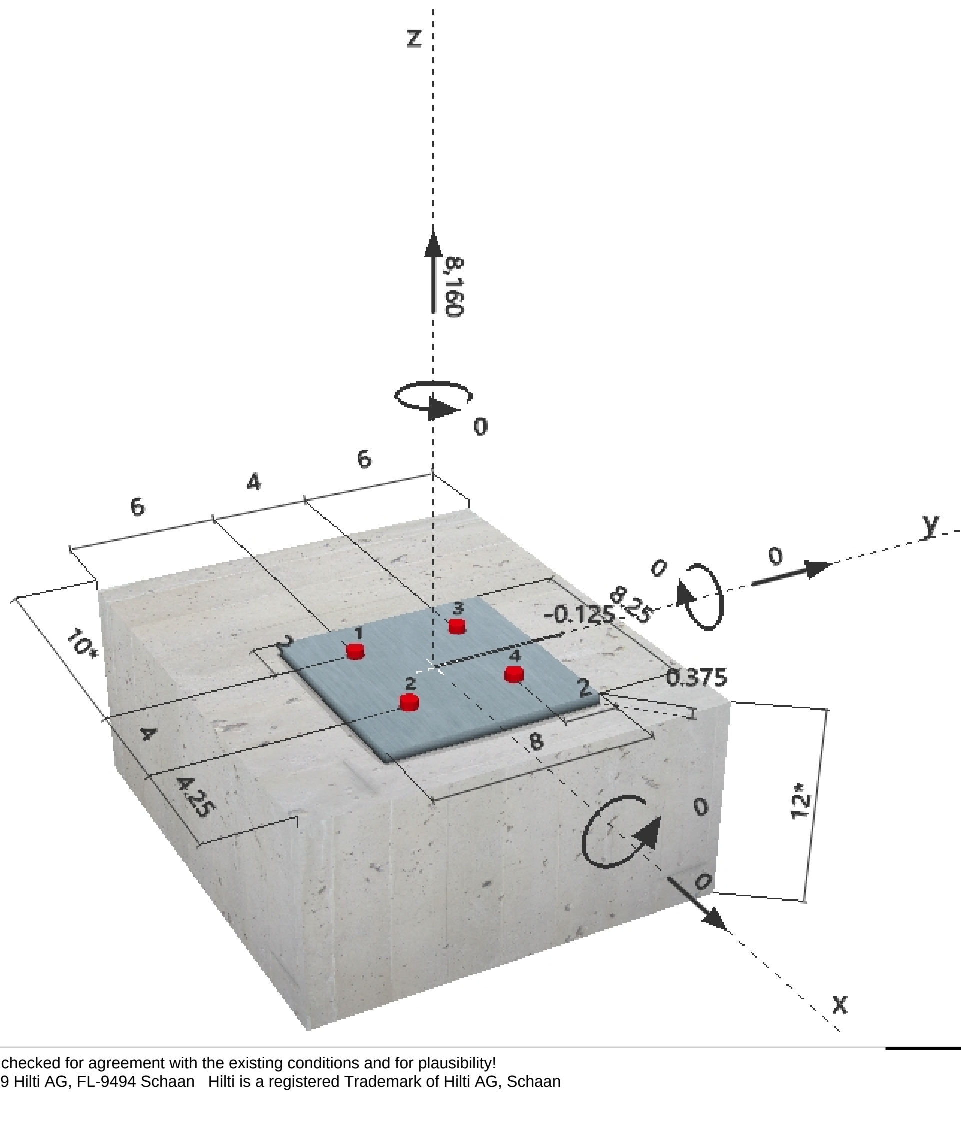
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B2-B

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 8.250 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

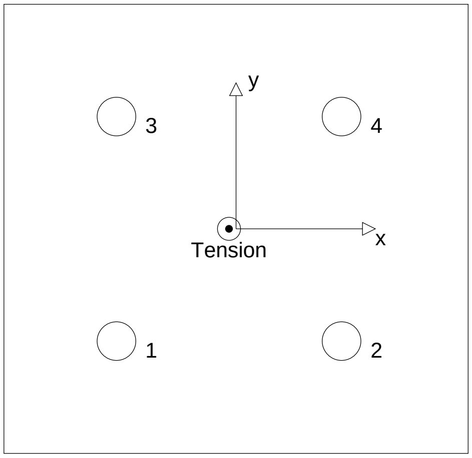
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2040	0	0	0
2	2040	0	0	0
3	2040	0	0	0
4	2040	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.125/0.000): 8160 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2040	9831	21	OK
Pullout Strength*	2040	14237	15	OK
Concrete Breakout Strength**	8160	13810	60	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	2040

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	2040

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	4.250	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
292.00	400.00	1.000	1.000	0.828	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
19729	0.700	13810	8160

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

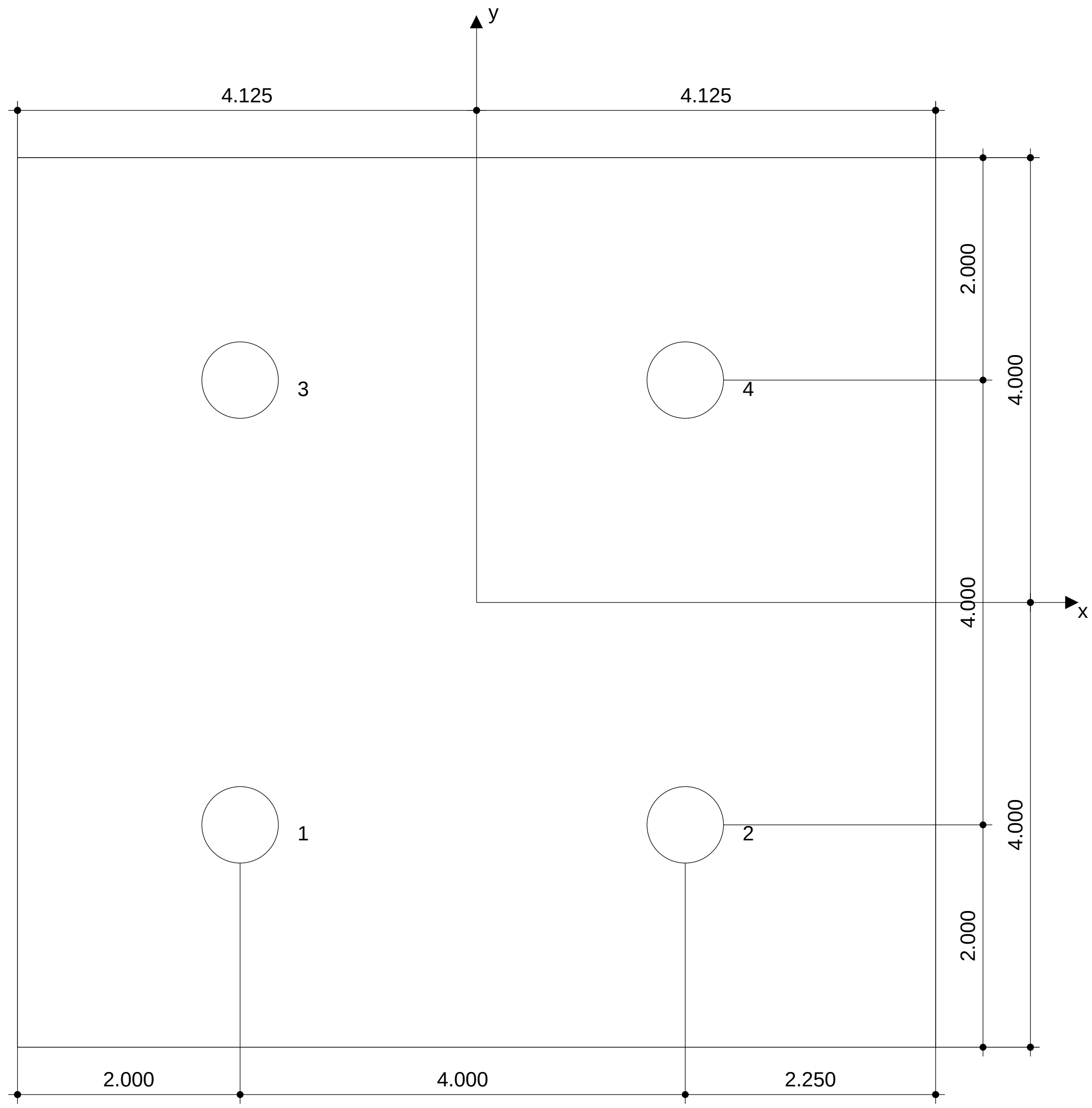
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.125	-2.000	10.000	8.250	6.000	10.000
2	1.875	-2.000	14.000	4.250	6.000	10.000
3	-2.125	2.000	10.000	8.250	10.000	6.000
4	1.875	2.000	14.000	4.250	10.000	6.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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- 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.

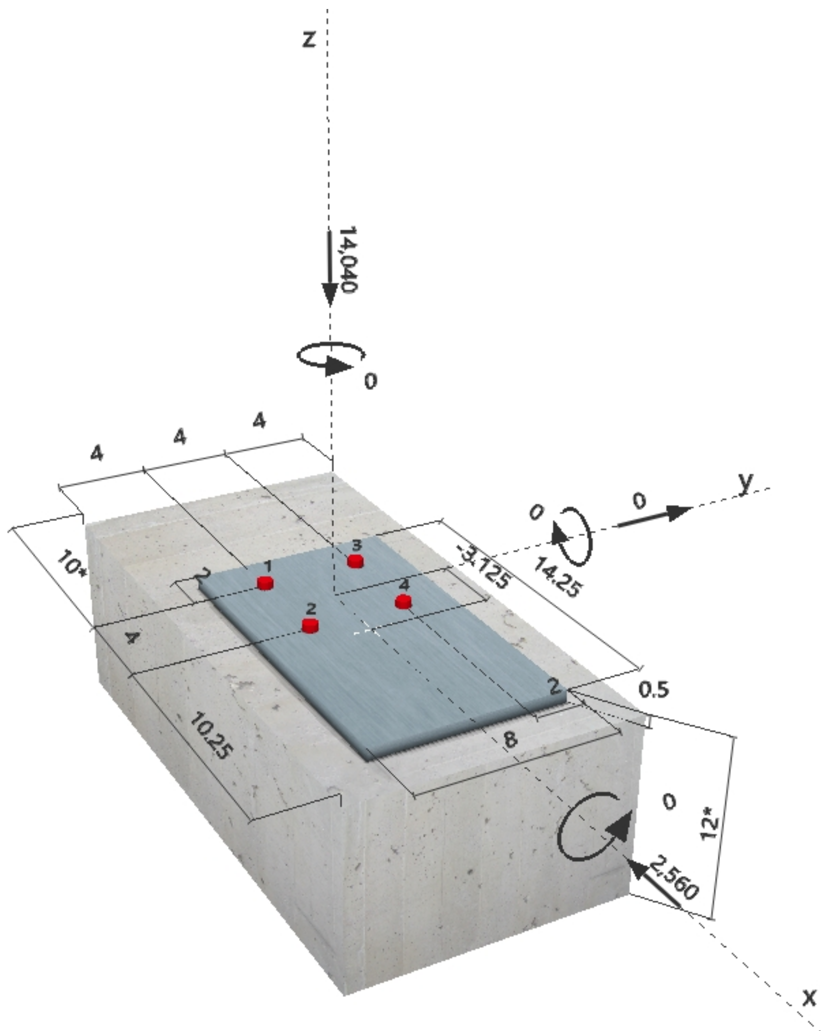
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B2-D, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 14.250 in. x 8.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

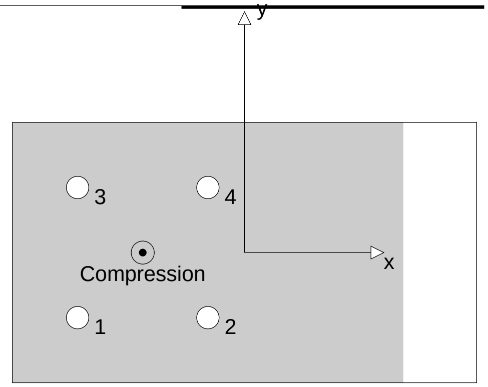
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	640	-640	0
2	0	640	-640	0
3	0	640	-640	0
4	0	640	-640	0

max. concrete compressive strain: 0.07 [‰]
max. concrete compressive stress: 292 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-3.125/0.000): 14040 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	640	5112	13	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2560	26846	10	OK
Concrete edge failure in direction x-**	2560	5042	51	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	640

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.833	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
291.00	420.25	1.000	1.000	0.817	1.000	27114

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
38351	0.700	26846	2560

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	4.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
144.00	288.00	1.000	0.800	1.000	12004

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
6722	0.750	5042	2560

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

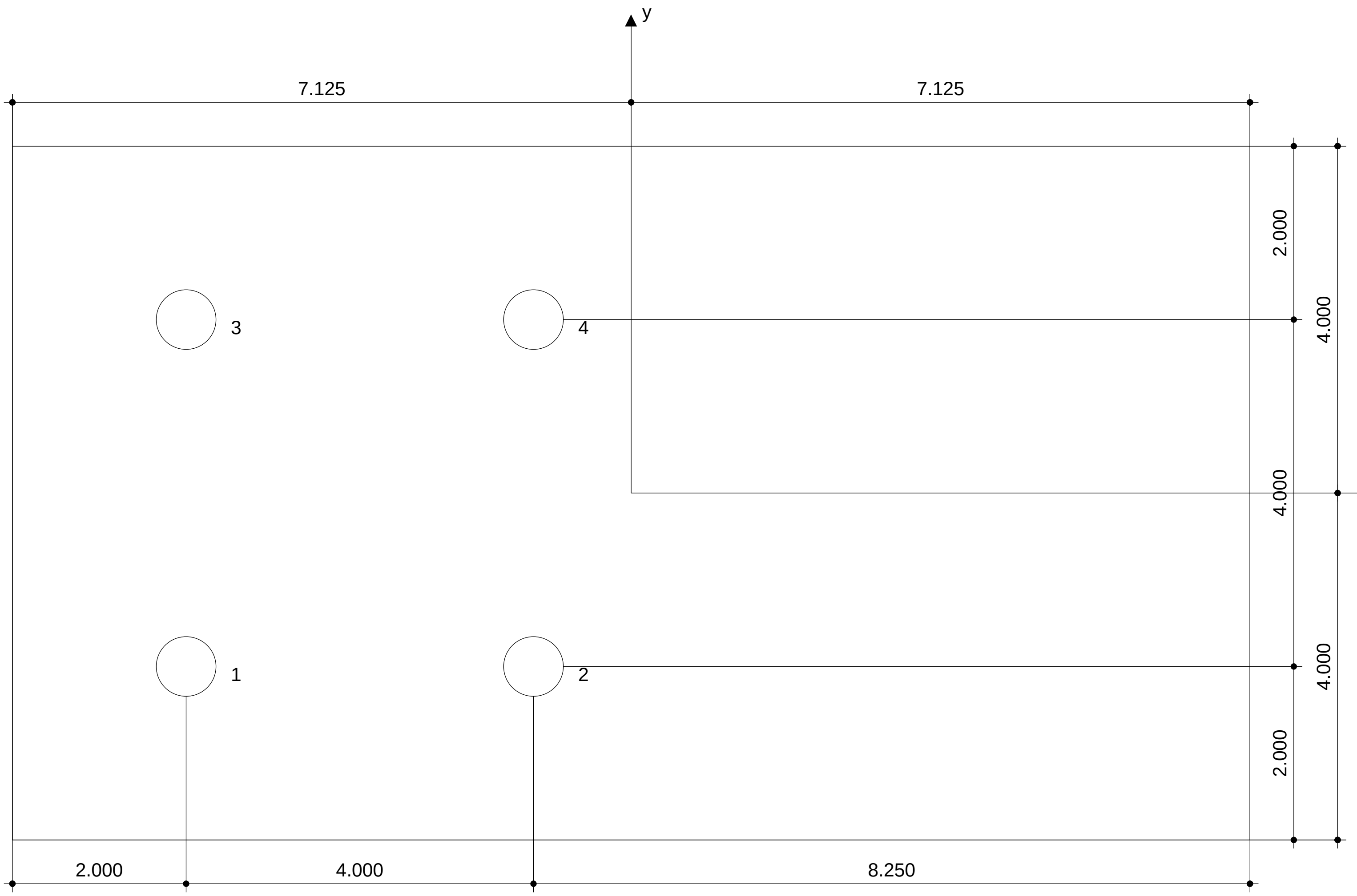
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-5.125	-2.000	10.000	14.250	4.000	8.000
2	-1.125	-2.000	14.000	10.250	4.000	8.000
3	-5.125	2.000	10.000	14.250	8.000	4.000
4	-1.125	2.000	14.000	10.250	8.000	4.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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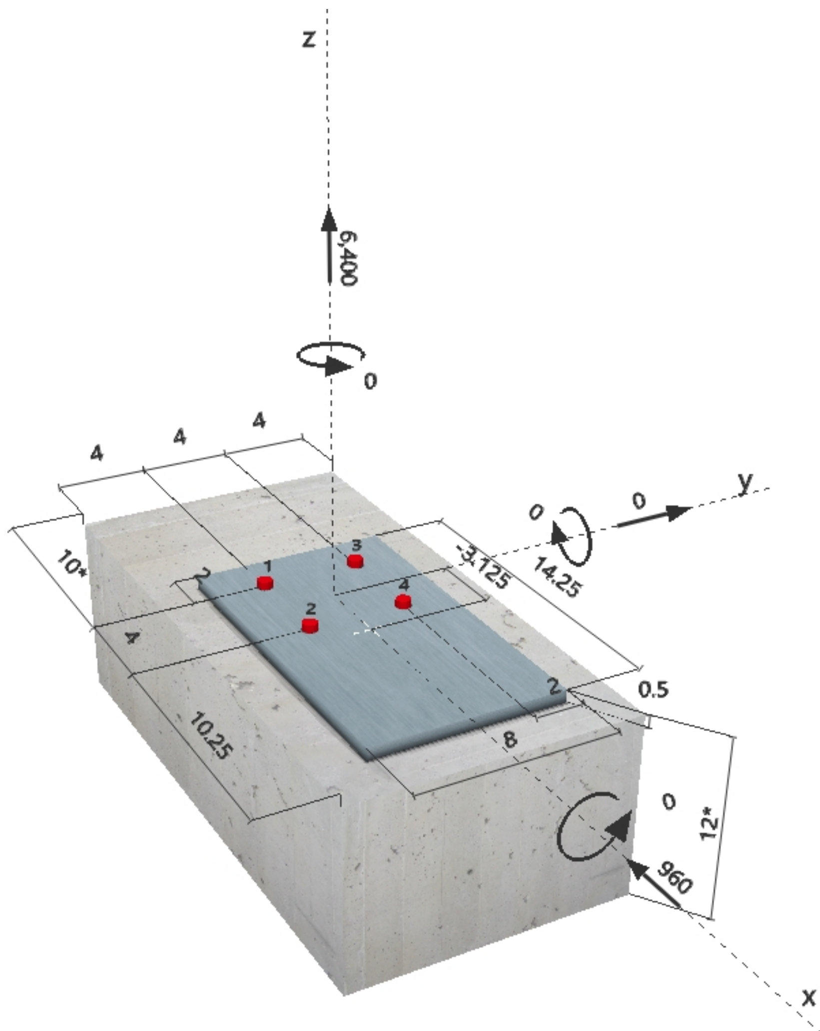
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B2-D, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 14.250 in. x 8.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

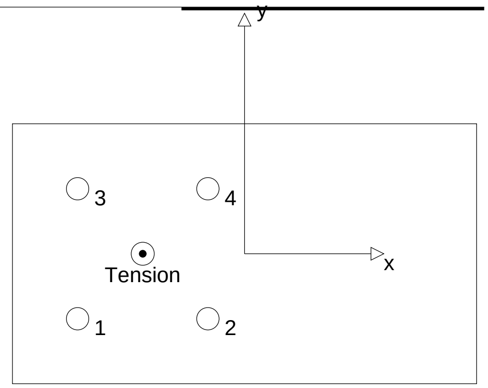
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1600	240	-240	0
2	1600	240	-240	0
3	1600	240	-240	0
4	1600	240	-240	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-3.125/0.000): 6400 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1600	9831	17	OK
Pullout Strength*	1600	14237	12	OK
Concrete Breakout Strength**	6400	13423	48	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\ A_{se,N}\ f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1600

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\ N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\ A_{brg}\ f'_c$ ACI 318-08 Eq. (D-15)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1600

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.833	0.000	0.000	4.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
291.00	420.25	1.000	1.000	0.817	1.000	27114

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
19175	0.700	13423	6400

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	240	5112	5	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	960	26846	4	OK
Concrete edge failure in direction x-**	960	5042	20	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	240

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.833	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
291.00	420.25	1.000	1.000	0.817	1.000	27114

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
38351	0.700	26846	960

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	4.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
144.00	288.00	1.000	0.800	1.000	12004

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
6722	0.750	5042	960

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.477	0.190	5/3	36	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

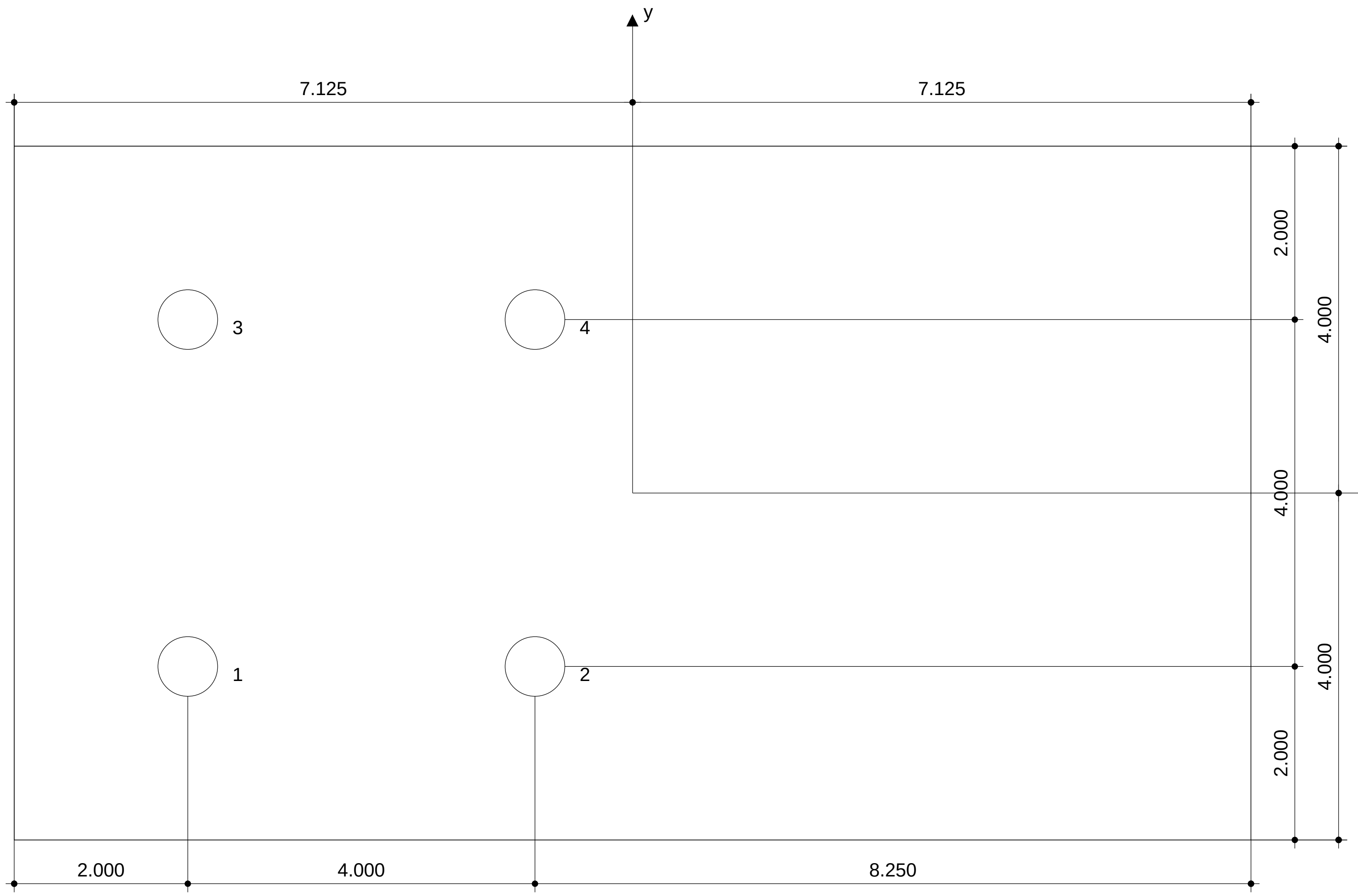
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-5.125	-2.000	10.000	14.250	4.000	8.000
2	-1.125	-2.000	14.000	10.250	4.000	8.000
3	-5.125	2.000	10.000	14.250	8.000	4.000
4	-1.125	2.000	14.000	10.250	8.000	4.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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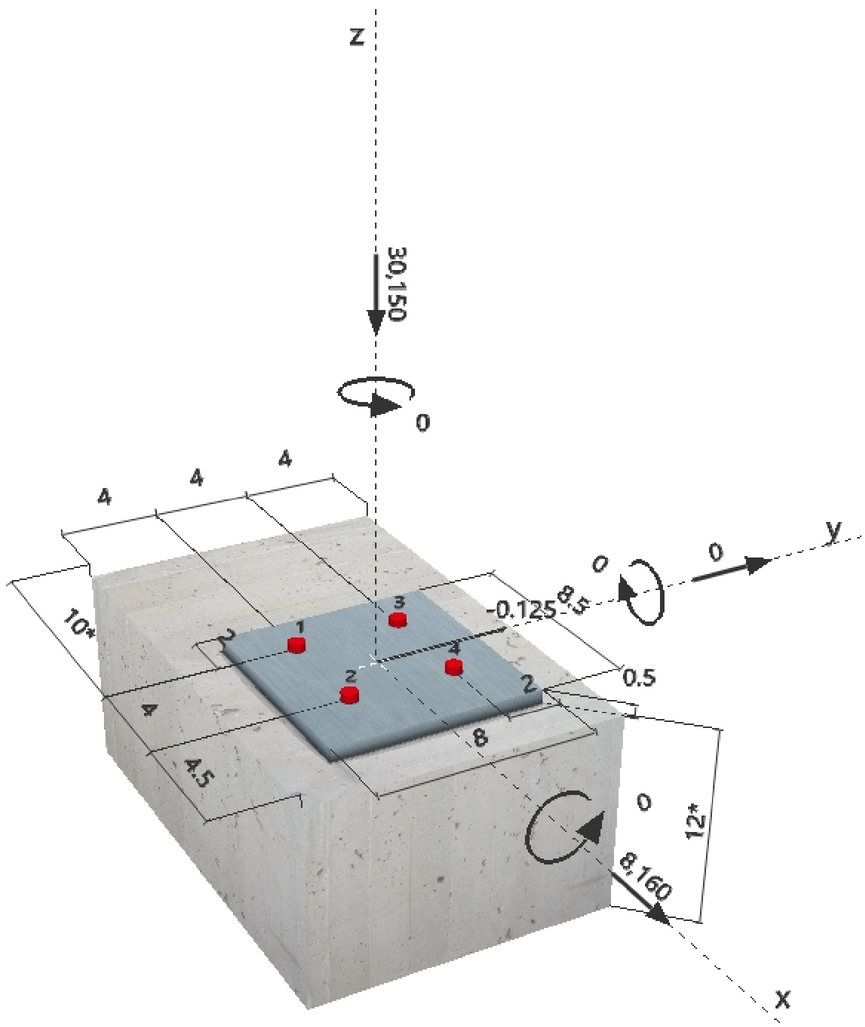
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B2-E, LC1 (B2-F SIMILAR)

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 8.500 in. x 8.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

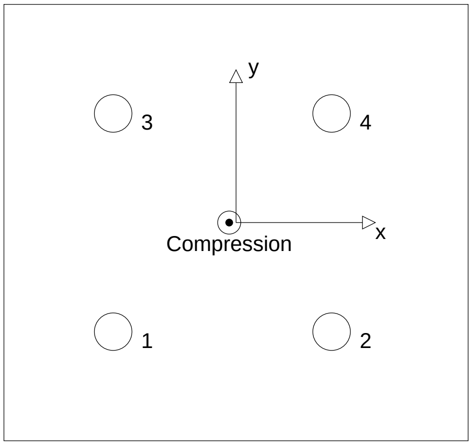
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	2040	2040	0
2	0	2040	2040	0
3	0	2040	2040	0
4	0	2040	2040	0

max. concrete compressive strain: 0.11 [‰]
max. concrete compressive stress: 482 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-0.125/0.000): 30150 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2040	5112	40	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8160	20809	40	OK
Concrete edge failure in direction x+**	8160	4149	197	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	2040

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
222.00	400.00	1.000	1.000	0.820	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
29727	0.700	20809	8160

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.500	4.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
81.00	91.13	1.000	0.878	1.000	5064

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
5532	0.750	4149	8160

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

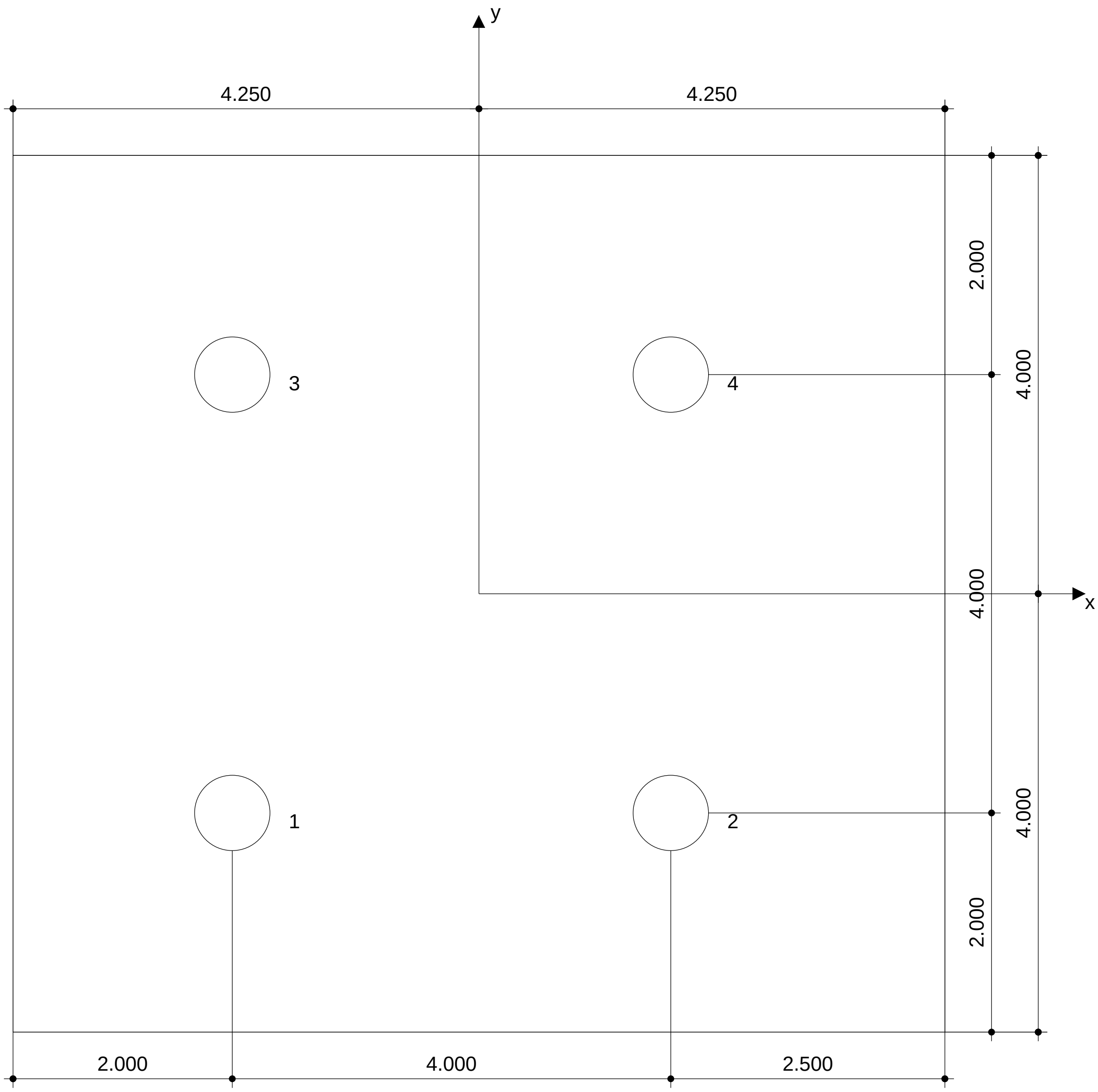
SEE CALCULATIONS
PAGE 547

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.250	-2.000	10.000	8.500	4.000	8.000
2	1.750	-2.000	14.000	4.500	4.000	8.000
3	-2.250	2.000	10.000	8.500	8.000	4.000
4	1.750	2.000	14.000	4.500	8.000	4.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Remarks; Your Cooperation Duties

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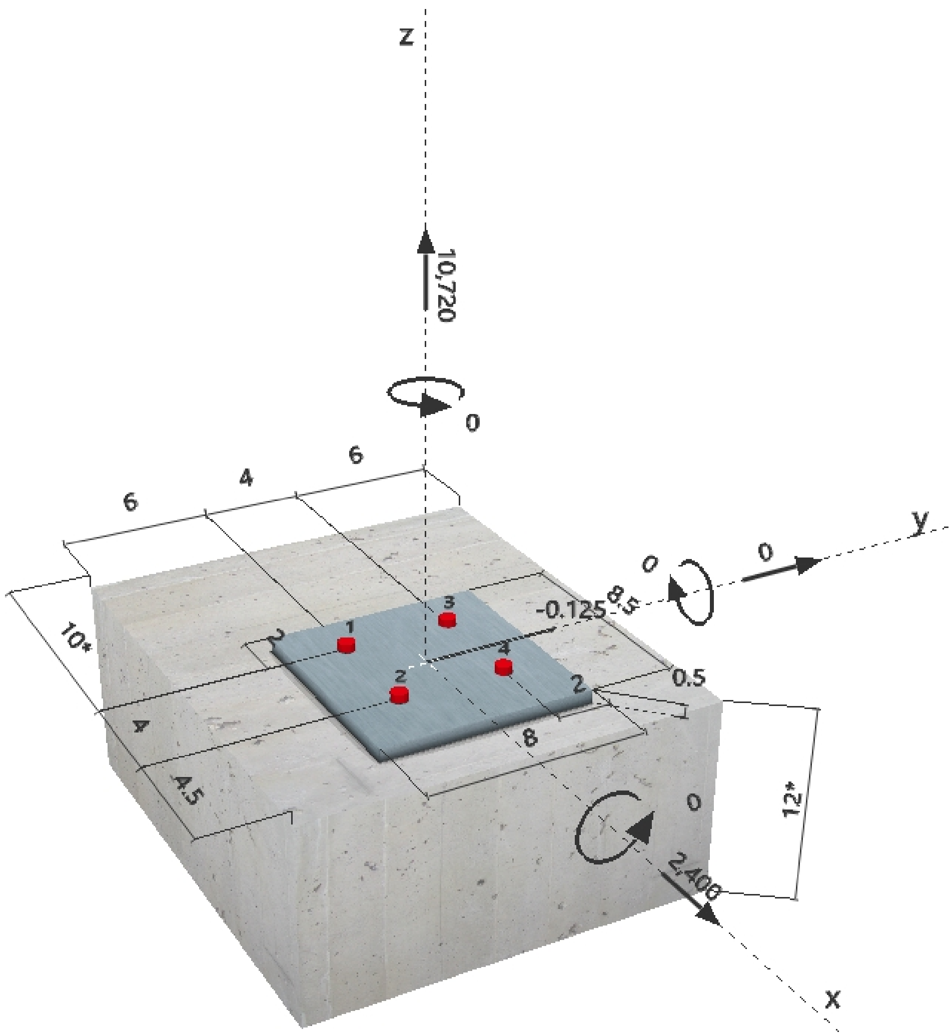
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B2-E, LC2 (B2-F SIMILAR)

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 8.500 in. x 8.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

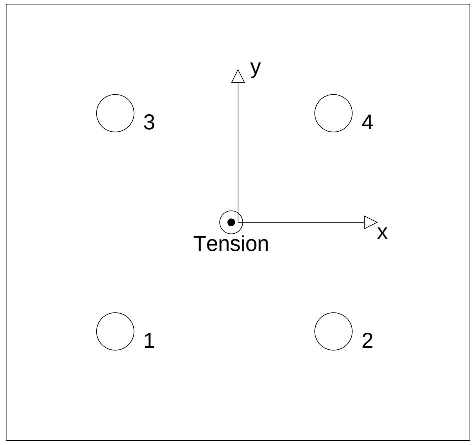
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2512	600	600	0
2	2848	600	600	0
3	2512	600	600	0
4	2848	600	600	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.125/0.000): 10720 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2848	9831	29	OK
Pullout Strength*	2848	14237	21	OK
Concrete Breakout Strength**	10720	13952	77	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	2848

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	2848

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.125	0.000	4.500	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
296.00	400.00	0.988	1.000	0.835	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
19931	0.700	13952	10720

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	600	5112	12	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2400	28253	9	OK
Concrete edge failure in direction x+**	2400	6092	40	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	600

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
296.00	400.00	1.000	1.000	0.835	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
40361	0.700	28253	2400

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_V}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.500	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
108.00	91.13	1.000	0.967	1.000	5064

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
8123	0.750	6092	2400

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.768	0.394	5/3	86	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

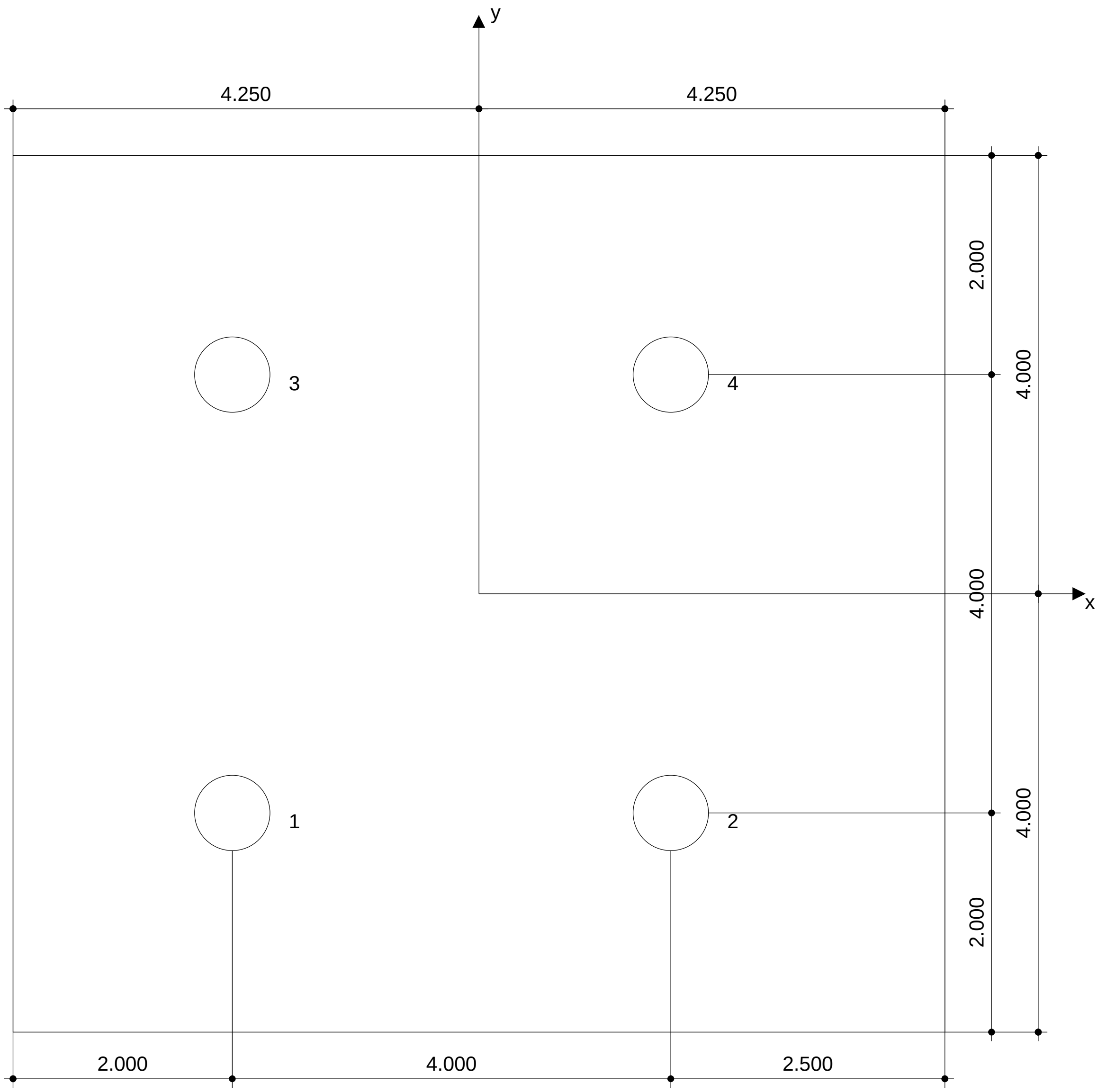
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.250	-2.000	10.000	8.500	6.000	10.000
2	1.750	-2.000	14.000	4.500	6.000	10.000
3	-2.250	2.000	10.000	8.500	10.000	6.000
4	1.750	2.000	14.000	4.500	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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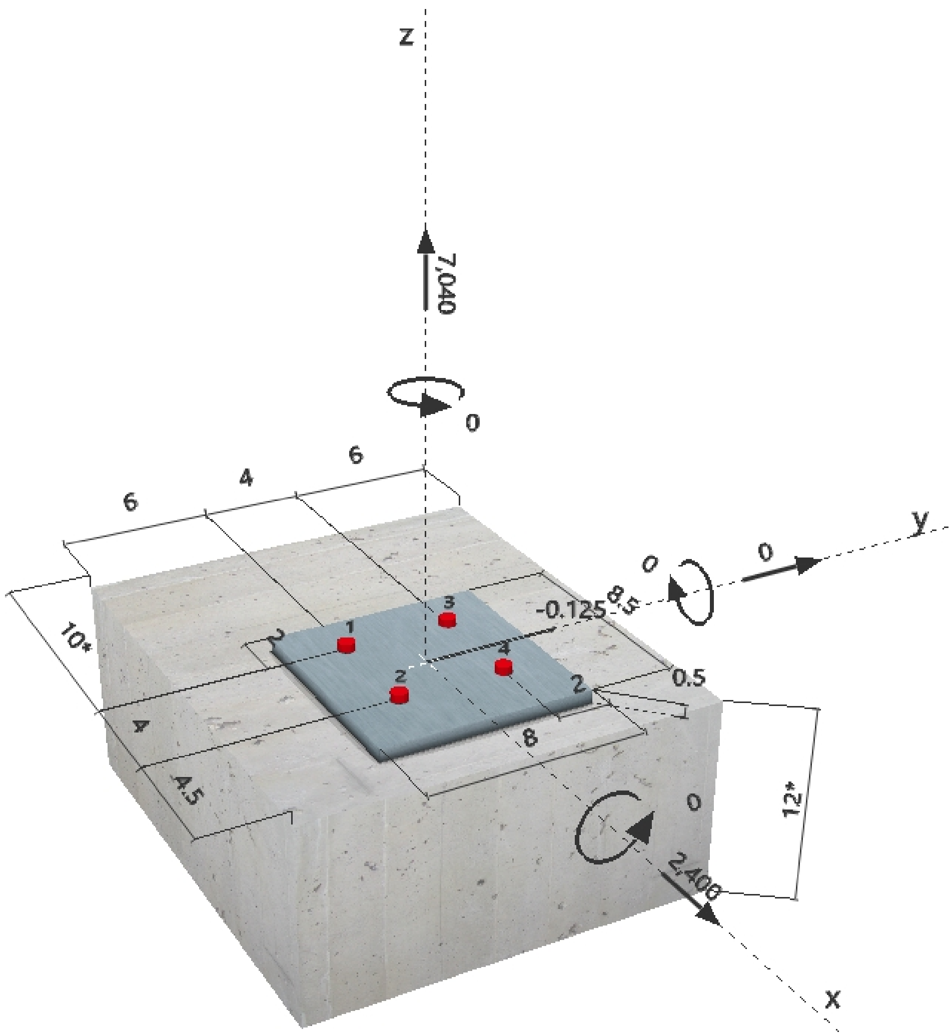
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B3-A (B3-B, B3-C, B3-D SIMILAR)

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 8.500 in. x 8.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

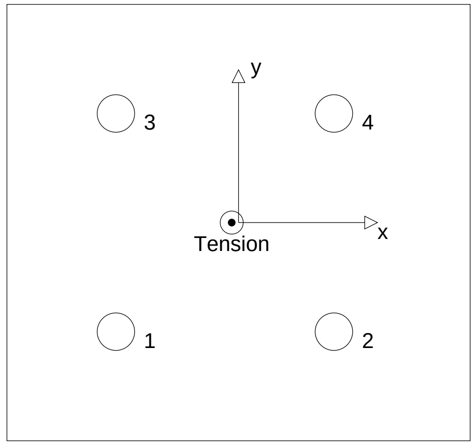
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1650	600	600	0
2	1870	600	600	0
3	1650	600	600	0
4	1870	600	600	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.125/0.000): 7040 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1870	9831	20	OK
Pullout Strength*	1870	14237	14	OK
Concrete Breakout Strength**	7040	13952	51	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1870

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1870

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.125	0.000	4.500	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
296.00	400.00	0.988	1.000	0.835	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
19931	0.700	13952	7040

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	600	5112	12	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2400	28253	9	OK
Concrete edge failure in direction x+**	2400	6092	40	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	600

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.500

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
296.00	400.00	1.000	1.000	0.835	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
40361	0.700	28253	2400

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.500	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
108.00	91.13	1.000	0.967	1.000	5064

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
8123	0.750	6092	2400

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.505	0.394	5/3	54	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

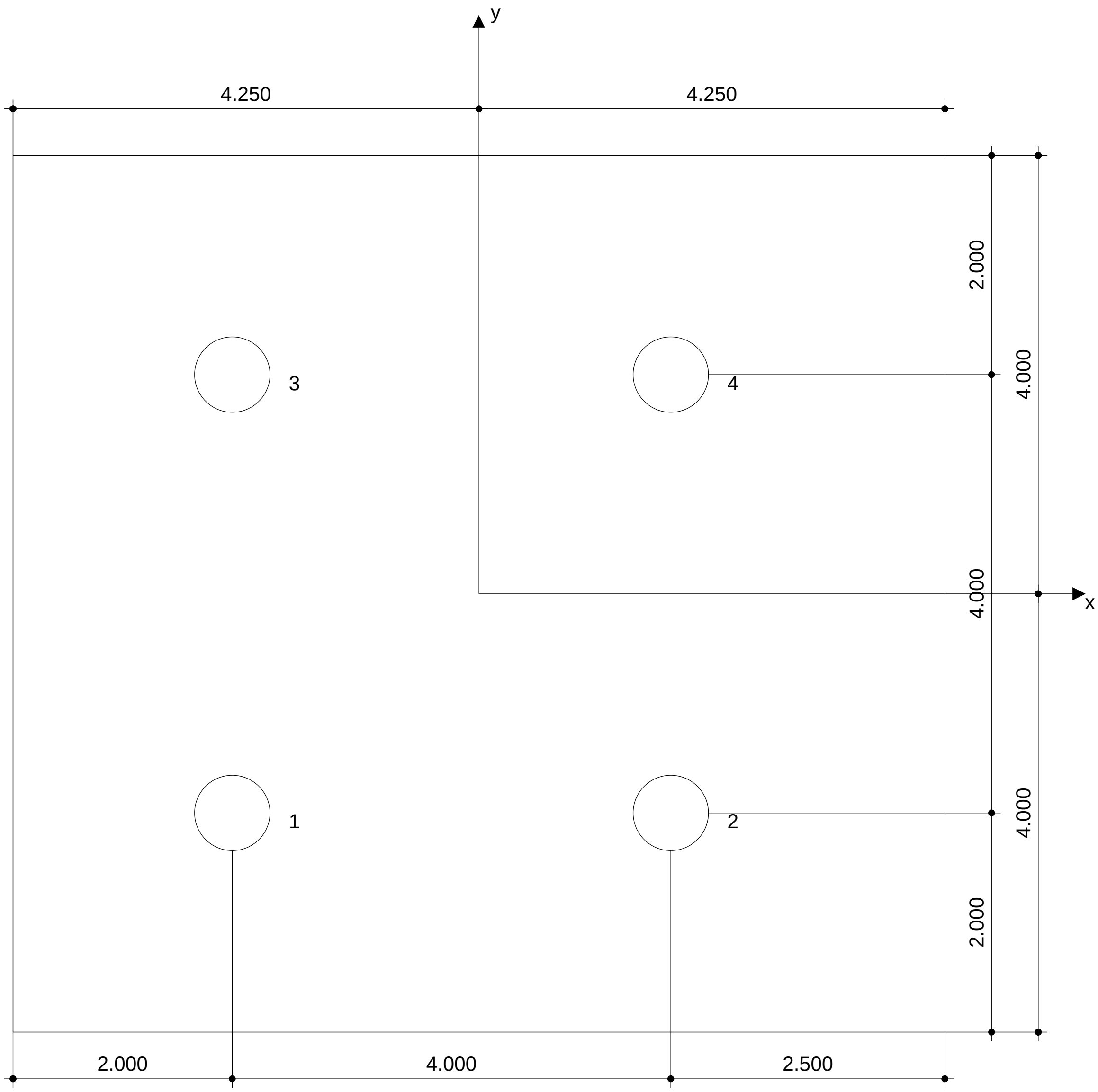
- Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading! Input data and results must be checked for agreement with the existing conditions 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening meets the design criteria!

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.250	-2.000	10.000	8.500	6.000	10.000
2	1.750	-2.000	14.000	4.500	6.000	10.000
3	-2.250	2.000	10.000	8.500	10.000	6.000
4	1.750	2.000	14.000	4.500	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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- 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.

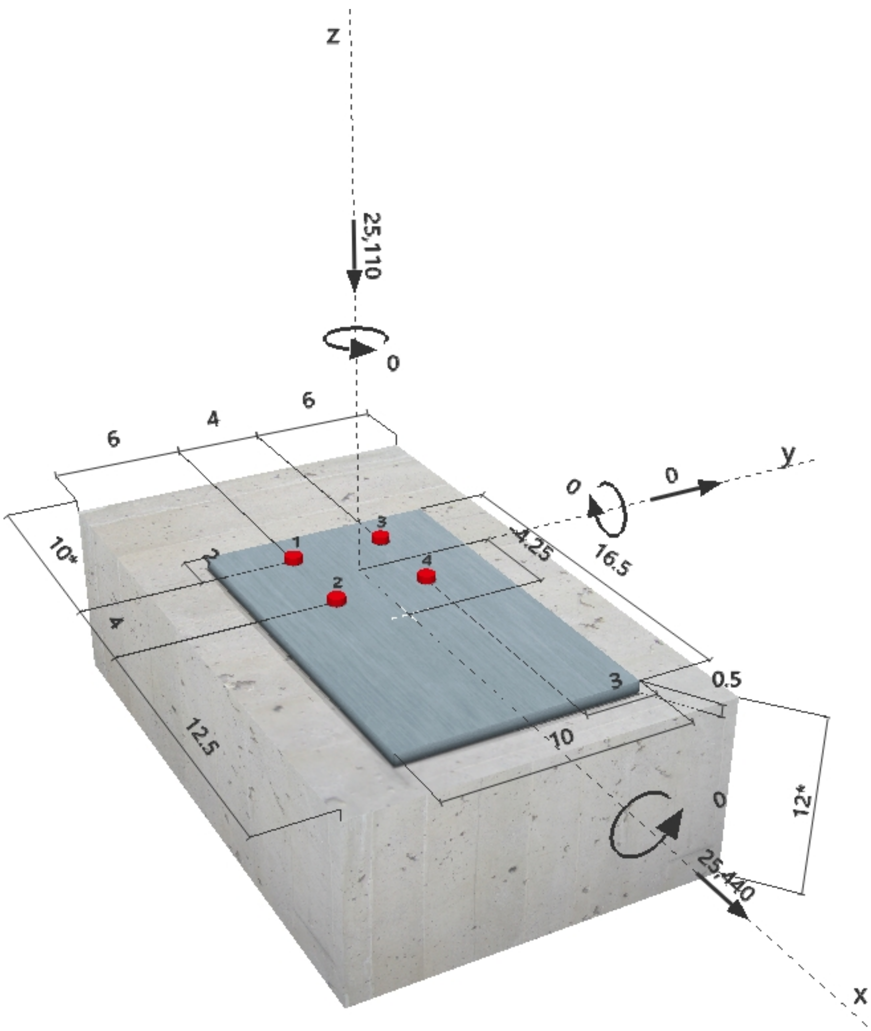
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B3-F, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 16.500 in. x 10.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

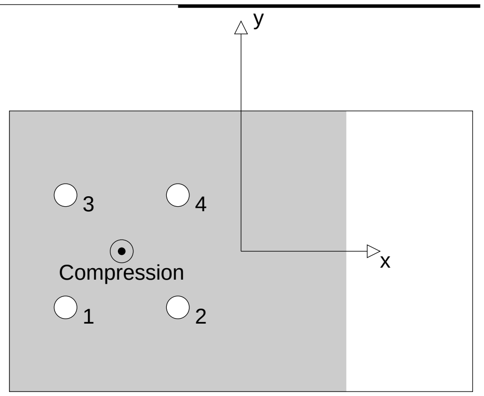
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	0	6360	6360	0
2	0	6360	6360	0
3	0	6360	6360	0
4	0	6360	6360	0

max. concrete compressive strain: 0.10 [‰]
max. concrete compressive stress: 418 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-4.250/0.000): 25110 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	6360	7555	85	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	25440	38627	66	OK
Concrete edge failure in direction x+**	25440	7824	326	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	6360

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
384.00	400.00	1.000	1.000	0.880	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
55182	0.700	38627	25440

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
192.00	288.00	1.000	0.850	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
10432	0.750	7824	25440

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

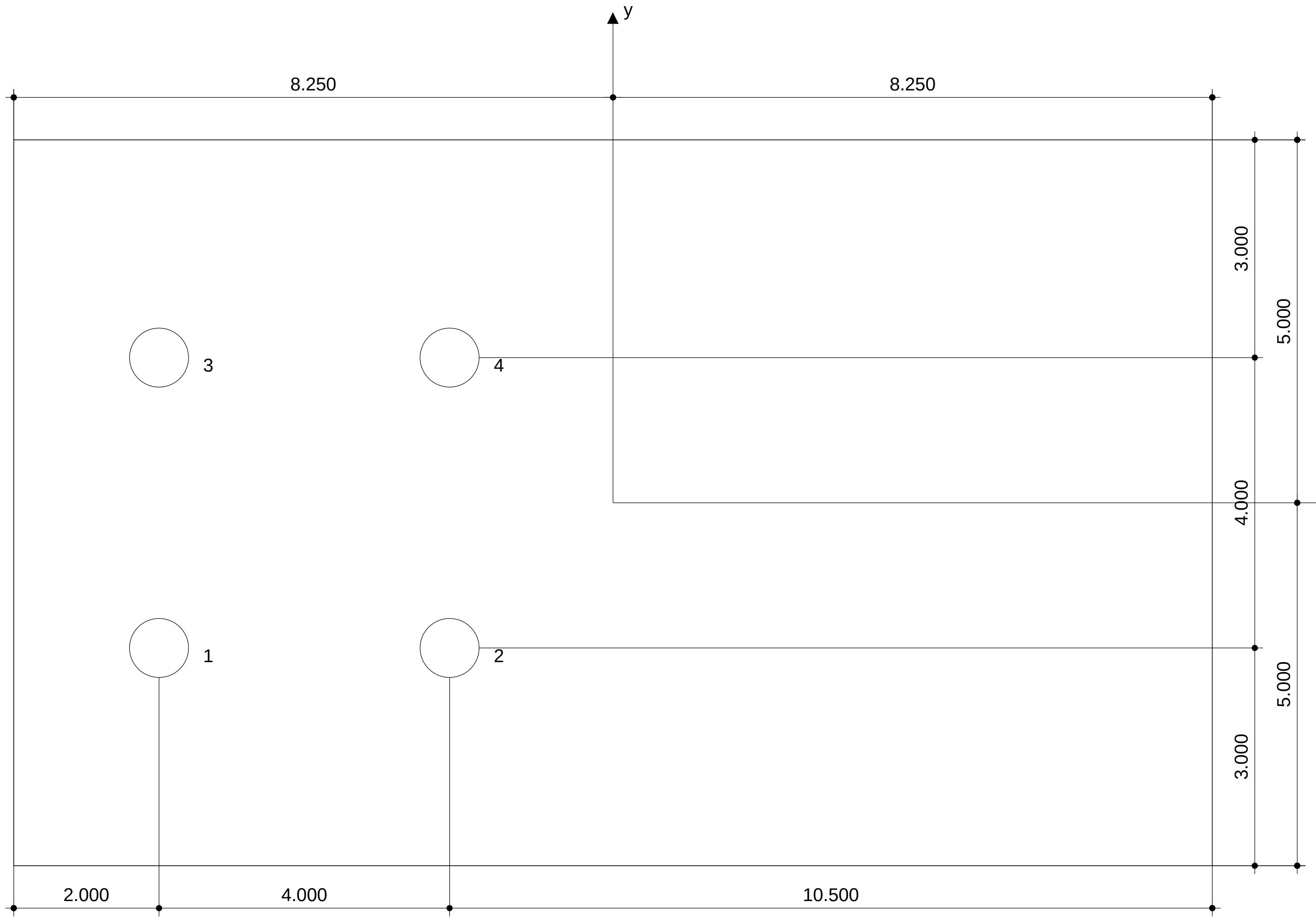
SEE CALCULATIONS
PAGE 547

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.500 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.250	-2.000	10.000	16.500	6.000	10.000
2	-2.250	-2.000	14.000	12.500	6.000	10.000
3	-6.250	2.000	10.000	16.500	10.000	6.000
4	-2.250	2.000	14.000	12.500	10.000	6.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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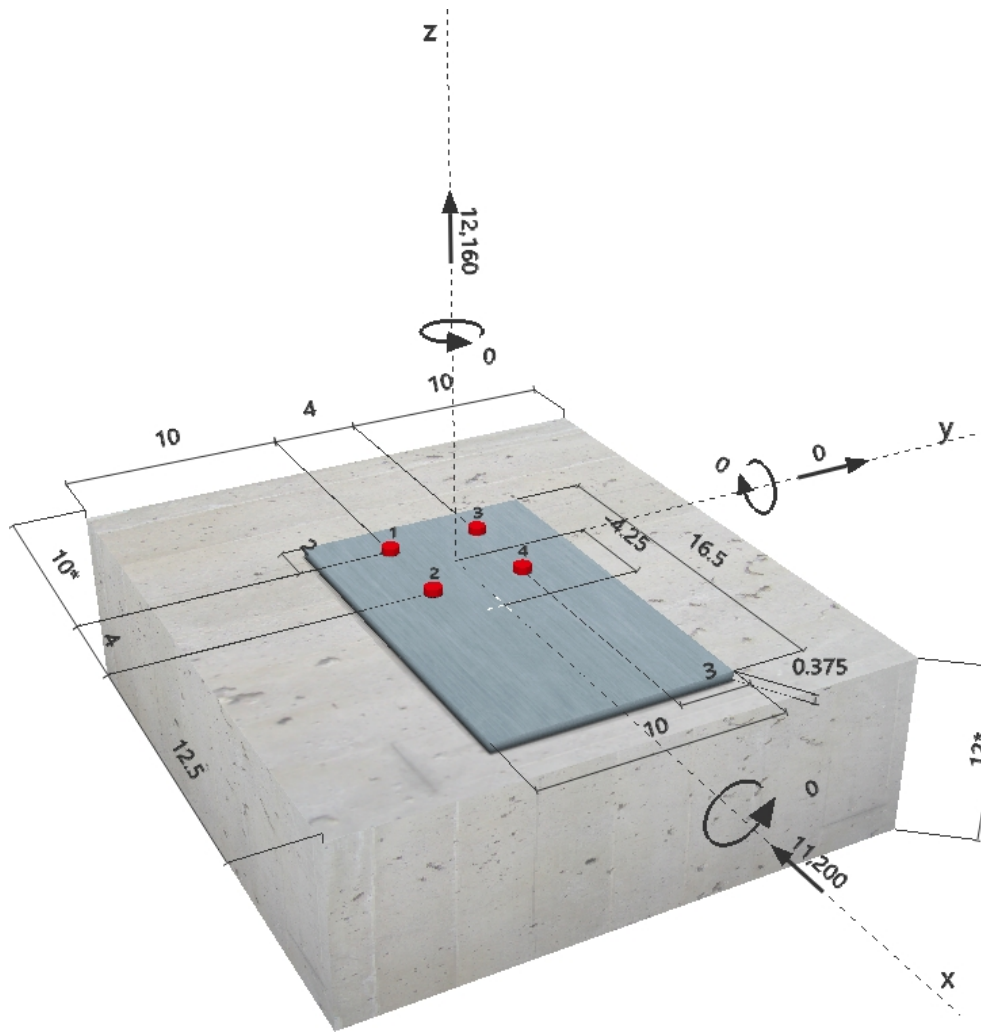
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B3-F, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 16.500 in. x 10.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

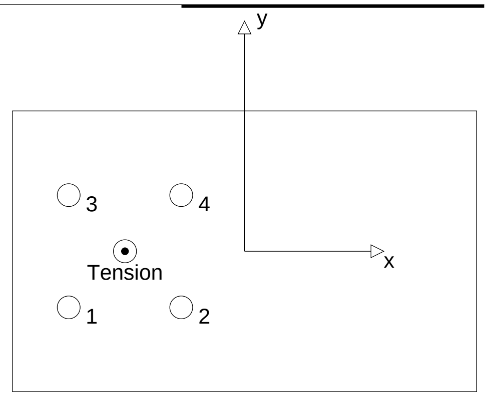
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	3040	2800	-2800	0
2	3040	2800	-2800	0
3	3040	2800	-2800	0
4	3040	2800	-2800	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-4.250/0.000): 12160 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	**Capacity ϕN_n [lb]**	**Utilization $\beta_N = N_{ua}/\phi N_n$**	**Status**
Steel Strength*	3040	14529	21	OK
Pullout Strength*	3040	20509	15	OK
Concrete Breakout Strength**	12160	30562	40	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	3040

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	3040

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
8.333	0.000	0.000	10.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
636.00	625.00	1.000	1.000	0.940	1.000	36515

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
43660	0.700	30562	12160

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2800	7555	38	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	11200	61124	19	OK
Concrete edge failure in direction x-**	11200	13117	86	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	2800

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	8.333	0.000	0.000	10.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
636.00	625.00	1.000	1.000	0.940	1.000	36515

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
87320	0.700	61124	11200

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	10.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
288.00	288.00	1.000	0.950	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
17489	0.750	13117	11200

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.398	0.854	5/3	99	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

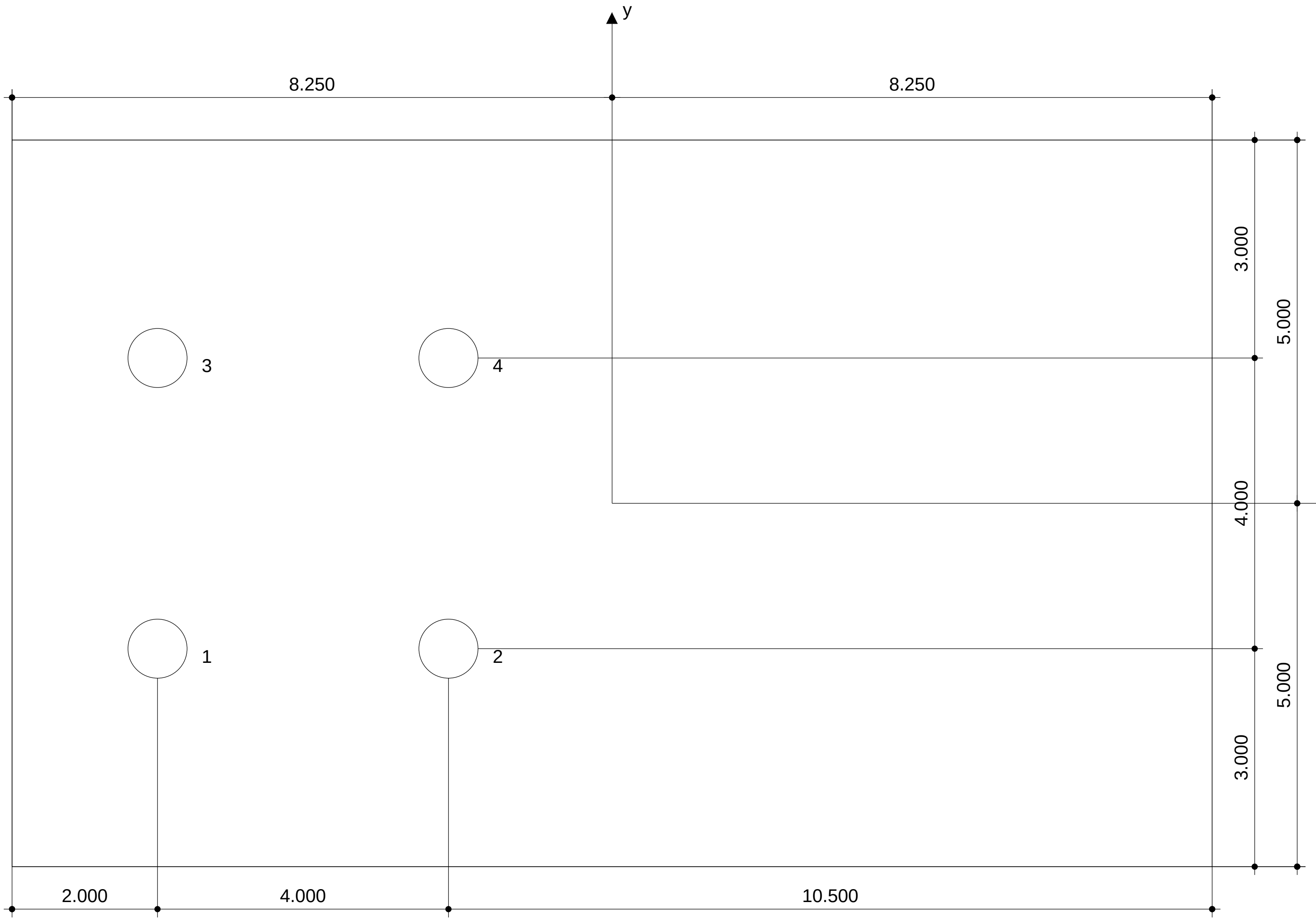
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.250	-2.000	10.000	16.500	10.000	14.000
2	-2.250	-2.000	14.000	12.500	10.000	14.000
3	-6.250	2.000	10.000	16.500	14.000	10.000
4	-2.250	2.000	14.000	12.500	14.000	10.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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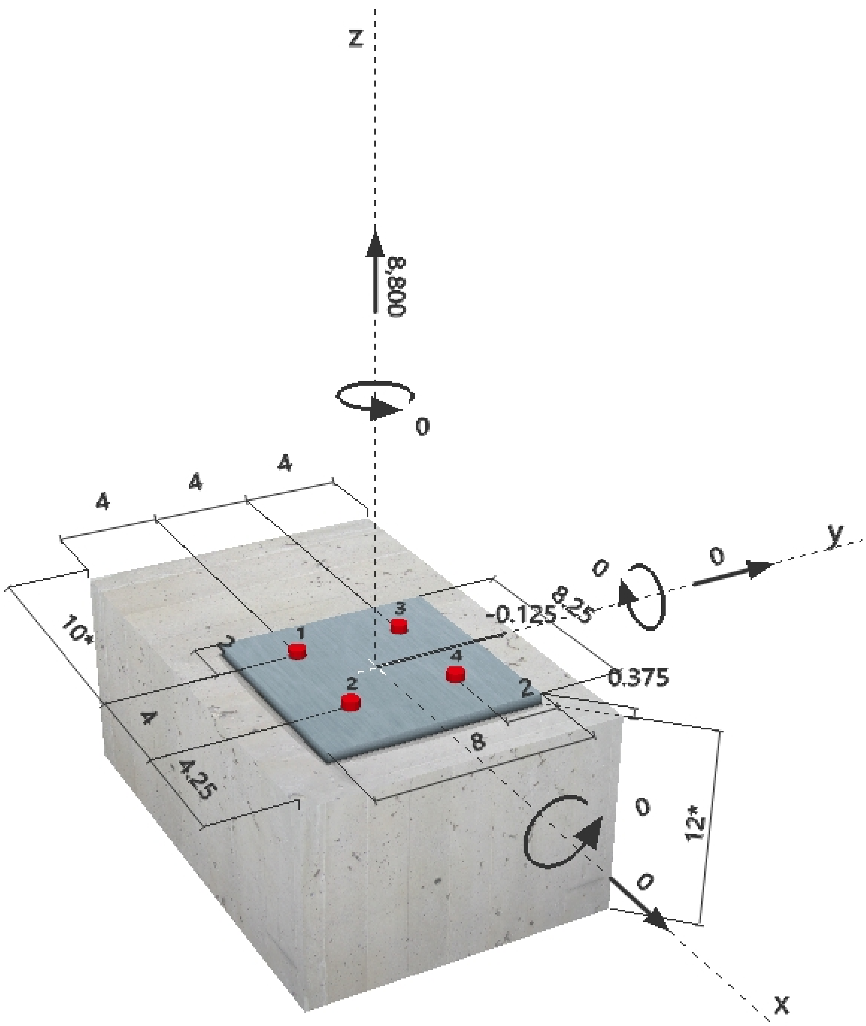
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-A, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 8.250 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

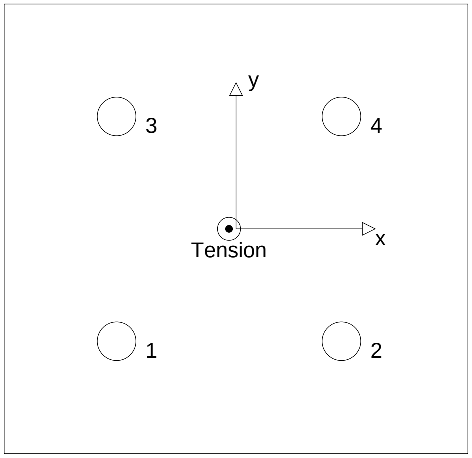
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2200	0	0	0
2	2200	0	0	0
3	2200	0	0	0
4	2200	0	0	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.125/0.000): 8800 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2200	9831	23	OK
Pullout Strength*	2200	14237	16	OK
Concrete Breakout Strength**	8800	10264	86	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\ A_{se,N}\ f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	2200

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\ N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\ A_{brg}\ f'_c$ ACI 318-08 Eq. (D-15)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	2200

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	4.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
219.00	400.00	1.000	1.000	0.820	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
14662	0.700	10264	8800

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

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

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

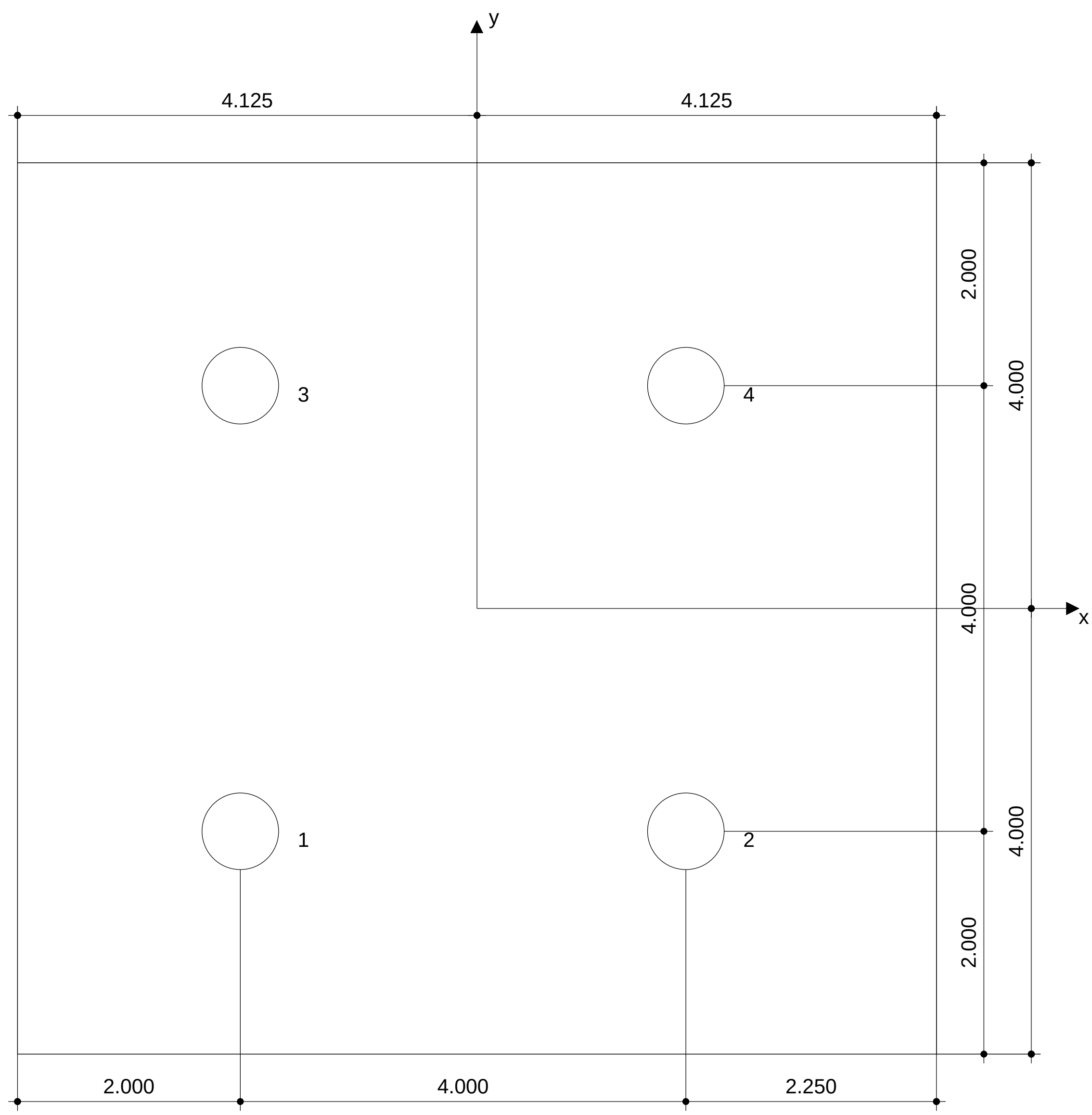
Fastening meets the design criteria!

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.125	-2.000	10.000	8.250	4.000	8.000
2	1.875	-2.000	14.000	4.250	4.000	8.000
3	-2.125	2.000	10.000	8.250	8.000	4.000
4	1.875	2.000	14.000	4.250	8.000	4.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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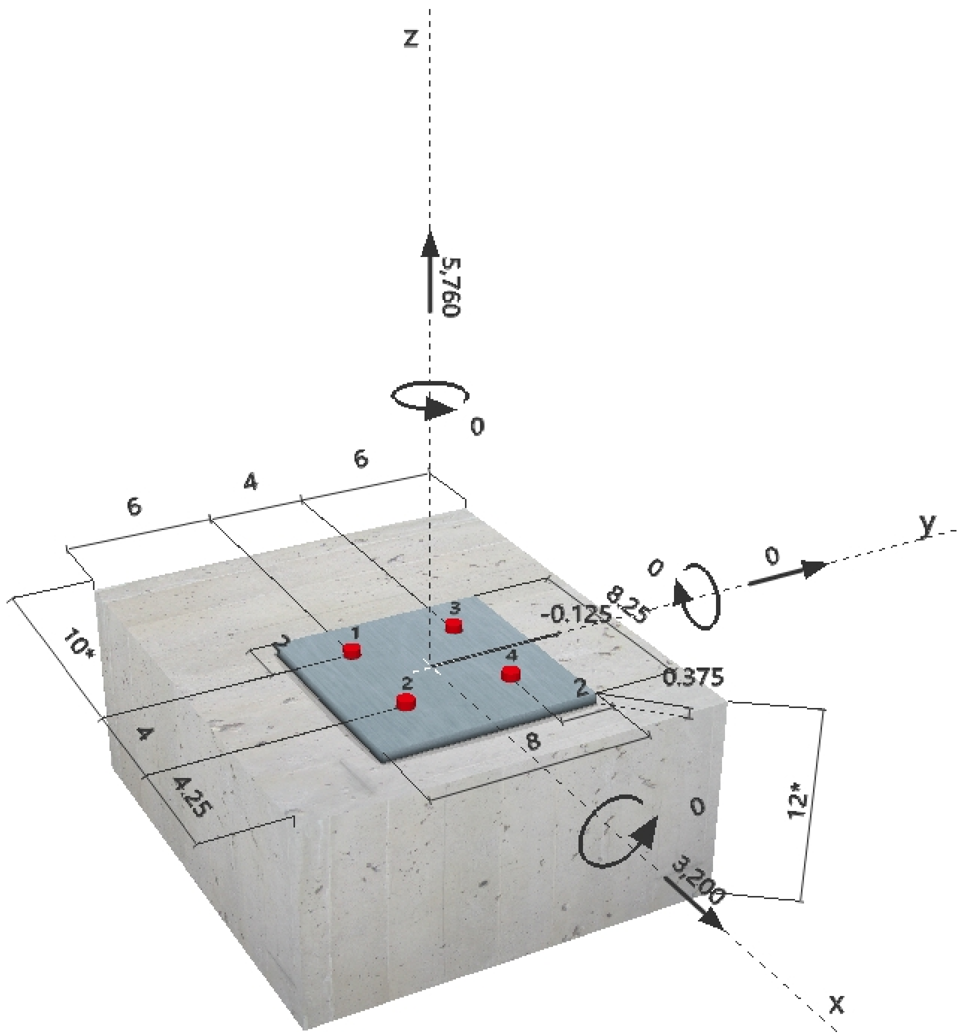
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-A, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 8.250 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

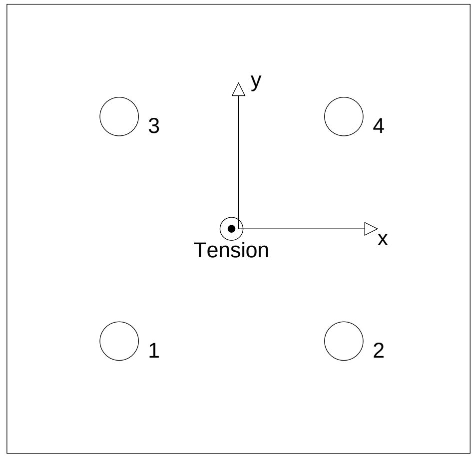
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1440	800	800	0
2	1440	800	800	0
3	1440	800	800	0
4	1440	800	800	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.125/0.000): 5760 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1440	9831	15	OK
Pullout Strength*	1440	14237	11	OK
Concrete Breakout Strength**	5760	13810	42	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1440

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1440

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	4.250	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
292.00	400.00	1.000	1.000	0.828	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
19729	0.700	13810	5760

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	800	5112	16	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	3200	27621	12	OK
Concrete edge failure in direction x+**	3200	6016	54	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	800

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.250

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
292.00	400.00	1.000	1.000	0.828	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
39458	0.700	27621	3200

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
4.250	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
102.00	81.28	1.000	0.982	1.000	4648

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
8022	0.750	6016	3200

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.417	0.532	5/3	59	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

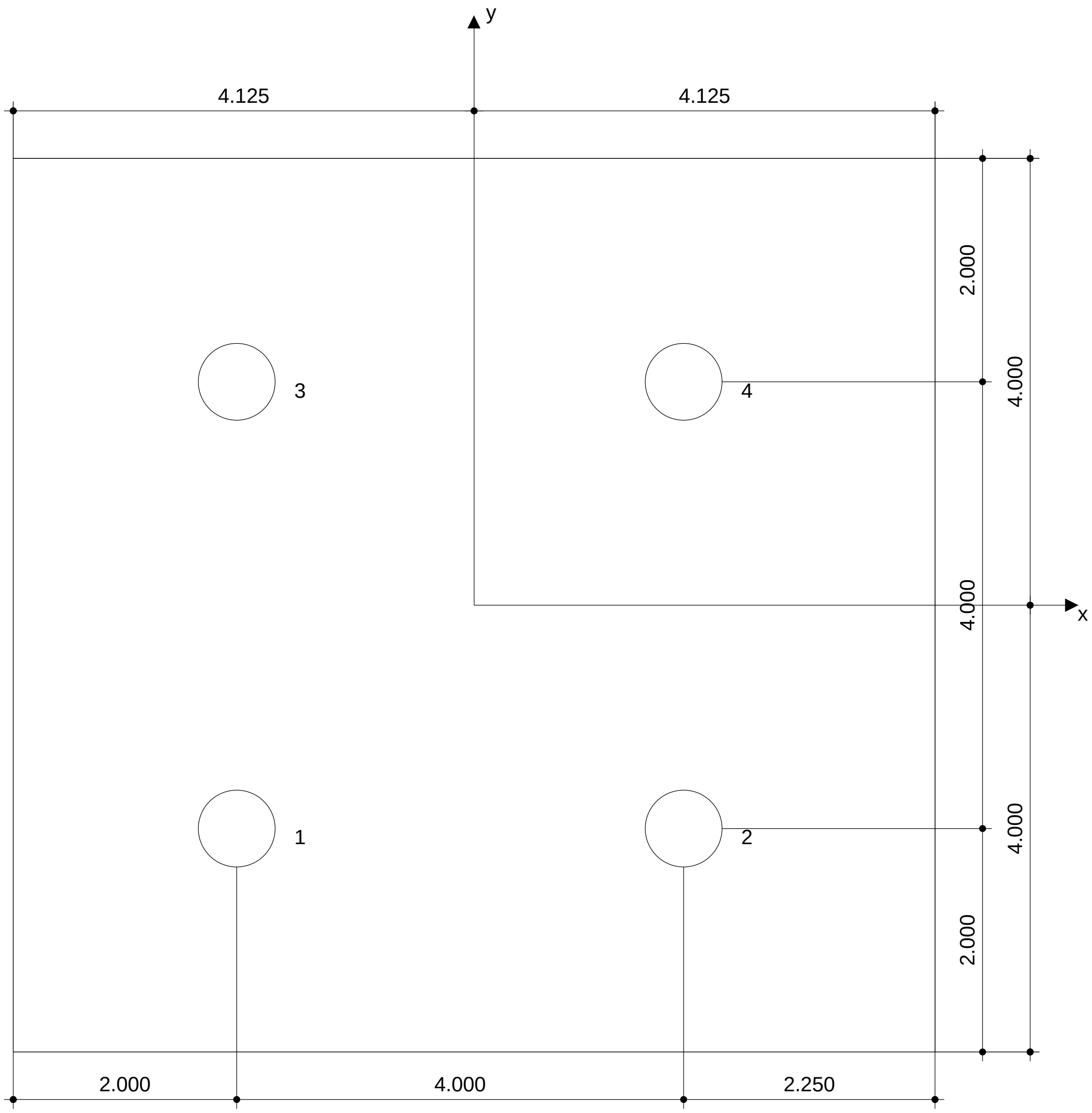
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.125	-2.000	10.000	8.250	6.000	10.000
2	1.875	-2.000	14.000	4.250	6.000	10.000
3	-2.125	2.000	10.000	8.250	10.000	6.000
4	1.875	2.000	14.000	4.250	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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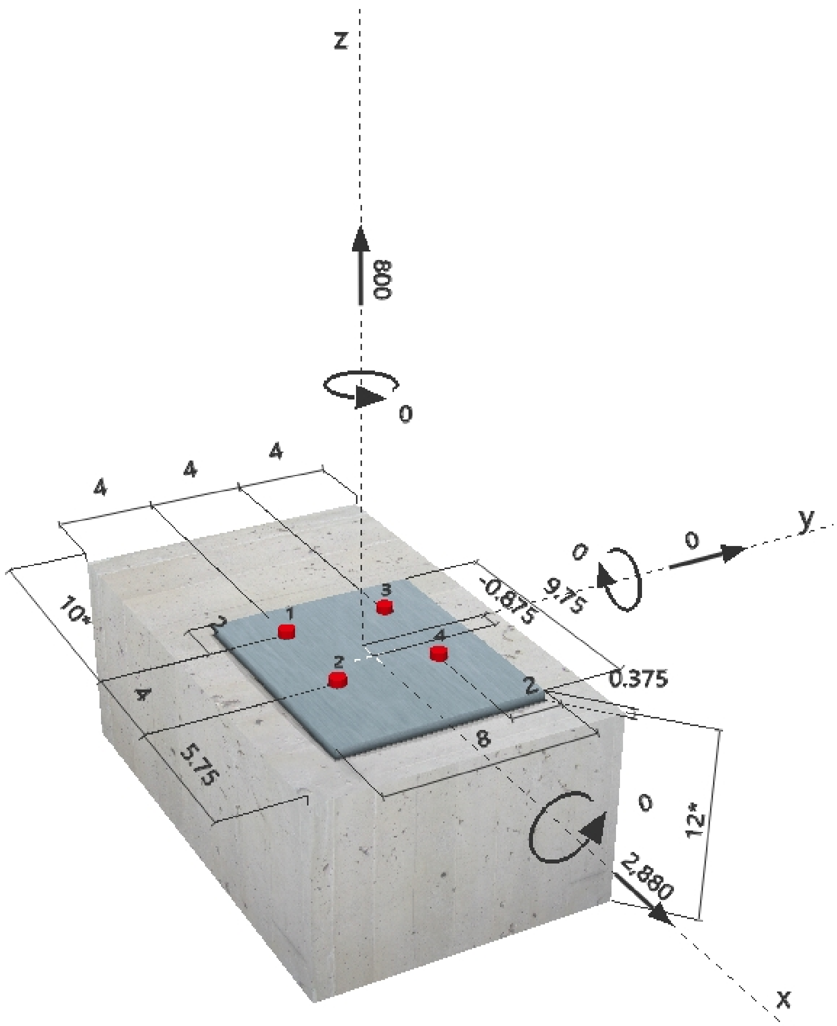
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-B, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 9.750 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

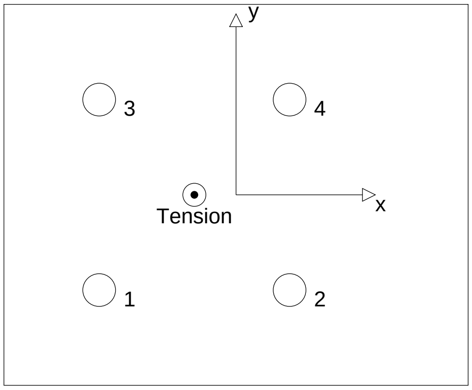
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	200	720	720	0
2	200	720	720	0
3	200	720	720	0
4	200	720	720	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.875/0.000): 800 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	200	9831	3	OK
Pullout Strength*	200	14237	2	OK
Concrete Breakout Strength**	800	11107	8	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	200

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	200

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	4.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
237.00	400.00	1.000	1.000	0.820	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
15867	0.700	11107	800

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	720	5112	15	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2880	22215	13	OK
Concrete edge failure in direction x+**	2880	4483	65	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	720

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
237.00	400.00	1.000	1.000	0.820	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
31736	0.700	22215	2880

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
5.750	4.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
103.50	148.78	1.000	0.839	1.000	7315

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
5978	0.750	4483	2880

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.072	0.642	5/3	50	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

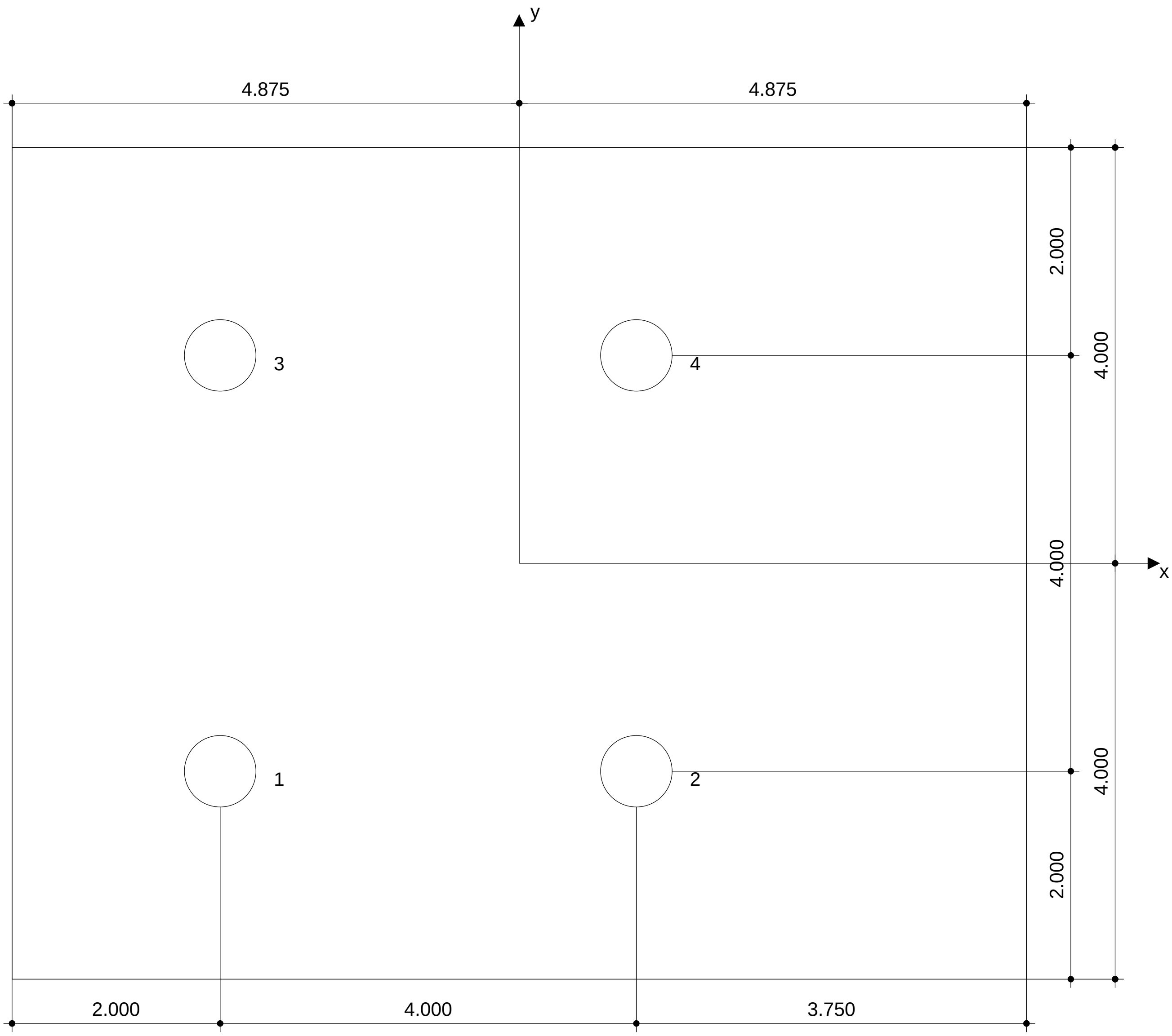
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.875	-2.000	10.000	9.750	4.000	8.000
2	1.125	-2.000	14.000	5.750	4.000	8.000
3	-2.875	2.000	10.000	9.750	8.000	4.000
4	1.125	2.000	14.000	5.750	8.000	4.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

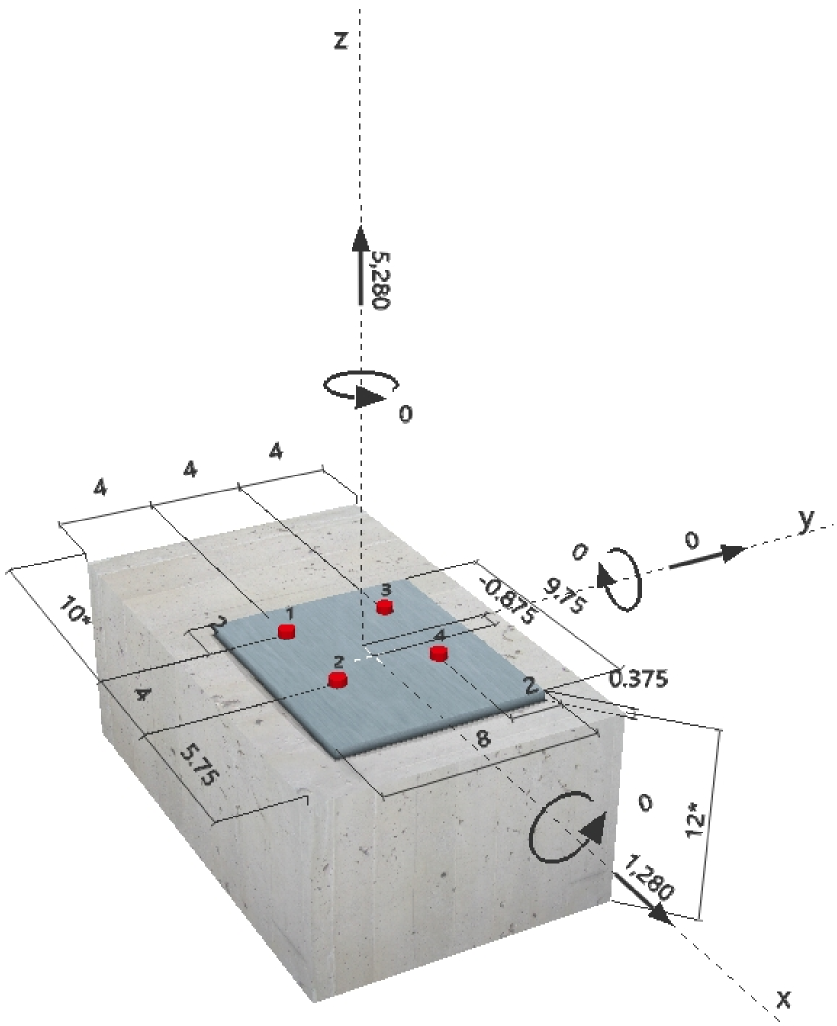
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-B, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 9.750 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A; edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

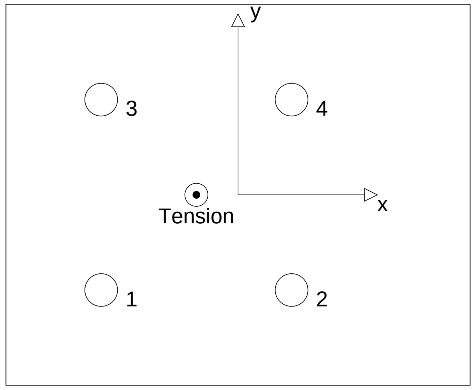
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1320	320	320	0
2	1320	320	320	0
3	1320	320	320	0
4	1320	320	320	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-0.875/0.000): 5280 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1320	9831	14	OK
Pullout Strength*	1320	14237	10	OK
Concrete Breakout Strength**	5280	11107	48	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1320

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1320

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	4.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
237.00	400.00	1.000	1.000	0.820	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
15867	0.700	11107	5280

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	320	5112	7	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1280	22215	6	OK
Concrete edge failure in direction x+**	1280	4483	29	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	320

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
237.00	400.00	1.000	1.000	0.820	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
31736	0.700	22215	1280

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
5.750	4.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
103.50	148.78	1.000	0.839	1.000	7315

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
5978	0.750	4483	1280

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.475	0.286	5/3	42	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

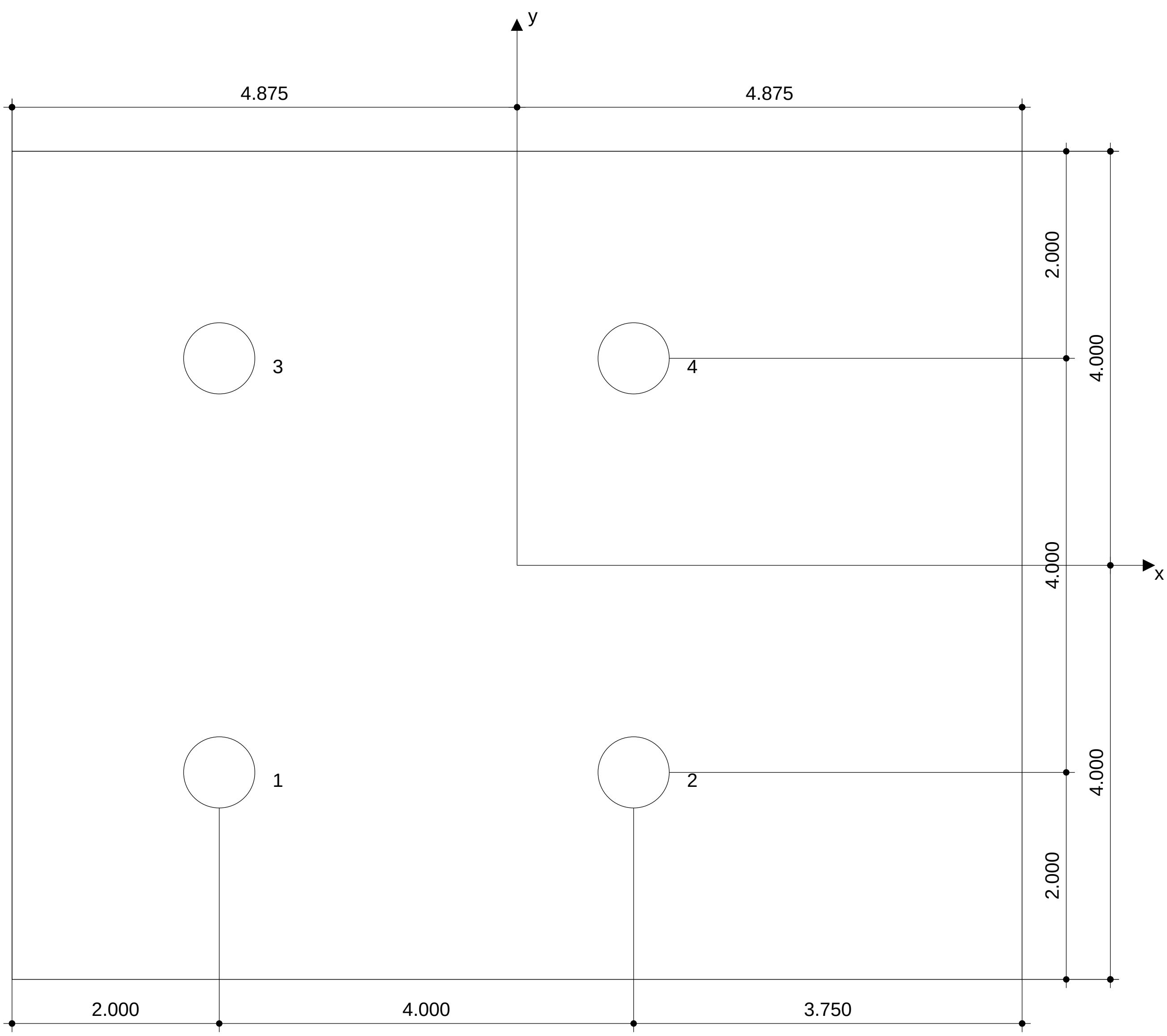
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.875	-2.000	10.000	9.750	4.000	8.000
2	1.125	-2.000	14.000	5.750	4.000	8.000
3	-2.875	2.000	10.000	9.750	8.000	4.000
4	1.125	2.000	14.000	5.750	8.000	4.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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- 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.

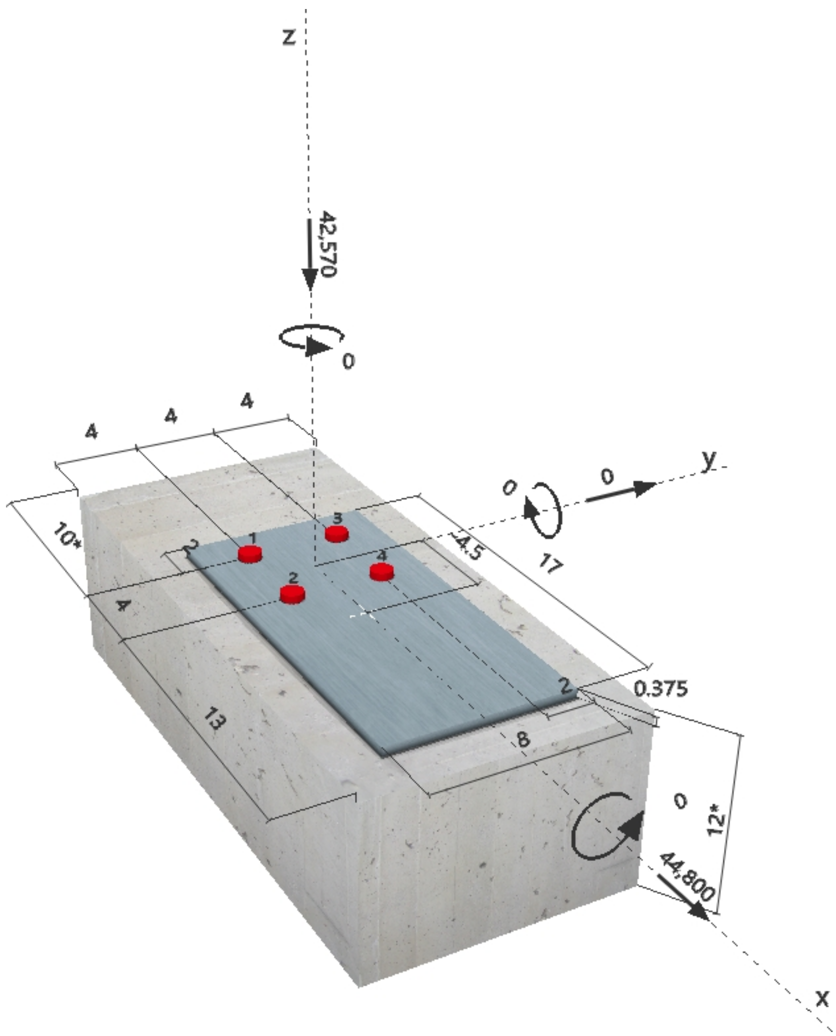
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-C, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 17.000 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



2 Load case/Resulting anchor forces

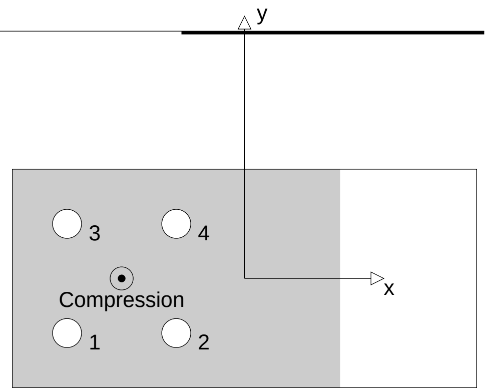
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	11200	11200	0
2	0	11200	11200	0
3	0	11200	11200	0
4	0	11200	11200	0

max. concrete compressive strain: 0.20 [‰]
max. concrete compressive stress: 887 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-4.500/0.000): 42570 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	11200	13708	82	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	44800	26995	166	not recommended
Concrete edge failure in direction x+**	44800	6295	712	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

V_{sa} [lb]
21089

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
21089	0.650	13708	11200

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	4.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
288.00	400.00	1.000	1.000	0.820	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
38565	0.700	26995	44800

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	4.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
7.500	1.000	1.000	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
144.00	288.00	1.000	0.800	1.000	14989

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
8394	0.750	6295	44800

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

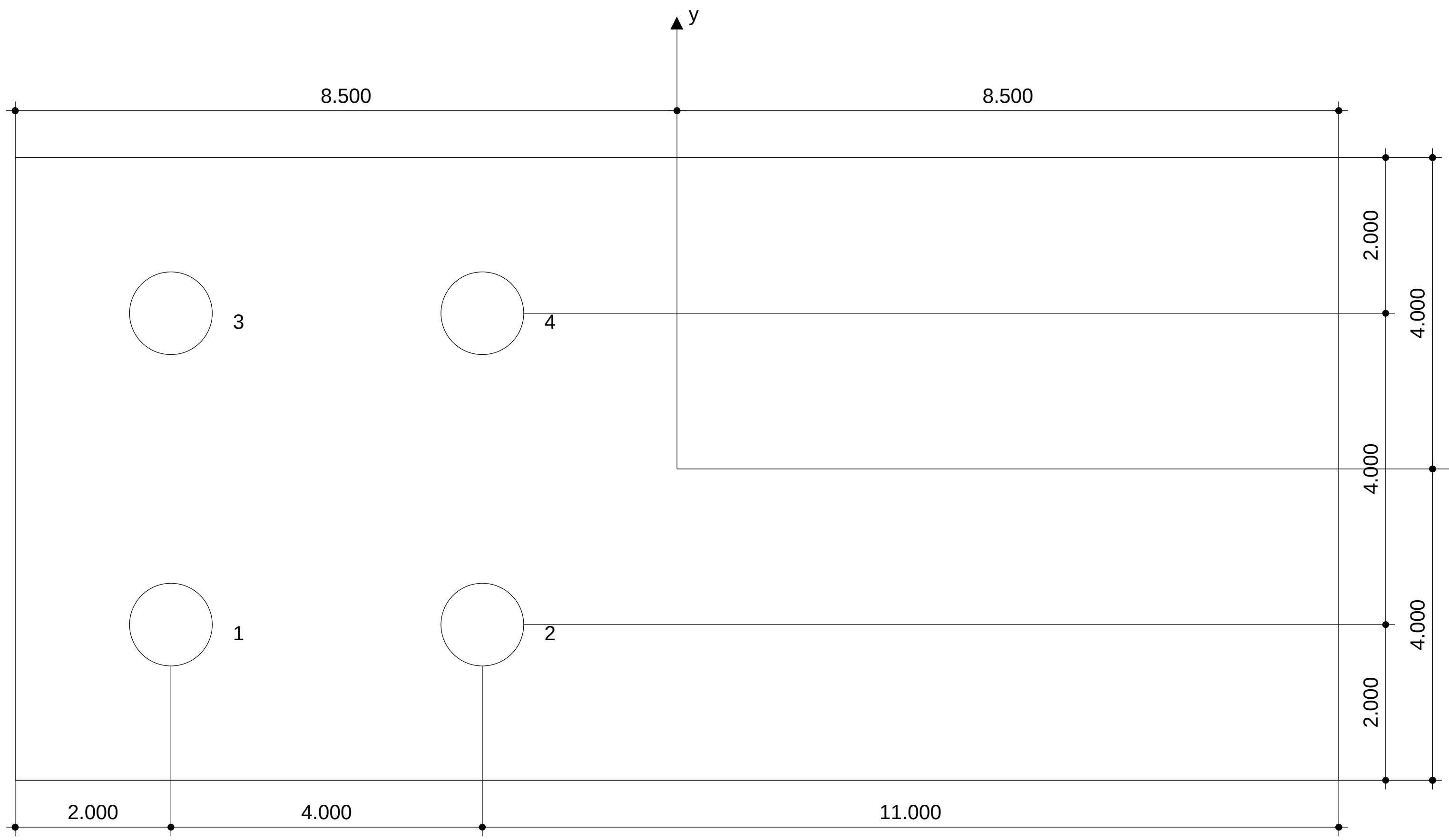
SEE CALCULATIONS
PAGE 548

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.672 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.500	-2.000	10.000	17.000	4.000	8.000
2	-2.500	-2.000	14.000	13.000	4.000	8.000
3	-6.500	2.000	10.000	17.000	8.000	4.000
4	-2.500	2.000	14.000	13.000	8.000	4.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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Profis Anchor 2.5.5

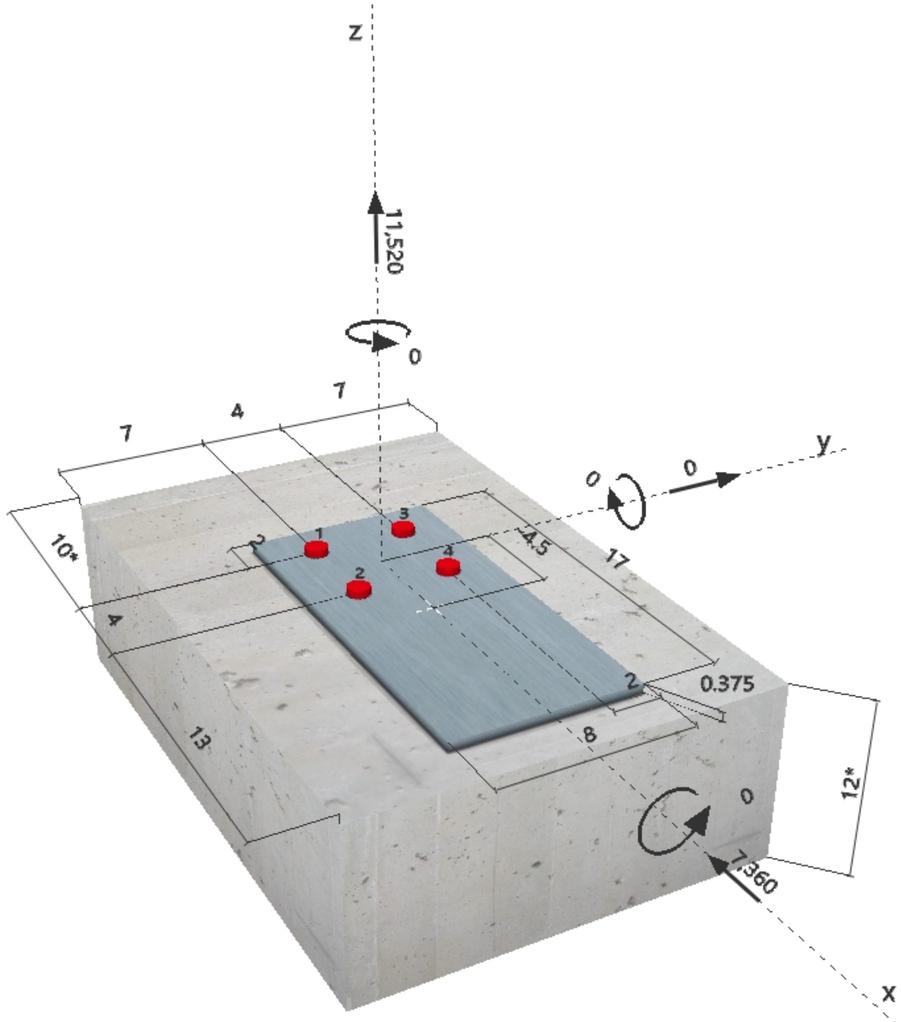
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-C, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 17.000 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

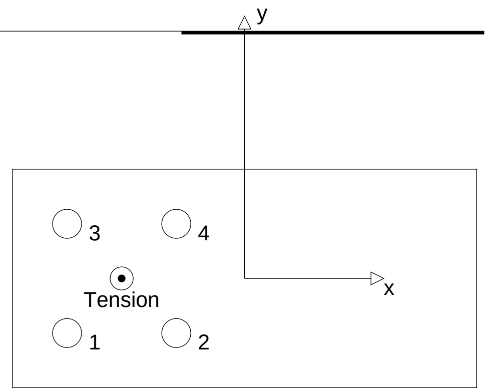
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	2880	1840	-1840	0
2	2880	1840	-1840	0
3	2880	1840	-1840	0
4	2880	1840	-1840	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-4.500/0.000): 11520 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	2880	26361	11	OK
Pullout Strength*	2880	36472	8	OK
Concrete Breakout Strength**	11520	22469	52	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\ A_{se,N}\ f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

N_{sa} [lb]
35148

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
35148	0.750	26361	2880

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\ N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\ A_{brg}\ f'_c$ ACI 318-08 Eq. (D-15)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	1.16	4000

Calculations

N_p [lb]
37216

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
52102	0.700	36472	2880

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)
$\phi\, N_{cbg} \geq N_{ua}$	ACI 318-08 Eq. (D-1)
A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)	
$A_{Nc0} = 9\, h_{ef}^2$	ACI 318-08 Eq. (D-6)
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$	ACI 318-08 Eq. (D-9)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$	ACI 318-08 Eq. (D-11)
$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$	ACI 318-08 Eq. (D-13)
$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$	ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	7.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
432.00	400.00	1.000	1.000	0.910	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
32098	0.700	22469	11520

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1840	13708	14	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	7360	44937	17	OK
Concrete edge failure in direction x-**	7360	10328	72	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.61	58000

Calculations

V_{sa} [lb]
21089

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
21089	0.650	13708	1840

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	7.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
432.00	400.00	1.000	1.000	0.910	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
64196	0.700	44937	7360

Company: NTrive
Specifier: KZZ
Address:
Phone I Fax: |
E-Mail:

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	7.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
7.500	1.000	1.000	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
216.00	288.00	1.000	0.875	1.000	14989

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
13771	0.750	10328	7360

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.513	0.713	5/3	90	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

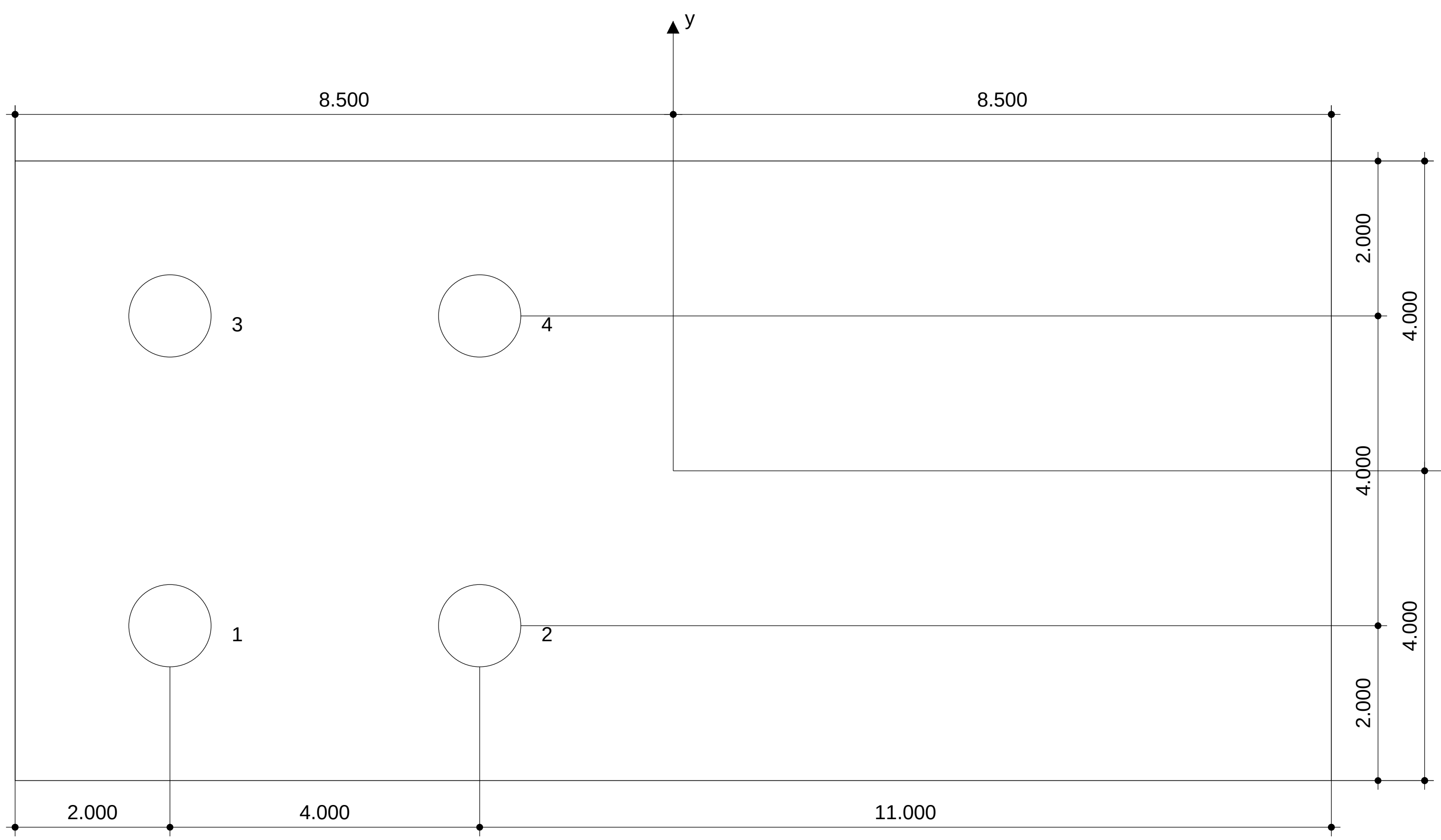
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 1.063 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.672 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.500	-2.000	10.000	17.000	7.000	11.000
2	-2.500	-2.000	14.000	13.000	7.000	11.000
3	-6.500	2.000	10.000	17.000	11.000	7.000
4	-2.500	2.000	14.000	13.000	11.000	7.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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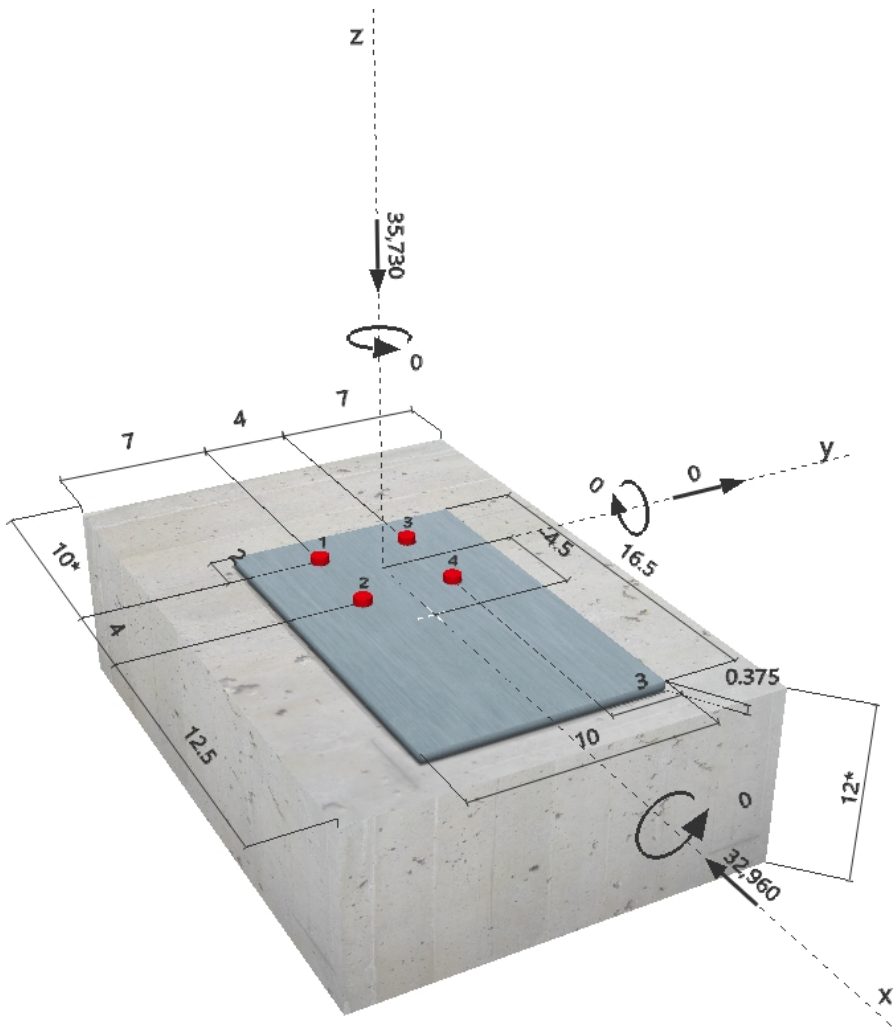
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-D, LC1

1 Input data

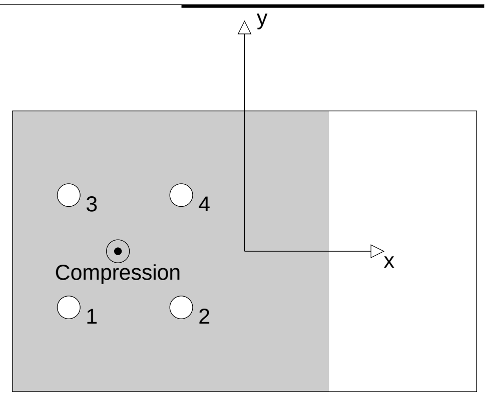
Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 16.500 in. x 10.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	0	8240	-8240	0
2	0	8240	-8240	0
3	0	8240	-8240	0
4	0	8240	-8240	0

max. concrete compressive strain: 0.15 [‰]
max. concrete compressive stress: 635 [psi]
resulting tension force in (x/y)=(0.000/0.000): 0 [lb]
resulting compression force in (x/y)=(-4.500/0.000): 35730 [lb]

3 Tension load

	Load N_{ua} [lb]	**Capacity ϕN_n [lb]**	**Utilization $\beta_N = N_{ua}/\phi N_n$**	**Status**
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	8240	7555	110	not recommended
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	32960	42332	78	OK
Concrete edge failure in direction x-**	32960	9061	364	not recommended

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	8240

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	8.333	0.000	0.000	7.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
477.00	625.00	1.000	1.000	0.868	1.000	36515

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
60474	0.700	42332	32960

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ — ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ — ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2}\sqrt{d_a}\right)\lambda\sqrt{f_c'}\ c_{a1}^{1.5}$ — ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	7.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
216.00	288.00	1.000	0.875	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
12081	0.750	9061	32960

5 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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

Fastening does not meet the design criteria!

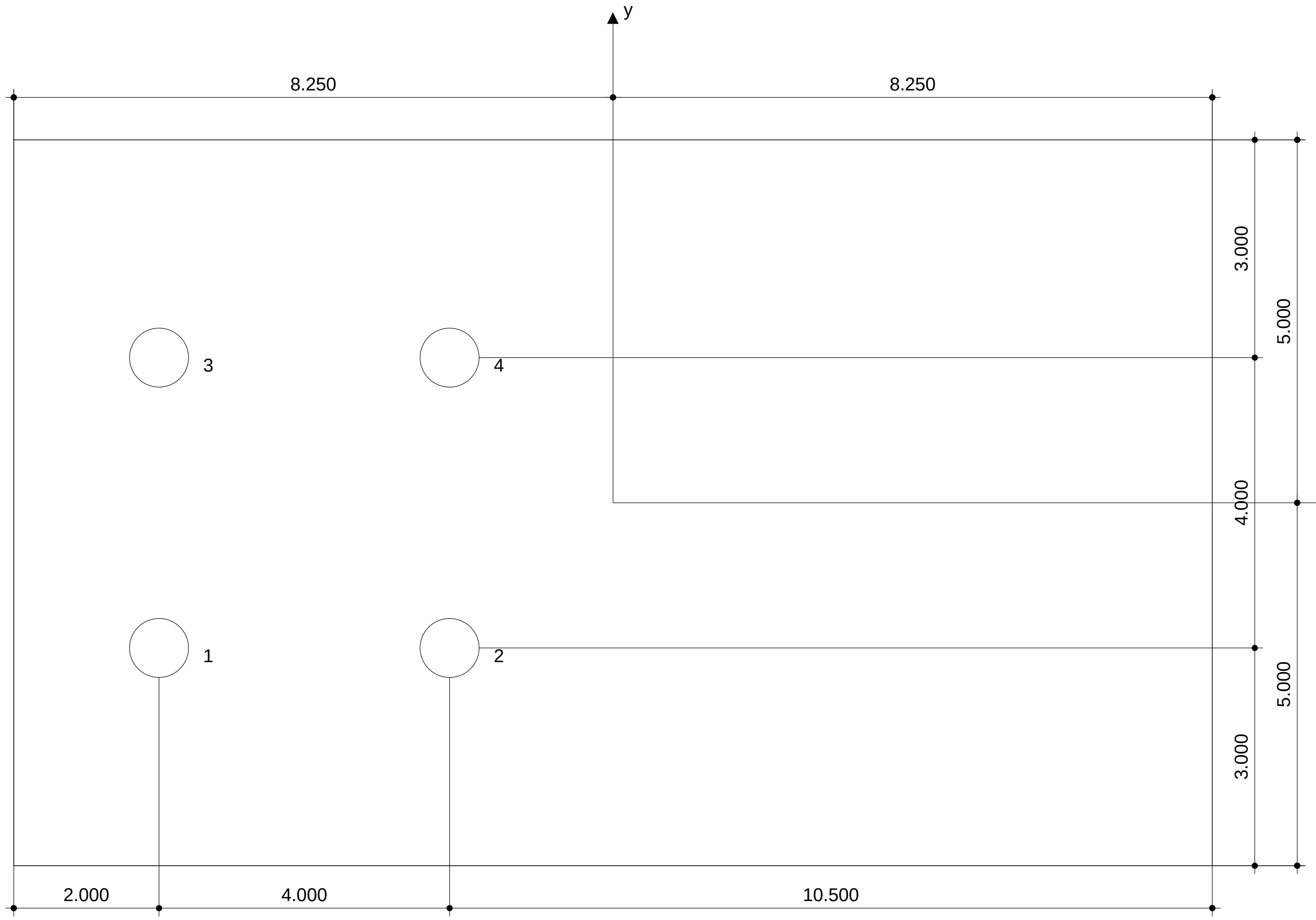
SEE CALCULATIONS
PAGE 548

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

6 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.250	-2.000	10.000	16.500	7.000	11.000
2	-2.250	-2.000	14.000	12.500	7.000	11.000
3	-6.250	2.000	10.000	16.500	11.000	7.000
4	-2.250	2.000	14.000	12.500	11.000	7.000

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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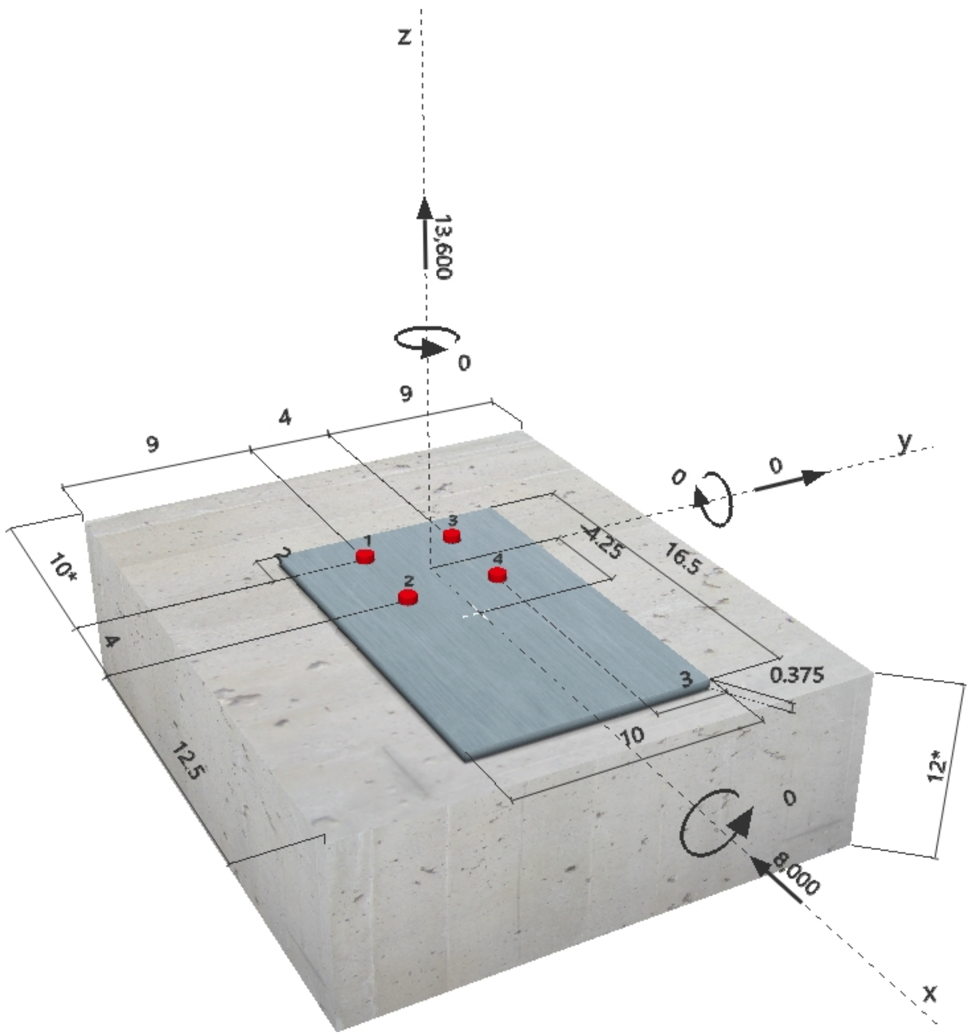
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-D, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 3/4**
Effective embedment depth:	h_{ef} = 9.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 16.500 in. x 10.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

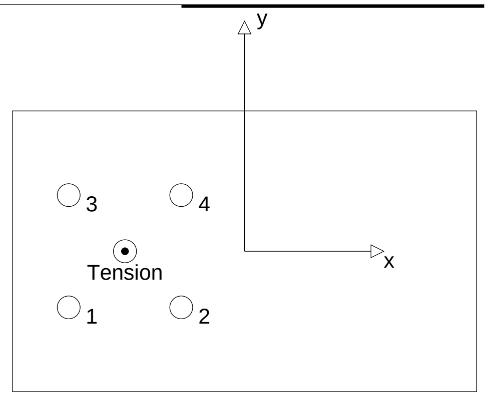
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	3400	2000	-2000	0
2	3400	2000	-2000	0
3	3400	2000	-2000	0
4	3400	2000	-2000	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-4.250/0.000): 13600 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	3400	14529	24	OK
Pullout Strength*	3400	20509	17	OK
Concrete Breakout Strength**	13600	27300	50	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\ A_{se,N}\ f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\ N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

N_{sa} [lb]
19372

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
19372	0.750	14529	3400

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\ N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\ A_{brg}\ f'_c$ ACI 318-08 Eq. (D-15)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.65	4000

Calculations

N_p [lb]
20928

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
29299	0.700	20509	3400

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
8.333	0.000	0.000	9.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
583.00	625.00	1.000	1.000	0.916	1.000	36515

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
39000	0.700	27300	13600

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	2000	7555	27	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	8000	54600	15	OK
Concrete edge failure in direction x-**	8000	11707	69	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.33	58000

Calculations

V_{sa} [lb]
11623

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
11623	0.650	7555	2000

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	8.333	0.000	0.000	9.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
583.00	625.00	1.000	1.000	0.916	1.000	36515

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
78000	0.700	54600	8000

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
8.000	9.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
6.000	1.000	0.750	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
264.00	288.00	1.000	0.925	1.000	13150

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
15610	0.750	11707	8000

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.498	0.683	5/3	85	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

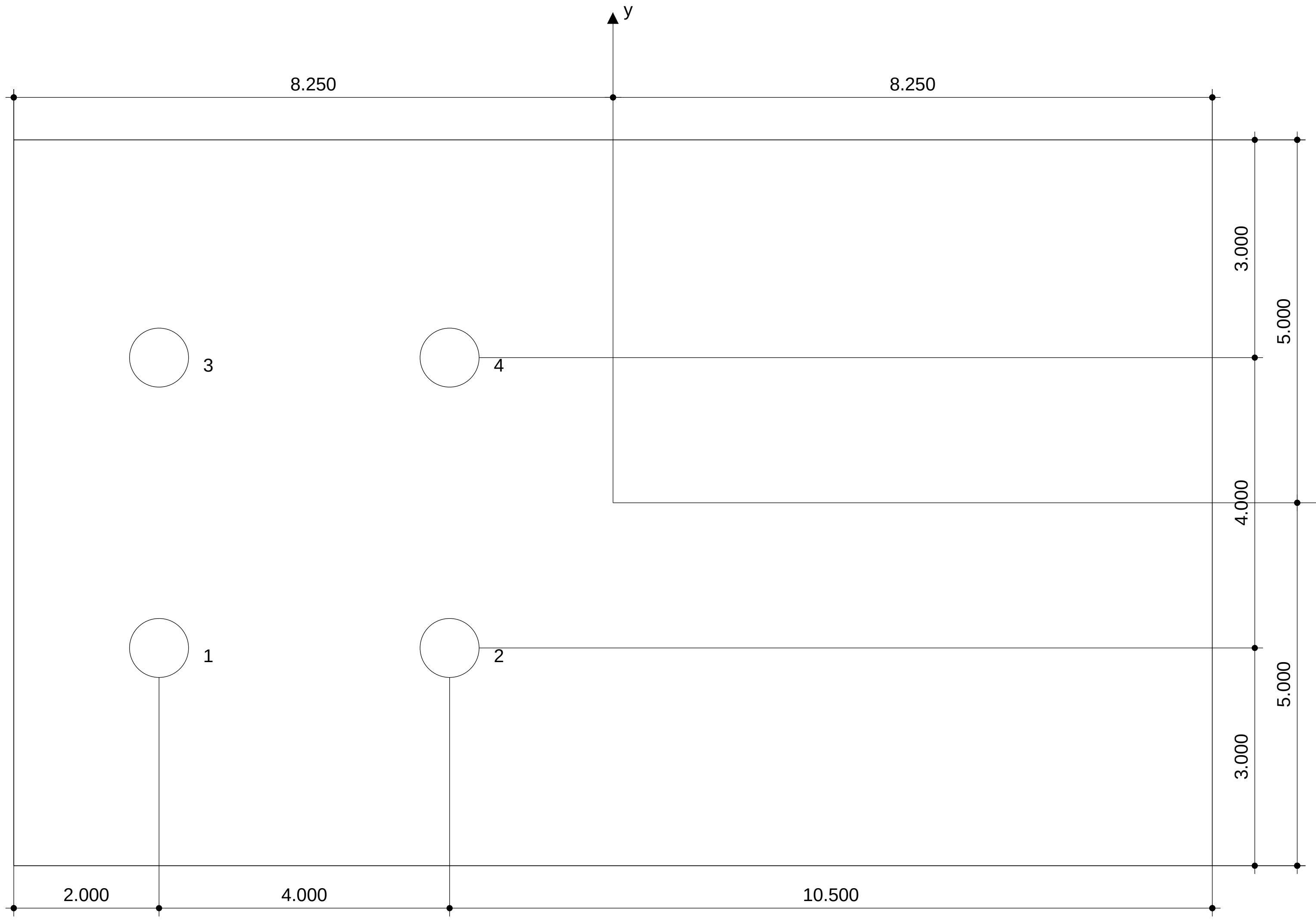
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.813 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 3/4
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 9.000 in.
Minimum thickness of the base material: 11.000 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-6.250	-2.000	10.000	16.500	9.000	13.000
2	-2.250	-2.000	14.000	12.500	9.000	13.000
3	-6.250	2.000	10.000	16.500	13.000	9.000
4	-2.250	2.000	14.000	12.500	13.000	9.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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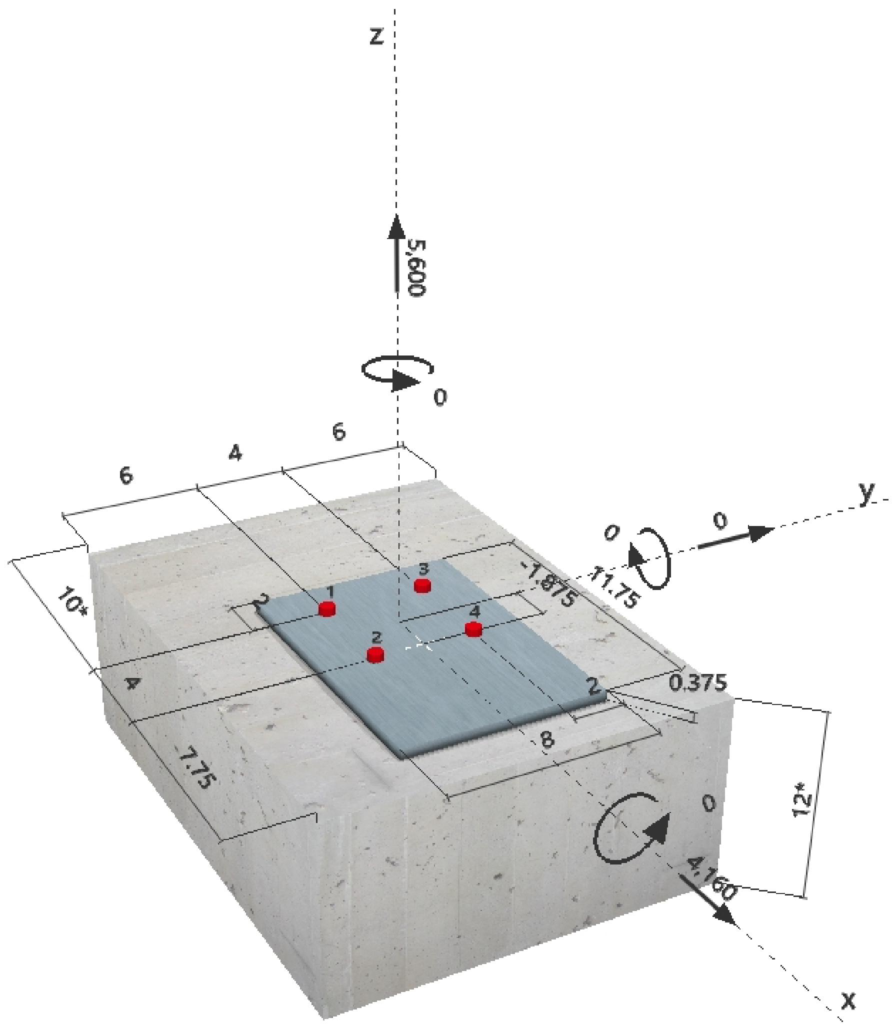
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-E, LC1

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 11.750 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

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



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

2 Load case/Resulting anchor forces

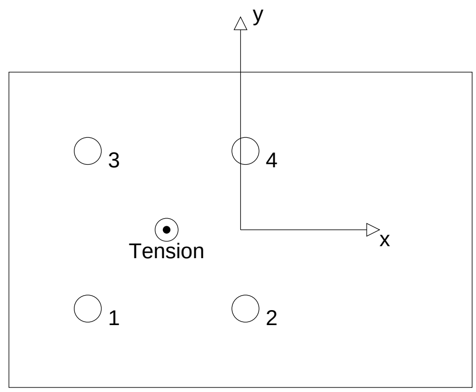
Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1400	1040	1040	0
2	1400	1040	1040	0
3	1400	1040	1040	0
4	1400	1040	1040	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-1.875/0.000): 5600 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1400	9831	15	OK
Pullout Strength*	1400	14237	10	OK
Concrete Breakout Strength**	5600	17503	32	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1400

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1400

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	6.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
348.00	400.00	1.000	1.000	0.880	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
25004	0.700	17503	5600

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1040	5112	21	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	4160	35006	12	OK
Concrete edge failure in direction x+**	4160	7070	59	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	1040

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 318-08 Eq. (D-31)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f_c' [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
348.00	400.00	1.000	1.000	0.880	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
50009	0.700	35006	4160

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f_c'}\, c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
7.750	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
186.00	270.28	1.000	0.855	1.000	11446

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\, V_{cbg}$ [lb]	V_{ua} [lb]
9426	0.750	7070	4160

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.320	0.588	5/3	57	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

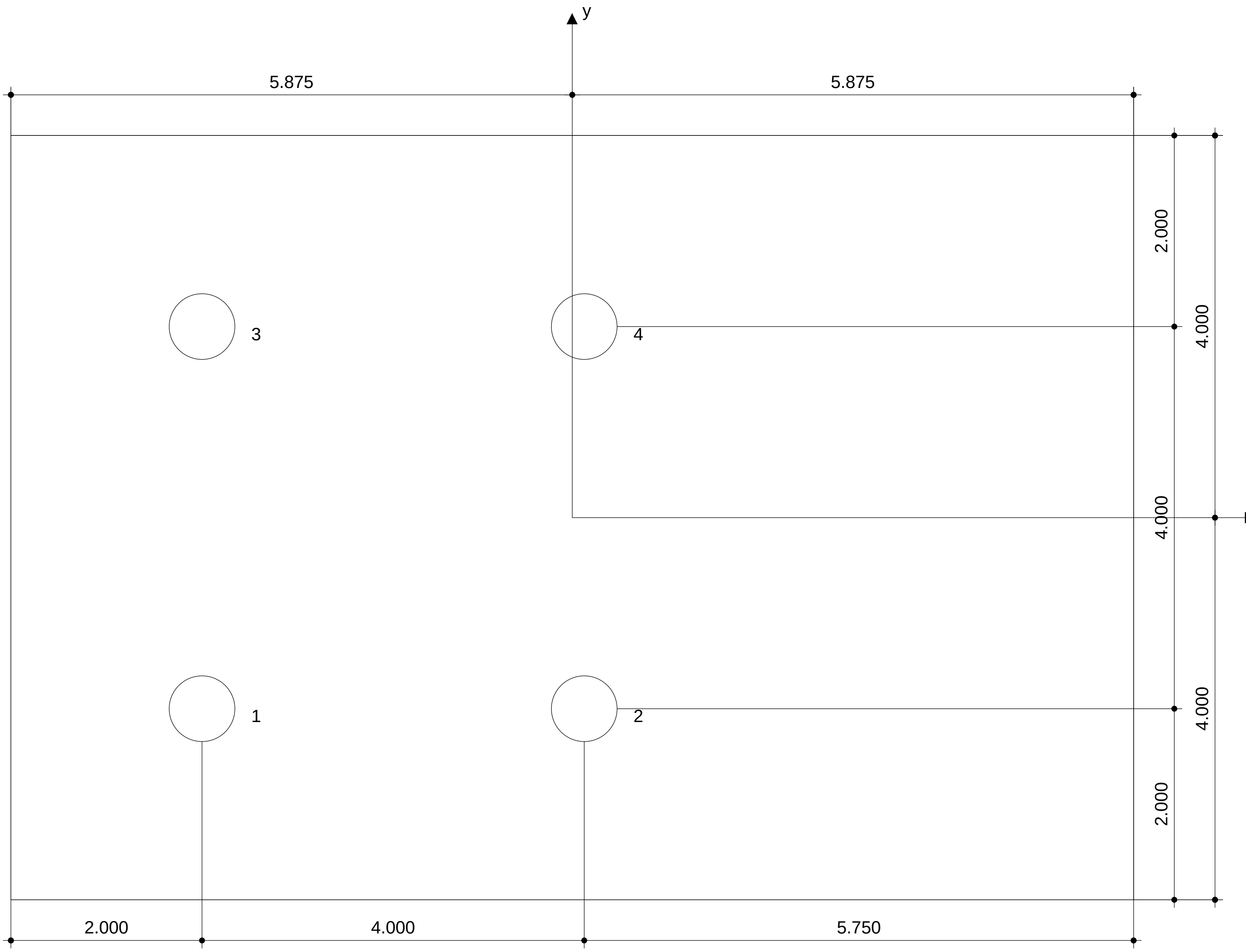
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-3.875	-2.000	10.000	11.750	6.000	10.000
2	0.125	-2.000	14.000	7.750	6.000	10.000
3	-3.875	2.000	10.000	11.750	10.000	6.000
4	0.125	2.000	14.000	7.750	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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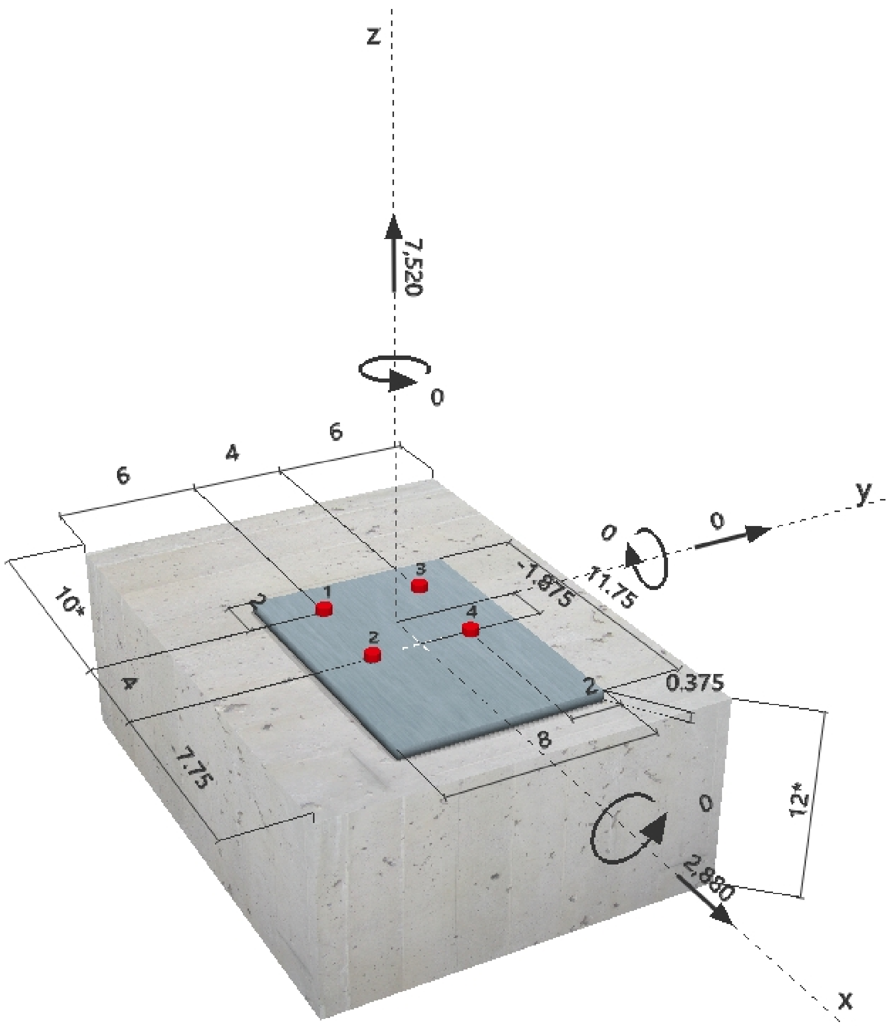
Company:	NTrive	Page:	1
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

Specifier's comments: B4-E, LC2

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 5/8**
Effective embedment depth:	h_{ef} = 7.500 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-08 / CIP
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 11.750 in. x 8.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	uncracked concrete, 4000, f_c' = 4000 psi; h = 12.000 in.
Reinforcement:	tension: condition B, shear: condition A;
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	no

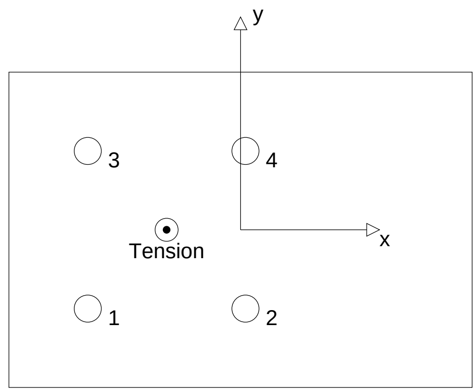
Geometry [in.] & Loading [lb, in.lb]



Company:	NTrive	Page:	2
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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	1880	720	720	0
2	1880	720	720	0
3	1880	720	720	0
4	1880	720	720	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-1.875/0.000): 7520 [lb]
resulting compression force in (x/y)=(0.000/0.000): 0 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1880	9831	20	OK
Pullout Strength*	1880	14237	14	OK
Concrete Breakout Strength**	7520	17503	43	OK
Concrete Side-Face Blowout, direction **	N/A	N/A	N/A	N/A

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

3.1 Steel Strength

$N_{sa} = n\, A_{se,N}\, f_{uta}$ ACI 318-08 Eq. (D-3)
$\phi\, N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

N_{sa} [lb]
13108

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\, N_{sa}$ [lb]	N_{ua} [lb]
13108	0.750	9831	1880

3.2 Pullout Strength

$N_{pN} = \psi_{c,p}\, N_p$ ACI 318-08 Eq. (D-14)
$N_p = 8\, A_{brg}\, f'_c$ ACI 318-08 Eq. (D-15)
$\phi\, N_{pN} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	f'_c [psi]
1.400	0.45	4000

Calculations

N_p [lb]
14528

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\, N_{pn}$ [lb]	N_{ua} [lb]
20339	0.700	14237	1880

Company:	NTrive	Page:	3
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-5)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\ \lambda\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
6.667	0.000	0.000	6.000	1.250

c_{ac} [in.]	k_c	λ	f_c' [psi]
0.000	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
348.00	400.00	1.000	1.000	0.880	1.000	26128

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
25004	0.700	17503	7520

Company:	NTrive	Page:	4
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	720	5112	15	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2880	35006	9	OK
Concrete edge failure in direction x+**	2880	7070	41	OK

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

4.1 Steel Strength

$V_{sa} = n\ 0.6\ A_{se,V}\ f_{uta}$ ACI 318-08 Eq. (D-20)
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.23	58000

Calculations

V_{sa} [lb]
7865

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
7865	0.650	5112	720

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 318-08 Eq. (D-31)
$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)
A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)
$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-08 Eq. (D-6)
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)
$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)
$N_b = k_c\ \lambda\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	6.667	0.000	0.000	6.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.250	-	24	1	4000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
348.00	400.00	1.000	1.000	0.880	1.000	26128

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
50009	0.700	35006	2880

Company:	NTrive	Page:	5
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

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 318-08 Eq. (D-22)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e'_v}{3c_{a1}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-08 Eq. (D-29)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\ c_{a1}^{1.5}$ ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
7.750	6.000	0.000	1.400	12.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
5.000	1.000	0.625	4000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
186.00	270.28	1.000	0.855	1.000	11446

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
9426	0.750	7070	2880

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.430	0.407	5/3	47	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!

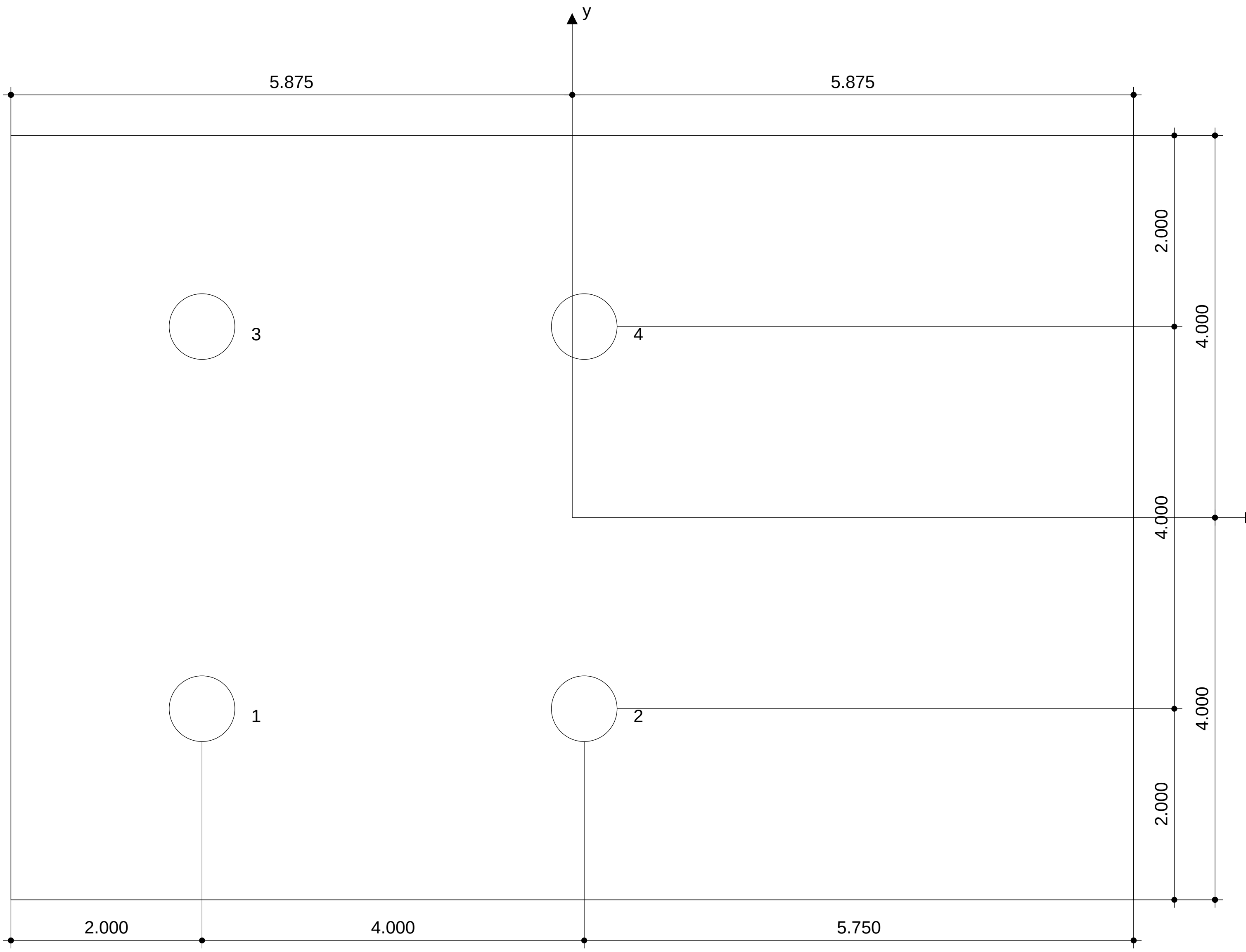
Fastening meets the design criteria!

Company:	NTrive	Page:	6
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: no profile
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.375 in.
Recommended plate thickness: not calculated
Cleaning: No cleaning of the drilled hole is required

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 5/8
Installation torque: -0.009 in.lb
Hole diameter in the base material: - in.
Hole depth in the base material: 7.500 in.
Minimum thickness of the base material: 9.422 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-3.875	-2.000	10.000	11.750	6.000	10.000
2	0.125	-2.000	14.000	7.750	6.000	10.000
3	-3.875	2.000	10.000	11.750	10.000	6.000
4	0.125	2.000	14.000	7.750	10.000	6.000

Company:	NTrive	Page:	7
Specifier:	KZZ	Project:	20150102.000
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	6/25/2015
E-Mail:			

8 Remarks; Your Cooperation Duties

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CHECK SHEAR FRICTION:

MB-J LC-2: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*139.6 K)), 0.6*12"*12.75")
ϕVn=MIN(37.7 K, 91.8 K)=37.7 K
Vu=1.6*19.1=30.6 K < 37.7 K, **OK**

MB-K LC-2: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*87 K)), 0.6*12.75"*10")
ϕVn=MIN(23.5 K, 76.5 K)=23.5 K
Vu=1.6*21.1=33.8 K > 23.5 K, **NEED TO DESIGN FOR 10.3 K MIN**

B2-E LC-1: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*33.5 K)), 0.6*8.5"*8")
ϕVn=MIN(9 K, 40.8 K)=9 K
Vu=1.6*5.1=8.2 K < 9 K, **OK**

B2-F LC-1: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*29.4 K)), 0.6*8.25"*8")
ϕVn=MIN(7.9 K, 39.6 K)=7.9 K
Vu=1.6*4=6.4 K < 7.9 K, **OK**

B3-F LC-1: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*27.9 K)), 0.6*16.5"*10")
ϕVn=MIN(7.5 K, 99 K)=7.5 K
Vu=1.6*15.9=25.4 K > 7.5 K, **NEED TO DESIGN FOR 17.9 K MIN**

B4-C LC-1: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*47.3 K)), 0.6*12"*17")
ϕVn=MIN(12.8 K, 122 K)=12.8 K
Vu=1.6*28=44.8 K > 12.8 K, **NEED TO DESIGN FOR 32 K MIN**

B4-D LC-1: ϕVn=MIN(0.3Pu, 0.6Ac)=MIN(0.3*(0.9*39.7 K)), 0.6*16.5"*10")
ϕVn=MIN(10.7 K, 99 K)=10.7 K
Vu=1.6*20.6=33 K > 10.7 K, **NEED TO DESIGN FOR 22.3 K MIN**

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CHECK BEARING AGAINST SLAB:

MB-J LC-1: $\phi Vn=0.55f'cAbrg=0.55*4\ KSI*8"*6"=105.6\ K$
$Vu=1.6*9.1=14.6\ K < 105.6\ K$, **OK** (LC-3 SIM)

MB-K LC-1: $\phi Vn=0.55f'cAbrg=0.55*4\ KSI*8"*6"=105.6\ K$
$Vu=1.6*9.2=14.7\ K < 105.6\ K$, **OK** (LC-3 SIM)

B4-C LC-1: $\phi Vn=0.55f'cAbrg=0.55*4\ KSI*12"*6"=158.4\ K$
$Vu=32\ K < 158.4\ K$, **OK**

B4-D LC-1: $\phi Vn=0.55f'cAbrg=0.55*4\ KSI*10"*6"=132\ K$
$Vu=22.3\ K < 132\ K$, **OK**

CHECK SHEAR FRICTION BETWEEN SLAB AND EARTH:

FOR SHEAR ACTING TOWARD BUILDING INTERIOR:
$Vall=\mu WA=0.7*150\ PCF*6"*A=52.5\ PSF*A$
$Vmax=12.1\ K$
$Areq=12.1\ K/52.5\ PSF=231\ SF$
$Amin=368\ SF > 231\ SF$, **OK**

CHECK TRANSFER OF SLAB SHEAR TO FOUNDATION WALL IN FLEXURE:

FOR SHEAR ACTING TOWARD BUILDING EXTERIOR (B4-C LC-1 WORST CASE):
$h=8"$
$d=8"-(1.5"+1")=5.5"$
$Mu=32\ K*1'=32\ FT*K$
$M=fyt/(0.85f'c)=60\ KSI/(0.85*3\ KSI)=23.53$
$R_N=Mu/(\phi bd^2)=32\ FT*K*(12\ IN/FT)/(0.9*18"*5.5^2) = 0.784\ KSI$
$\rho=1/23.53*[1-\sqrt{(1-2*23.53*.784/60\ KSI)}] = 0.016$
$As_{REQ}=\rho bd=0.016*18"*5.5"=1.60\ IN^2$
$As=4*0.44\ IN^2=1.76\ IN^2 > 1.60\ IN^2$, **OK**
PROVIDE (4) #6 REBAR

CHECK TIE ROD BETWEEN B3-E & B3-F

$T_U=17.9\ K$ (B3-F LC-1 RESIDUAL DESIGN FORCE)
$As_{REQ}=(17.9\ K)/(0.9*60\ KSI) = 0.33\ IN^2$
$As=2*0.31\ IN^2=0.62\ IN^2 > 0.33\ IN^2$, **OK**
PROVIDE (2) #5

DESIGN TENSILE REINFORCEMENT OF ANCHOR RODS:

MB-K LC-3: $d_{max}=h_{ef}/=9/3=3"$
$n_{req}=Nua/\phi sfyAs=6.6\ K/(0.9*60\ KSI*0.2\ IN^2)=0.61$
PROVIDE (1) #4 EACH ANCHOR

Xcel Sports Complex
Jefferson, WI

Pier Analysis

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

JOB XCEL SPORTS COMPLEX NO. 20150104

SHEET NO. 601 OF

CALCULATED BY KZZ DATE 7/6/15

CHECKED BY DATE

DESCRIPTION PIER ANALYSIS

CHECK MINIMUM STEEL IN PIERS:

P1: Asmin=0.01*A=0.01*12"*12"=1.44 IN^2
As=4*0.44=1.76 IN^2 > 1.44 IN^2, **OK**
PROVIDE (4) #6

P2: Asmin=0.01*A=0.01*12"*16"=1.92 IN^2
As=6*0.44=2.64 IN^2 > 1.92 IN^2, **OK**
PROVIDE (6) #6

P3: Asmin=0.01*A=0.01*12"*24"=2.88 IN^2
As=8*0.44=3.52 IN^2 > 2.88 IN^2, **OK**
PROVIDE (8) #6

P4: Asmin=0.01*A=0.01*16"*12"=1.92 IN^2
As=6*0.44=2.64 IN^2 > 1.92 IN^2, **OK**
PROVIDE (6) #6

P5: Asmin=0.01*A=0.01*16"*16"=2.56 IN^2
As=6*0.44=2.64 IN^2 > 2.56 IN^2, **OK**
PROVIDE (6) #6

P6: Asmin=0.01*A=0.01*16"*18"=2.88 IN^2
As=8*0.44=3.52 IN^2 > 2.88 IN^2, **OK**
PROVIDE (8) #6

P7: Asmin=0.01*A=0.01*16"*22"=3.52 IN^2
As=8*0.44=3.52 IN^2 = 3.52 IN^2, **OK**
PROVIDE (8) #6

P8: Asmin=0.01*A=0.01*18"*22"=3.96 IN^2
As=10*0.44=4.4 IN^2 > 3.96 IN^2, **OK**
PROVIDE (10) #6

P9: Asmin=0.01*A=0.01*18"*24"=4.32 IN^2
As=10*0.44=4.4 IN^2 > 4.32 IN^2, **OK**
PROVIDE (10) #6

P10: Asmin=0.01*A=0.01*18"*27"=4.86 IN^2
As=12*0.44=5.28 IN^2 > 4.86 IN^2, **OK**
PROVIDE (12) #6

P11: Asmin=0.01*A=0.01*20"*22"=4.4 IN^2
As=10*0.44=4.4 IN^2 > 4.4 IN^2, **OK**
PROVIDE (10) #6

P12: Asmin=0.01*A=0.01*22"*24"=5.28 IN^2
As=12*0.44=5.28 IN^2 > 5.28 IN^2, **OK**
PROVIDE (12) #6

P13: Asmin=0.01*A=0.01*24"*22"=5.28 IN^2
As=12*0.44=5.28 IN^2 > 5.28 IN^2, **OK**
PROVIDE (12) #6

P14: Asmin=0.01*A=0.01*24"*26"=6.24 IN^2
As=14*0.44=6.16 IN^2 ≈ 6.24 IN^2, **SAY OK**
PROVIDE (14) #6

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CHECK TENSILE CAPACITY OF PIERS:

CHECK MIN TENSILE REINFORCING FOR MAX TENSILE FORCE:

Tu=1.6*26.4 K=42.2 K

ϕTn=ϕAsFy=0.9*4*0.44 IN^2*60 KSI=86.4 K > 42.2 K, **OK**

PROVIDE (4) #6 MIN IN ALL PIERS

CHECK UNREINFORCED SHEAR CAPACITY OF PIERS:

P1: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*12"*10.5"=10.36 K
Vu=0 K < 10.36 K, **OK**

P2: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*12"*14.5"=14.31 K
Vu=2.88 K < 14.31 K, **OK**

P3: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*12"*22.5"=22.20 K
Vu=2.56 K < 22.20 K, **OK**

P4: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*16"*10.5"=13.81 K
Vu=3.20 K < 13.81 K, **OK**

P5: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*16"*14.5"=19.07 K
Vu=8.16 K < 19.07 K, **OK**

P6: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*16"*16.5"=21.71 K
Vu=5.12 K < 21.71 K, **OK**

P7: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*16"*20.5"=26.97 K
Vu=6.24 K < 26.97 K, **OK**

P8: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*18"*20.5"=30.34 K
Vu=8.16 K < 30.34 K, **OK**

P9: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*18"*22.5"=33.30 K
Vu=8.96 K < 33.30 K, **OK**

P10: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*18"*25.5"=37.74 K
Vu=44.80 K > 37.74 K, **PROVIDE SHEAR REINFORCEMENT**

P11: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*20"*20.5"=33.71 K
Vu=8.32 K < 33.71 K, **OK**

P12: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*22"*22.5"=40.70 K
Vu=32.96 K < 40.70 K, **OK**

P13: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*24"*20.5"=40.45 K
Vu=33.76 K < 40.45 K, **OK**

P14: ϕVc=ϕ2λ√(f'c)b_wd=0.65*2*1*√(4000 PSI)*24"*24.5"=48.34 K
Vu=25.44 K < 48.34 K, **OK**

CHECK SHEAR REINFORCEMENT OF PIER:

P10: ϕVs=ϕAvfytd/s=0.75*2*0.11 IN2*60 KSI*25.5"/12"=21.04 K
s_{MAX}=MIN(0.5d, 24", Avfyt/50bw)=MIN(0.5*25.5", 24", (2*0.11*60000)/(50*18))
s_{MAX}=MIN(12.75", 24", 14.67")=14.67", USE 12" OC
ϕVn=ϕVc+ϕVs=37.74 K+21.04 K=58.78 K > Vu=44.80 K, **OK**
PROVIDE #3 @ 12" OC

Xcel Sports Complex
Jefferson, WI

Footing Analysis

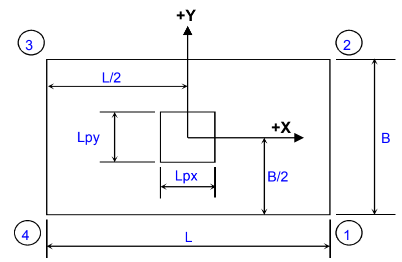
RECTANGULAR SPREAD FOOTING ANALYSIS AND DESIGN

For Assumed Rigid Footings with One Concentric Pier
Subjected to Uniaxial or Biaxial Eccentricity

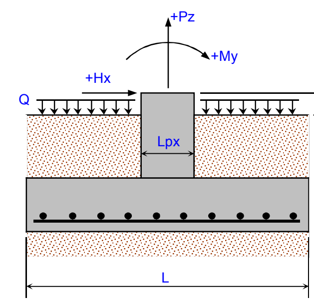
Job Name:	XCEL Sports Complex	Subject:	Building Footings		
Job Number:	20150104	Originator:	KZZ	Checker:	APE

Input Data:

Allow. Net Soil Pressure, Pa(net) =	3.000	ksf
Design for P(max)net or Pa(net) ?	P(max)	
Soil Unit Weight, γs =	0.110	kcf
Passive Pressure Coefficient, Kp =	2.050	
Coefficient of Base Friction, μ =	0.280	
Concrete Unit Weight, γc =	0.150	kcf
Conc. Compressive Strength, f'c =	3	ksi
Reinforcing Yield Strength, fy =	60	ksi
Applicable ACI Code =	318-05	
USD Load Fact. for Concrete, LF =	1.6	
ϕ Factor for Flexure and Tension =	0.90	
ϕ Factor for Comp. and Bearing =	0.65	
ϕ Factor for Shear =	0.75	



Footing Plan



Footing Elevation

Assumptions:

1. For uniaxial eccentricity (either ex or ey) the maximum gross soil pressure is calculated as follows:
   for ex <= L/6: P(max)gross = (Σ Pz)/(B*L)*(1+6*ABS(ex)/L) and P(min)gross = (Σ Pz)/(B*L)*(1-6*ABS(ex)/L) , for ex > L/6: P(max)gross = (2* Σ Pz)/(3*B*(L/2-ABS(ex))) and P(min)gross = 0
   for ey <= B/6: P(max)gross = (Σ Pz)/(L*B)*(1+6*ABS(ey)/B) and P(min)gross = (Σ Pz)/(L*B)*(1-6*ABS(ey)/B) , for ey > B/6: P(max)gross = (2* Σ Pz)/(3*L*(B/2-ABS(ey))) and P(min)gross = 0
   where: Σ Pz = summation of vertical load and all weights = applied column vertical load (Pz) + soil weight + excess pier weight + surcharge (Q).
2. Concurrent biaxial eccentricities (both ex and ey) are permitted up to point where full contact (100% bearing) on the footing base is still maintained.
   P(max)gross = (Σ Pz)/(B*L)*(1+6*ABS(ex)/L+6*ABS(ey)/B) and P(min)gross = (Σ Pz)/(B*L)*(1-6*ABS(ex)/L-6*ABS(ey)/B)
   where: controlling biaxial eccentricity criteria is as follows: 6*ABS(ex)/L+6*ABS(ey)/B <= 1.0
3. Maximum net soil pressure is calculated as follows: P(max)net = P(max)gross-(D+T)* γs >= 0
4. Program considers all applied moments and horizontal loads as forces causing overturning. However, uplift load (Pz > 0) is considered as a force causing overturning only when there is an applicable resultant eccentricity in the direction of overturning. Combination of frictional resistance between footing base and soil as well as passive soil pressure against footing base and pier is used for total sliding resistance.
5. Program includes uniform live load surcharge (Q) in calculation of soil bearing pressures, and is assumed to act over entire footing plan area (L*B). Uniform live load surcharge (Q) is not included in any of stability checks.
6. One-way and two-way shear capacity checks are based on full uniform design net bearing pressure, P(net) = either P(max)net or Pa(net), as selected by user.
7. Footing flexural reinforcing for bottom face is based on full uniform design net bearing pressure, P(net) = either P(max)net or Pa(net), as selected by user. Footing flexural reinforcing for top face is determined only when there is an applied column uplift load (Pz > 0), and is based on bending from footing self-weight plus any soil and live load surcharge (Q) weight.
8. Minimum temperature reinforcing is determined as follows: As(temp) = ρ(temp)*12*T (all reinforcing placed in bottom face only) for no column uplift and with soil cover (D > 0)
   As(temp) = ρ(temp)/2*12*T (reinforcing divided equally between top/bottom faces) for either with column uplift and/or no soil cover (D = 0)
   where: ρ(temp) = 0.0020 for fy = 40 or 50 ksi, ρ(temp) = 0.0018 for fy = 60 ksi, and ρ(temp) = 0.0018*60/fy for fy > 60 ksi.
9. For rectangular footings, the flexural reinforcing (per foot) running in the short direction is calculated by: As(short) = ρ(short)*12*d*2*β/(β +1) , where β = ratio of LongSide to ShortSide.

COLUMN LOCATION	COLUMN LOADS: Case 1: Maximum Load Condition					Case 2: Minimum Load Condition					FOOTING DATA: Pier Dimensions			Base Dimensions			SOIL DATA & SURCHARGE	
	Axial Pz (kips)	Shear Hx (kips)	Shear Hy (kips)	Moment Mx (ft-kips)	Moment My (ft-kips)	Axial Pz (kips)	Shear Hx (kips)	Shear Hy (kips)	Moment Mx (ft-kips)	Moment My (ft-kips)	Length Lpx (ft.)	Width Lpy (ft.)	Height h (ft.)	Length L (ft.)	Width B (ft.)	Thickness T (ft.)	Depth D (ft.)	Surch. Q (ksf)
MB-A	-115.80	5.60	0.00	0.00	0.00	11.50	5.60	0.00	0.00	0.00	2	1.5	2.5	7	7	2	3.50	0.08
MB-B	-123.20	0.00	0.00	0.00	0.00	4.60	5.20	0.00	0.00	0.00	1.83	1.67	2.5	7	7	2	3.50	0.08
MB-C	-122.20	0.00	0.00	0.00	0.00	4.80	5.10	0.00	0.00	0.00	1.83	1.5	2.5	7	7	2	3.50	0.08
MB-D	-123.20	0.00	0.00	0.00	0.00	5.40	5.10	0.00	0.00	0.00	1.83	1.67	2.5	7	7	2	3.50	0.08
MB-E	-47.00	0.00	0.00	0.00	0.00	8.80	5.50	0.00	0.00	0.00	0	0	0	7	7	2	1.00	0.08
MB-F	-88.50	-20.70	0.00	0.00	0.00	31.80	5.40	0.00	0.00	0.00	0	0	0	11.5	11.5	2	1.00	0.08
MB-G	-58.20	20.70	0.00	0.00	0.00	27.20	-4.80	0.00	0.00	0.00	1.5	1.33	2.5	10	10	2	3.50	0.08
MB-H	-58.20	20.70	0.00	0.00	0.00	27.20	-4.80	0.00	0.00	0.00	0	0	0	11.5	11.5	2	1.00	0.08
MB-I	-167.70	2.40	0.00	0.00	0.00	9.00	8.40	0.00	0.00	0.00	1.83	2	2.5	8	8	1.5	3.50	0.08
MB-J	-139.60	19.10	0.00	0.00	0.00	18.00	9.10	0.00	0.00	0.00	1.83	2	2.5	10	10	2	3.50	0.08
MB-K	-87.00	21.10	0.00	0.00	0.00	26.40	9.20	0.00	0.00	0.00	1.83	2	2.5	10	10	2	3.50	0.08
MB-L	-36.20	0.70	0.00	0.00	0.00	6.60	3.90	0.00	0.00	0.00	1.83	1.33	2.5	7	7	2	3.50	0.08
MB-M	-78.00	21.10	0.00	0.00	0.00	24.30	12.10	0.00	0.00	0.00	0	0	0	11.5	11.5	2	1.00	0.08
MB-N	-80.90	20.60	0.00	0.00	0.00	18.50	11.90	0.00	0.00	0.00	0	0	0	11.5	11.5	2	1.00	0.08
B2-B	-27.60	0.00	0.00	0.00	0.00	5.10	0.00	0.00	0.00	0.00	1	1	2.5	5	5	1.5	3.50	0.08
B2-D	-23.60	1.60	0.00	0.00	0.00	4.00	0.60	0.00	0.00	0.00	2	1	2.5	5	5	1.5	3.50	0.08
B2-E	-36.50	5.10	0.00	0.00	0.00	6.60	1.50	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
B2-F	-29.40	4.00	0.00	0.00	0.00	6.70	1.50	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
B3-A	-12.70	0.00	0.00	0.00	0.00	4.40	1.50	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
B3-B	-8.80	0.00	0.00	0.00	0.00	2.90	1.10	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
B3-C	-11.10	0.00	0.00	0.00	0.00	2.60	0.40	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
B3-D	-18.70	0.00	0.00	0.00	0.00	2.20	1.00	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
B3-E	-42.50	15.90	0.00	0.00	0.00	6.70	3.60	0.00	0.00	0.00	0	0	0	7	7	2	1.00	0.08
B3-F	-27.90	15.90	0.00	0.00	0.00	7.50	7.00	0.00	0.00	0.00	2.167	2	2.5	7	7	2	3.50	0.08
B4-A	-14.80	0.00	0.00	0.00	0.00	5.50	0.00	0.00	0.00	0.00	1	1.33	2.5	5	5	1.5	3.50	0.08
B4-B	-6.70	0.60	0.00	0.00	0.00	3.30	1.80	0.00	0.00	0.00	1.33	1	2.5	5	5	1.5	3.50	0.08
B4-C	-47.30	28.00	0.00	0.00	0.00	7.20	4.60	0.00	0.00	0.00	2.25	1.5	2.5	10	10	2	3.50	0.08
B4-D	-39.70	20.60	0.00	0.00	0.00	8.50	5.00	0.00	0.00	0.00	2	1.83	2.5	7	7	2	3.50	0.08
B4-E	-16.60	0.50	0.00	0.00	0.00	4.70	2.60	0.00	0.00	0.00	1.33	1.33	2.5	5	5	1.5	3.50	0.08
MB-O	-54.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00	1.50	1.00	0.08

COLUMN LOCATION	RESULTS: Bearing Pressures		Stability Checks					Shear Capacity Checks			Footing Reinforcing: Bottom Face				Top Face			
	P(max) (gross) (ksf)	P(max) (net) (ksf)	F.S. Overturning X-axis	F.S. Overturning Y-axis	F.S. Sliding X-direction	F.S. Sliding Y-direction	F.S. Uplift	One-Way Vu/ϕVc X-direction	One-Way Vu/ϕVc Y-direction	Two-Way Vu/ϕVc	X-direction (in.^2/ft.)	X-direction (No. - Size)	Y-direction (in.^2/ft.)	Y-direction (No. - Size)	X-direction (in.^2/ft.)	X-direction (No. - Size)	Y-direction (in.^2/ft.)	Y-direction (No. - Size)
MB-A	3.563	2.958	---	1.79	4.38	---	2.92	0.20	0.29	0.34	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
MB-B	3.274	2.669	---	2.97	5.18	---	7.29	0.20	0.25	0.31	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
MB-C	3.253	2.648	---	2.95	5.18	---	6.99	0.20	0.26	0.32	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
MB-D	3.274	2.669	---	2.80	5.23	---	6.21	0.20	0.25	0.31	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
MB-E	1.444	1.114	---	1.68	1.72	---	2.28	0.17	0.18	#DIV/0!	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
MB-F	1.317	0.987	---	1.61	2.43	---	1.71	0.33	0.35	#DIV/0!	0.294	13 - #5	0.310	13 - #5	0.259	13 - #5	0.259	13 - #5
MB-G	1.901	1.296	---	2.17	2.87	---	2.52	0.27	0.30	0.40	0.259	11 - #5	0.259	11 - #5	0.259	11 - #5	0.259	11 - #5
MB-H	1.088	0.758	---	1.88	2.02	---	1.99	0.25	0.27	#DIV/0!	0.259	13 - #5	0.259	13 - #5	0.259	13 - #5	0.259	13 - #5
MB-I	3.417	2.867	---	2.24	3.03	---	4.33	0.64	0.69	0.78	0.355	9 - #6	0.363	9 - #6	0.194	9 - #4	0.194	9 - #4
MB-J	2.671	2.066	---	2.61	4.39	---	3.80	0.41	0.43	0.53	0.311	11 - #5	0.314	11 - #5	0.259	11 - #5	0.259	11 - #5
MB-K	2.199	1.594	---	1.97	3.29	---	2.59	0.31	0.33	0.41	0.259	11 - #5	0.259	11 - #5	0.259	11 - #5	0.259	11 - #5
MB-L	1.553	0.948	---	2.89	6.52	---	5.08	0.07	0.10	0.12	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
MB-M	1.241	0.911	---	1.90	1.55	---	2.23	0.30	0.32	#DIV/0!	0.271	13 - #5	0.286	13 - #5	0.259	13 - #5	0.259	13 - #5
MB-N	1.259	0.929	---	2.40	1.71	---	2.93	0.31	0.33	#DIV/0!	0.277	13 - #5	0.292	13 - #5	0.259	13 - #5	0.259	13 - #5
B2-B	1.789	1.239	---	---	---	---	2.99	0.12	0.14	0.18	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B2-D	1.935	1.385	---	3.07	13.01	---	3.81	0.05	0.16	0.15	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B2-E	3.123	2.573	---	1.69	4.97	---	2.31	0.20	0.24	0.30	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B2-F	2.628	2.078	---	1.67	5.84	---	2.27	0.16	0.20	0.24	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B3-A	1.192	0.642	---	2.24	9.26	---	3.46	0.05	0.06	0.07	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B3-B	1.036	0.486	---	3.27	13.01	---	5.25	0.04	0.05	0.06	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B3-C	1.128	0.578	---	4.70	36.00	---	5.86	0.04	0.05	0.07	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B3-D	1.432	0.882	---	4.01	14.51	---	6.92	0.07	0.08	0.10	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B3-E	1.909	1.579	---	2.29	1.50	---	3.00	0.23	0.26	#DIV/0!	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
B3-F	2.580	1.975	---	2.03	2.32	---	4.47	0.12	0.15	0.20	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
B4-A	1.276	0.726	---	---	---	---	2.77	0.07	0.07	0.09	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B4-B	1.068	0.518	---	2.47	7.38	---	4.62	0.04	0.06	0.07	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
B4-C	1.989	1.384	---	4.59	2.03	---	9.51	0.25	0.32	0.36	0.259	11 - #5	0.259	11 - #5	0.259	11 - #5	0.259	11 - #5
B4-D	3.192	2.587	---	2.25	1.93	---	3.94	0.17	0.22	0.28	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5	0.259	8 - #5
B4-E	1.444	0.894	---	1.72	5.31	---	3.24	0.07	0.08	0.10	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4	0.194	6 - #4
MB-O	2.570	2.295	---	---	---	---	---	0.35	0.41	#DIV/0!	0.389	6 - #6	0.389	6 - #6	---	---	---	---

RECTANGULAR SPREAD FOOTING

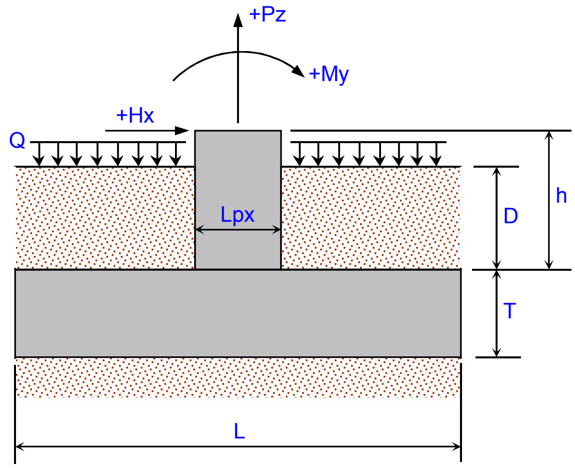
Job Name:	XCEL Sports Complex	Subject:	Building Footings		
Key:	MB-A	Variant:	1	Checker:	APE

Input Data:

SAMPLE CALCULATION OF MB-A LC-1

Footing Data:

Footing Length, L =	7	ft.
Footing Width, B =	7	ft.
Footing Thickness, T =	2	ft.
Concrete Unit Wt., γc =	0.15	kcf
Soil Depth, D =	3.5	ft.
Soil Unit Wt., γs =	0.11	kcf
Pass. Press. Coef., Kp =	2.05	
Coef. of Base Friction, μ =	0.28	
Uniform Surcharge, Q =	0.075	ksf

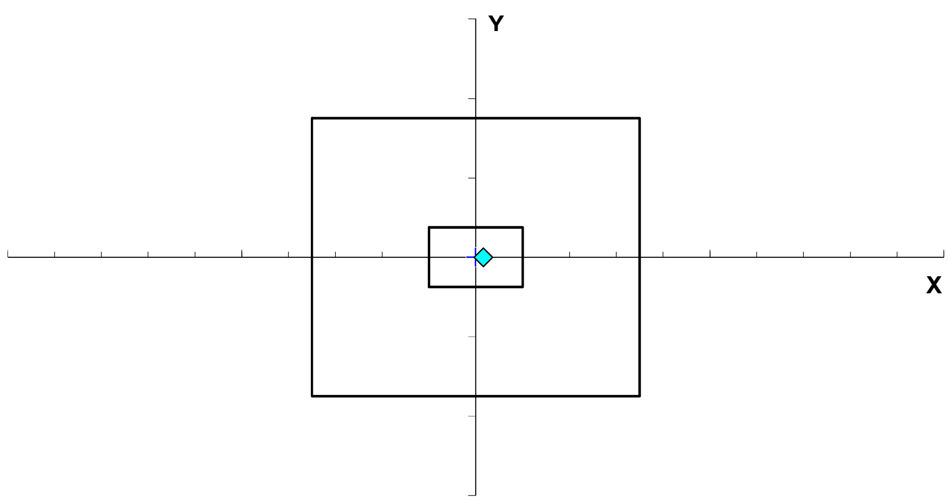


Nomenclature

Pier/Loading Data:

Number of Piers = 1

	Pier #1								
Xp (ft.) =	0.000	0.000							#VALUE!
Yp (ft.) =	0.000	0.000							
Lpx (ft.) =	2	2							
Lpy (ft.) =	1.5	1.5							
h (ft.) =	2.5	2.5							
Pz (k) =	-115.8	-115.8							
Hx (k) =	5.6	5.6							
Hy (k) =	0.000	0.000							
Mx (ft-k) =	0.000	0.000							
My (ft-k) =	0.000	0.000							



FOOTING PLAN

(continued)

Results:

Total Resultant Load and Eccentricities:

ΣPz =	-153.34	kips
ex =	0.16	ft. (<= L/6)
ey =	0.00	

Overturning Check:

ΣMrx =	N.A.	ft-kips
ΣMox =	N.A.	ft-kips
FS(ot)x =	N.A.	
ΣMry =	523.83	ft-kips
ΣMoy =	25.20	ft-kips
FS(ot)y =	20.787	(>= 1.5)

Sliding Check:

Pass(x) =	14.21	kips
Frict(x) =	41.91	kips
FS(slid)x =	N.A.	
Passive(y) =	14.21	kips
Frict(y) =	41.91	kips
FS(slid)y =	N.A.	

Uplift Check:

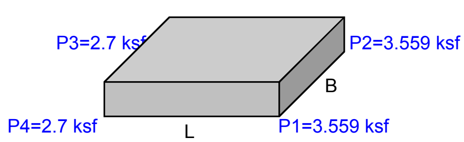
ΣPz(down) =	-149.67	kips
ΣPz(uplift) =	0.00	kips
FS(uplift) =	N.A.	

Bearing Length and % Bearing Area:

Dist. x =	N.A.	ft.
Dist. y =	N.A.	ft.
Brg. Lx =	7	ft.
Brg. Ly =	7	ft.
%Brg. Area =	100.00	%
Biaxial Case =	N.A.	

Gross Soil Bearing Corner Pressures:

P_1 =	3.559	ksf
P_2 =	3.559	ksf
P_3 =	2.700	ksf
P_4 =	2.700	ksf



CORNER PRESSURES

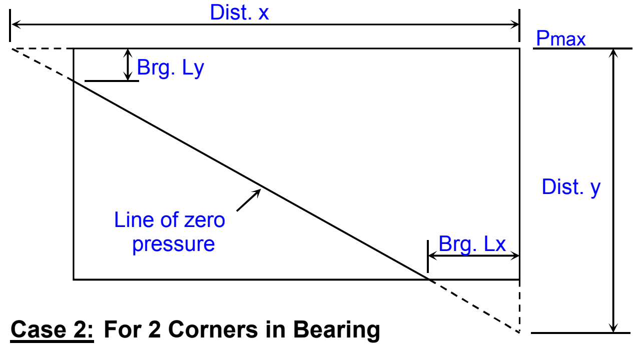
Maximum Net Soil Pressure:

$P_{max}(net) = P_{max}(gross)-(D+T)*\gamma s$

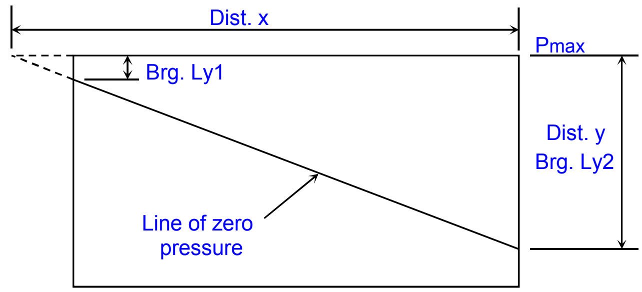
$P_{max}(net)$ =	2.954	ksf

Nomenclature for Biaxial Eccentricity:

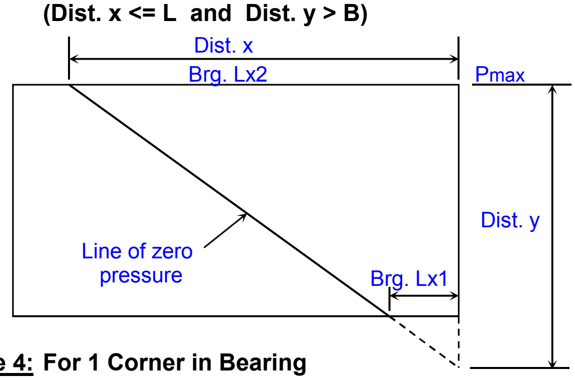
Case 1: For 3 Corners in Bearing
(Dist. x > L and Dist. y > B)



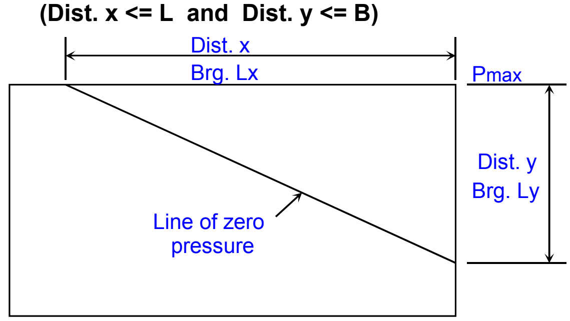
Case 2: For 2 Corners in Bearing
(Dist. x > L and Dist. y <= B)



Case 3: For 2 Corners in Bearing
(Dist. x <= L and Dist. y > B)



Case 4: For 1 Corner in Bearing
(Dist. x <= L and Dist. y <= B)



RECTANGULAR SPREAD FOOTING

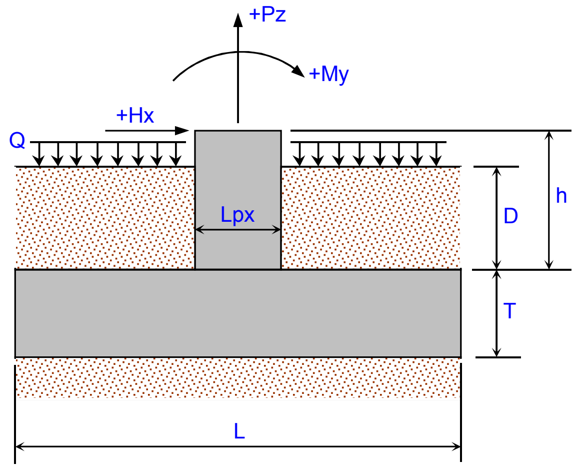
Job Name:	XCEL Sports Complex	Subject:	Building Foundations		
Key:	MB-A	Variant:	2	Checker:	APE

Input Data:

SAMPLE CALCULATION OF MB-A LC-2

Footing Data:

Footing Length, L =	7	ft.
Footing Width, B =	7	ft.
Footing Thickness, T =	2	ft.
Concrete Unit Wt., γc =	0.15	kcf
Soil Depth, D =	3.5	ft.
Soil Unit Wt., γs =	0.11	kcf
Pass. Press. Coef., Kp =	2.05	
Coef. of Base Friction, μ =	0.28	
Uniform Surcharge, Q =	0.075	ksf

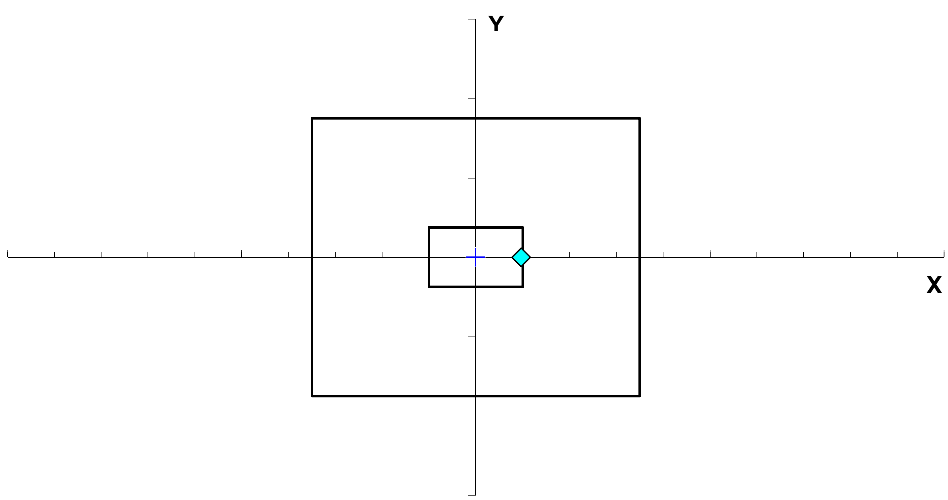


Nomenclature

Pier/Loading Data:

Number of Piers = 1

	Pier #1								
Xp (ft.) =	0.000	0.000							#VALUE!
Yp (ft.) =	0.000	0.000							
Lpx (ft.) =	2	2							
Lpy (ft.) =	1.5	1.5							
h (ft.) =	2.5	2.5							
Pz (k) =	11.5	11.5							
Hx (k) =	5.6	5.6							
Hy (k) =	0.000	0.000							
Mx (ft-k) =	0.000	0.000							
My (ft-k) =	0.000	0.000							



FOOTING PLAN

(continued)

Results:

Total Resultant Load and Eccentricities:

ΣPz =	-26.04	kips
ex =	0.97	ft. (<= L/6)
ey =	0.00	

Overturning Check:

ΣMrx =	N.A.	ft-kips
ΣMox =	N.A.	ft-kips
FS(ot)x =	N.A.	
ΣMry =	117.48	ft-kips
ΣMoy =	64.40	ft-kips
FS(ot)y =	1.824	(>= 1.5)

Sliding Check:

Pass(x) =	14.21	kips
Frict(x) =	6.26	kips
FS(slid)x =	N.A.	
Passive(y) =	14.21	kips
Frict(y) =	6.26	kips
FS(slid)y =	N.A.	

Uplift Check:

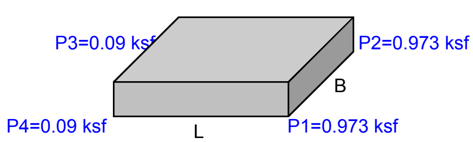
ΣPz(down) =	-22.37	kips
ΣPz(uplift) =	0.00	kips
FS(uplift) =	N.A.	

Bearing Length and % Bearing Area:

Dist. x =	N.A.	ft.
Dist. y =	N.A.	ft.
Brg. Lx =	7	ft.
Brg. Ly =	7	ft.
%Brg. Area =	100.00	%
Biaxial Case =	N.A.	

Gross Soil Bearing Corner Pressures:

P_1 =	0.973	ksf
P_2 =	0.973	ksf
P_3 =	0.090	ksf
P_4 =	0.090	ksf



CORNER PRESSURES

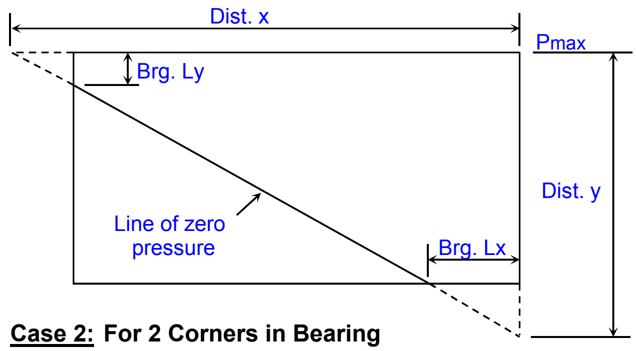
Maximum Net Soil Pressure:

$P_{max}(net) = P_{max}(gross)-(D+T)*\gamma s$

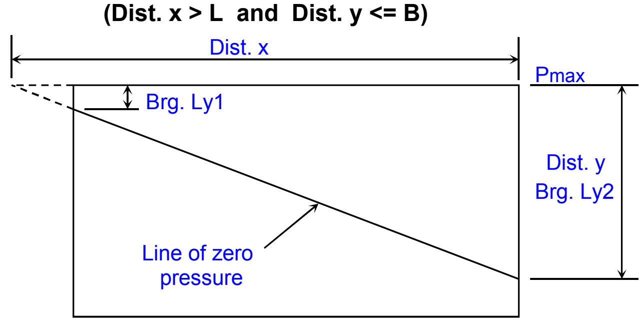
P_{max}(net) =	0.368	ksf

Nomenclature for Biaxial Eccentricity:

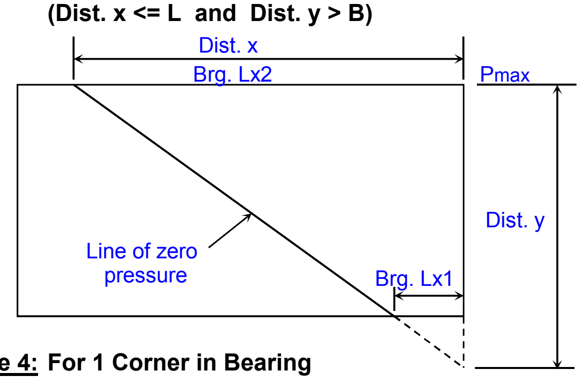
Case 1: For 3 Corners in Bearing
(Dist. x > L and Dist. y > B)



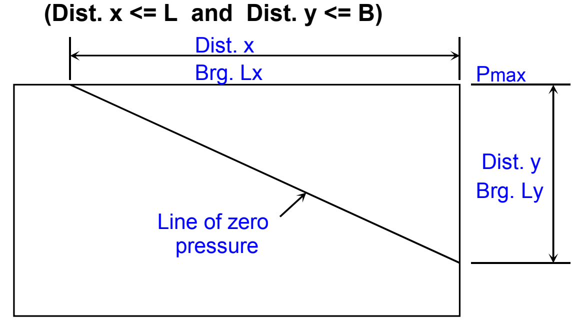
Case 2: For 2 Corners in Bearing
(Dist. x > L and Dist. y <= B)



Case 3: For 2 Corners in Bearing
(Dist. x <= L and Dist. y > B)



Case 4: For 1 Corner in Bearing
(Dist. x <= L and Dist. y <= B)



Xcel Sports Complex
Jefferson, WI

Roof Overhang Analysis

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

JOB SPORTS COMPLEX NO.

SHEET NO. 801 OF

CALCULATED BY ACV DATE 6/9/15

CHECKED BY DATE

DESCRIPTION GLULAM OVERHANG SIZING

WIND LOAD: PER ASCE 7-05 (UPLIFT ONLY)
$q_z = 0.00256{*}K_z{*}K_{zt}{*}K_d{*}V^2{*}I = 0.00256{*}0.99{*}1.0{*}0.85{*}90^2{*}1.0 = 17.44$ PSF
$K_z = 0.99$ (TABLE 6-3)
$K_{zt} = 1.0$ (SECTION 6.5.7.2)
$K_d = 0.85$ (TABLE 6-4)
V = 90 MPH (FIGURE 6-1)
I =1.0 (TABLE 6-1)
p_1 = qz(GCp±GCpi)= 17.44 PSF*(-2 ± -0.18)=-38.02 PSF
p_2 = -29.30 PSF
GCp_1 = -2.0 (FIGURE 6-11B)
GCp_2 = -1.5 (FIGURE 6-11B)
GCpi = -0.18 (FIGURE 6-6)

OVERHANG SIZING
OVERHANG = 7 FT
BACKSPAN = 9 FT

W_{OH} = 152.1 LB/FT
W_{BS} = 117.2 LB/FT

M_{MAX} = 3724 K-FT
MAX ALLOW. DEFL. = 84/240 = 0.35 IN
I_{MIN} = 5*0.0127 K/IN*(84 IN)^4/(384*18000 KSI*.35 IN) = 125.5 IN^4

CHECK 5.5"X7.5" 24-E11
$C_D = C_t = C_V = C_{fu} = 1$
$C_m = 0.8$
F^*_b = 2400*0.8 = 1920 KSI
$l_u/d = 11.2$
l_e = 98.1 IN
$R_b = 4.93$
$C_T = 1.21$
E'_{MIN} = 921.5 KSI
F_{BEN} = 45.5 KSI
$C_L = 0.998$
F'_b = 1915.8 PSI

M'n = 8.232 K-FT > 1.396 K-FT **OK**
I_X = 193.4 IN^4 > 125.5 IN^4 **OK**

PROVIDE 5.5"X7.5" 24-E11 OR 5.5"X7.5" 24-V10 GLULAM BEAM

NTRIVE
INNOVATIVE ENGINEERING

Ntrive Engineering

280 Shuman Blvd Ste 270

Naperville, IL 60563

JOB: SPORTS COMPLEX NO.

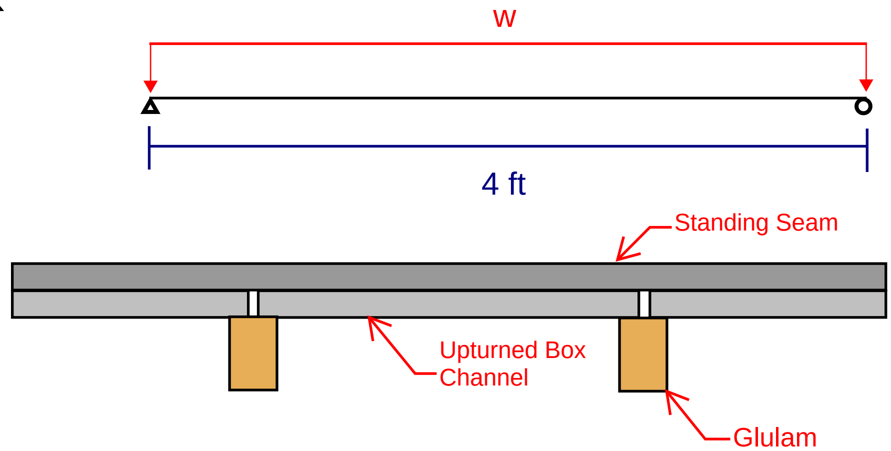
SHEET NO. 802 OF

CALCULATED BY: ACV DATE 6/9/2015

CHECKED BY: DATE

DESCRIPTION: SQUARE HSS PURLIN CHECK

SQUARE HSS PURLIN CHECK



Properties:

1-1/2" x 1-1/2" x 3/16"

b/t = h/t =5.6
E = 29000 ksi
F_Y = 46 ksi
Z = 0.406 in^3
I = 0.235 in^4

Slenderness:

$\lambda_p = 2.42\sqrt{(E/Fy)} = 60.8 > 5.6$
$\lambda_p = 1.12\sqrt{(E/Fy)} = 28.1 > 5.6$ Member is compact.

Capacity:

$M_n = F_Y{*}Z$ = 18.7 k-in = 1556.3 ft-lb

Demand:

$w_{(main)}$ = 29.3 psf *(4 ft) = 117.2 lb/ft
$w_{(overhang)}$ = 38.0 psf *(4 ft) = 152.0 lb/ft

$M_{MAX(main)}$ = 234.4 ft-lb < 1556.3 ft-lb
$M_{MAX\ (overhang)}$ = 304.0 ft-lb < 1556.3 ft-lb **OK**

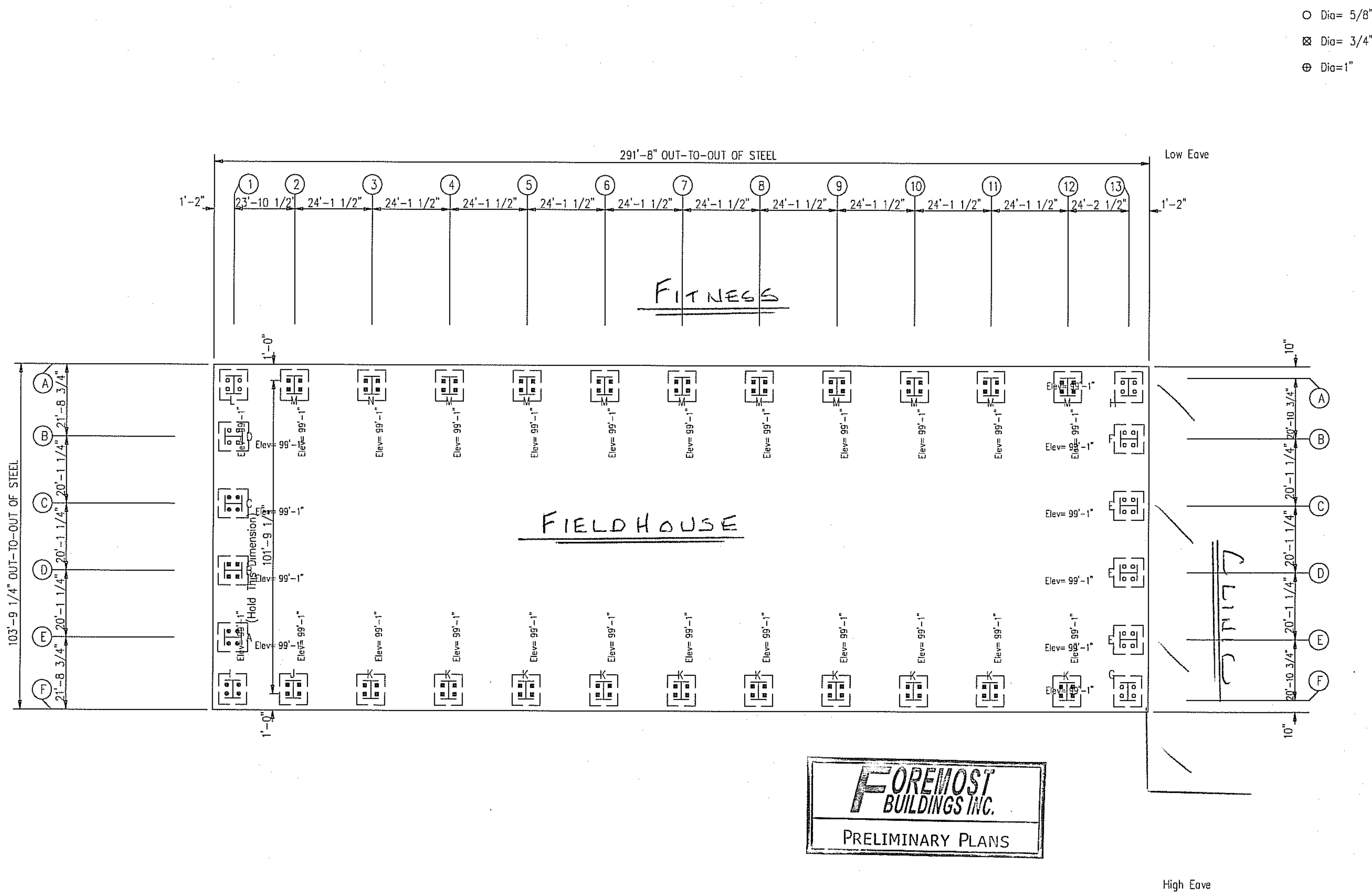
Deflection:

d_{ALLOW} = L/240 = 0.2 in

$d_{(main)}$ = 0.0198 in < 0.2 in **OK**
$d_{(overhang)}$ = 0.0258 in < 0.2 in **OK**

Xcel Sports Complex
Jefferson, WI

Appendix A:
Pre-manufactured Metal Building Reactions



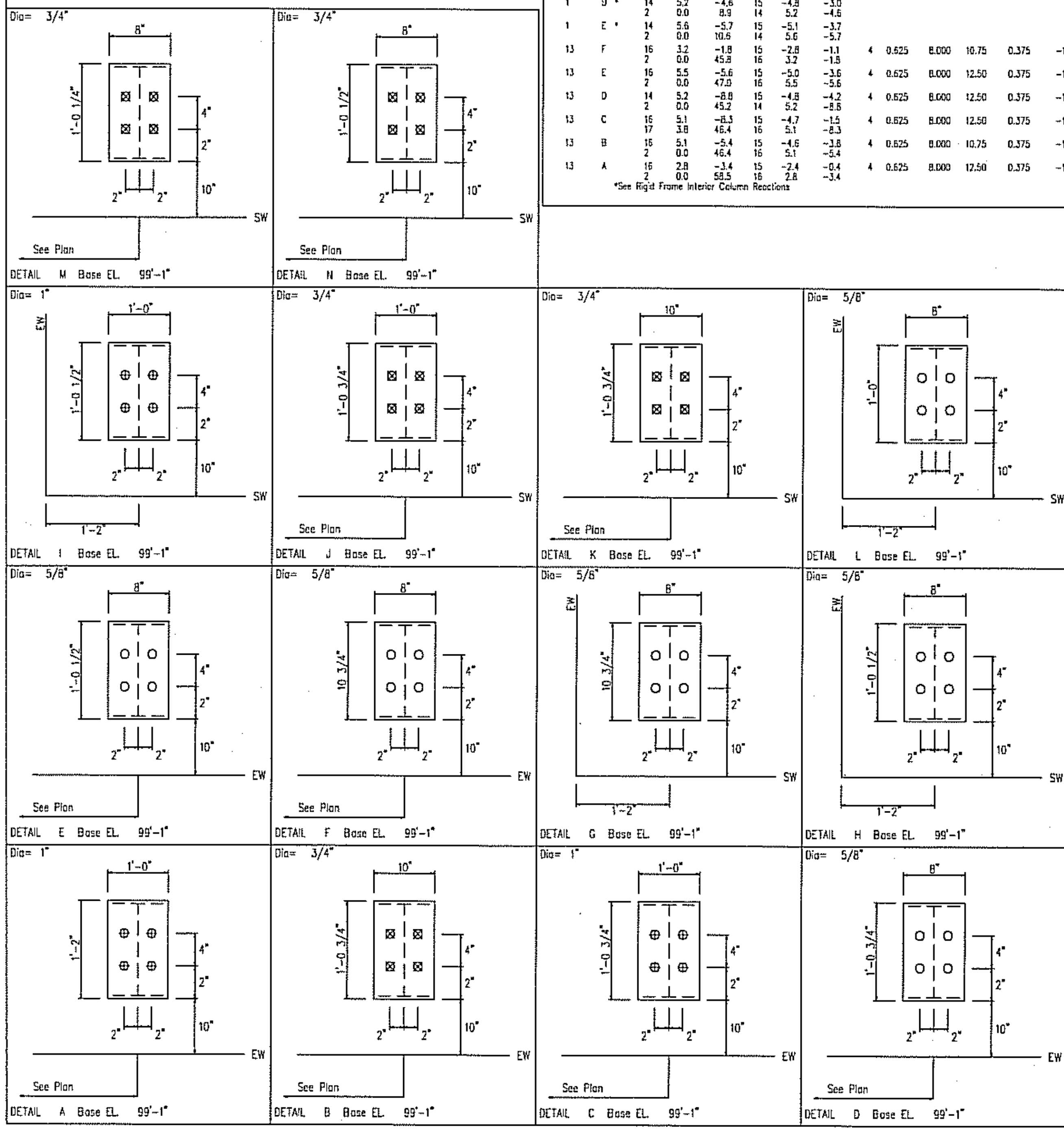
ANCHOR BOLT PLAN

NOTE: All Base Plates @ 100'-0" (U.N.)

GENERAL NOTES

1. REVIEW DRAWING 5A FOR ANCHOR BOLT SIZES, LOCATIONS AND PATTERNS
(IE:) CENTERLINE OF A.B. OR CENTERLINE OF PATTERN OR CENTERLINE OF COLUMN.

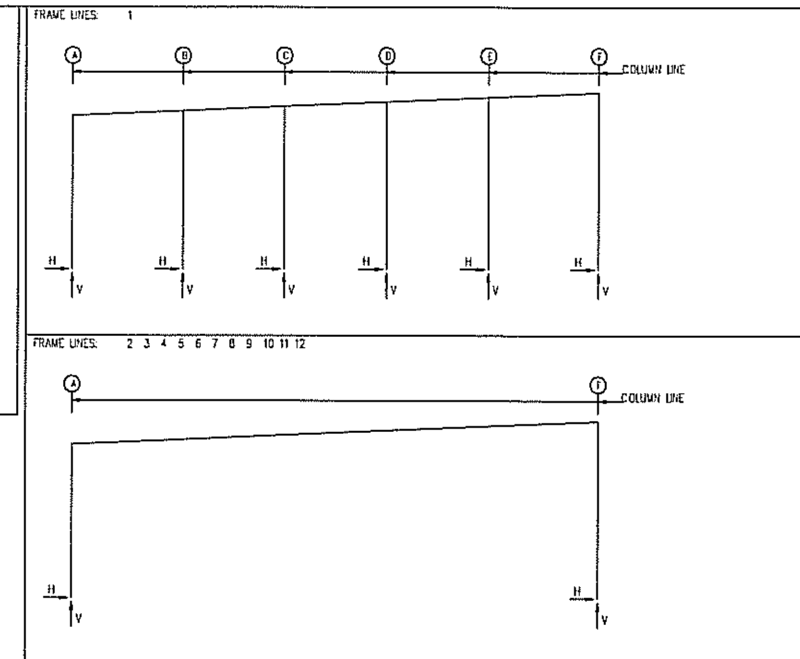
FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	MAIN	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT		DATE: 6/23/15	SHEET: 6 OF 10	
ADDRESS	JEFFERSON, WI	DO NOT SCALE DRAWING	ISSUE:	



ENDWALL COLUMN: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc. Bolt Qty	Anc. Bolt Dia	Base_Plate (in) Width	Base_Plate (in) Length	Thick	Grout (in)
1	B *	14 2	5.1 0.0	-5.4 10.0	15 14	-4.7 5.1	-3.9 -5.4						
1	C *	14 2	5.1 0.0	-4.8 9.0	15 14	-4.7 5.1	-3.0 -4.8						
1	D *	14 2	5.2 0.0	-4.6 8.9	15 14	-4.8 5.2	-3.0 -4.6						
1	E *	14 2	5.6 0.0	-5.7 10.6	15 14	-5.1 5.6	-3.7 -5.7						
13	F	16 2	3.2 0.0	-1.8 45.8	15 16	-2.8 3.2	-1.1 -1.8	4	0.625	8.000	10.75	0.375	-11
13	E	16 2	5.5 0.0	-5.6 47.0	15 16	-5.0 5.5	-3.6 -5.6	4	0.625	8.000	12.50	0.375	-11
13	D	14 2	5.2 0.0	-8.8 45.2	15 14	-4.8 5.2	-4.2 -8.8	4	0.625	8.000	12.50	0.375	-11
13	C	16 17	5.1 3.8	-8.3 46.4	15 16	-4.7 5.1	-1.5 -8.3	4	0.625	8.000	12.50	0.375	-11
13	B	16 2	5.1 0.0	-5.4 46.4	15 16	-4.6 5.1	-3.8 -5.4	4	0.625	8.000	10.75	0.375	-11
13	A	16 2	2.8 0.0	-3.4 58.5	15 16	-2.4 2.8	-0.4 -3.4	4	0.625	8.000	12.50	0.375	-11

*See Rigid Frame Interior Column Reactions



RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Anc._Bolt Dia	Base_Plate (in) Width	Base_Plate (in) Length	Thick	Grout (in)
1	A	6 1	3.6 -0.7	-3.0 36.2	7 5	-3.9 -2.1	-4.2 -6.6	4	0.625	8.000	12.00	0.375	-11
1	F	8 3	8.4 -2.4	-6.3 167.7	5 6	-6.0 6.6	2.8 -9.0	4	1.000	12.00	12.50	1.000	-11
1	B	9 11	0.0 0.0	-7.3 123.2	9	0.0	-7.3	4	0.625	8.000	13.75	0.625	-11
1	C	5 12	0.0 0.0	-6.5 122.2	5	0.0	-6.5	4	1.000	12.00	12.50	1.000	-11
1	D	9 13	0.0 0.0	-6.4 123.5	9	0.0	-6.4	4	0.750	10.00	10.50	0.750	-11
1	E	5 4	0.0 0.0	-11.5 115.8	5	0.0	-11.5	4	1.000	12.00	12.50	1.000	-11

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Anc._Bolt Dia	Base_Plate (in) Width	Base_Plate (in) Length	Thick	Grout (in)
2	A	1	19.1	78.0	5	-11.7	-18.7	4	0.750	8.000	12.25	0.625	-11
2	F	6 1	9.1 -19.1	-9.4 139.6	2 10	-19.1 5.5	139.6 -18.0	4	0.750	12.00	12.75	0.750	-11

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Anc._Bolt Dia	Base_Plate (in) Width	Base_Plate (in) Length	Thick	Grout (in)
3	A	1	20.6	80.9	5	-11.9	-18.6	4	0.750	8.000	12.50	0.625	-11
3	F	6 2	9.0 -20.6	-9.4 85.0	2 10	-20.6 5.6	85.0 -18.1	4	0.750	10.00	12.75	0.500	-11

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Anc._Bolt Dia	Base_Plate (in) Width	Base_Plate (in) Length	Thick	Grout (in)
4*	A	2	21.1	77.1	5 9	-12.1 -5.1	-19.1 -24.3	4	0.750	8.000	12.25	0.625	-11
4*	F	6 1	9.2 -21.1	-9.8 87.0	1 10	-21.1 5.7	87.0 -26.4	4	0.750	10.00	12.75	0.500	-11

4* Frame lines: 4 5 6 7 8 9 10 11 12

GENERAL NOTES

1. FOUNDATION DESIGN AND CONSTRUCTION ARE NOT THE RESPONSIBILITY OF FOREMOST BUILDINGS, INC.
2. THE BUILDING REACTION DATA REPORTS THE LOADS WHICH THIS BUILDING PLACES ON THE FOUNDATION.
3. ANCHOR BOLTS SHALL BE ACCURATELY SET TO A TOLERANCE OF +/- 1/8" IN BOTH ELEVATION AND LOCATION.
4. COLUMN BASE PLATES ARE DESIGNED NOT TO EXCEED A BEARING PRESSURE OF 1125 POUNDS PER SQUARE INCH.
5. ALL COLUMN BASE PLATES ARE TO BE SET AT FINISHED FLOOR ELEVATION OF 100'- 0" UNLESS OTHERWISE NOTED ON THE ANCHOR BOLT SETTING PLAN.....
6. SEE REACTION TABLES FOR PROPER BASE PLATE WIDTHS AND LENGTHS.

*** Additional Load Information ***

Snow Drift (Magnitude psf Width ft)
:

Ground Snow:

Crane 1
Capacity (Tons) : @R000
Wheel Load (Kips) : @R006
Wheel Base (Feet) : @R007
Service Class : @R001

Crane 2
Capacity (Tons) : @R016
Wheel Load (Kips) : @R022
Wheel Base (Feet) : @R023
Service Class : @R017

NOTES FOR REACTIONS

1. All loading conditions are examined and only maximum/minimum H or V and the corresponding H or V are reported.
2. Positive reactions are as shown in the sketch. Foundation loads are in opposite directions.
3. Bracing reactions are in the plane of the brace with the H pointing away from the braced bay. The vertical reaction is downward.
4. Building reactions are based on the following building data:

Width (ft)	= 103.8
Length (ft)	= 291.7
Eave Height (ft)	= 26.8/ 33.1
Roof Slope (rise/12)	= 0.5
Dead Load (psf)	= 2.5
Collateral Load (psf)	= 5.0
Live Load (psf)	= 20.0
Snow Load (psf)	= 24.0
Wind Speed (mph)	= 90.0
Wind Code	= IBC II (IBC 09)
Exposure	= C
Closed/Open	= C
Importance Wind	= 1.00
Importance Seismic	= 1.00
Seismic Design Category	= B
Seismic Coeff (Fa*Ss)	= 0.12

5. Loading conditions are:
   1 Dead+Collateral+Snow
   2 Dead+Collateral+Snow+Side_Snow
   3 Dead+Collateral+0.75Snow+0.75Wind_Left2+0.75Side_Snow+0.75Floor_Live
   4 Dead+Collateral+0.75Snow+0.75Wind_Right2+0.75Side_Snow+0.75Floor_Live
   5 0.6Dead+Wind_Left1
   6 0.6Dead+Wind_Right1
   7 0.6Dead+Wind_Left2
   8 0.6Dead+Wind_Right2
   9 0.6Dead+Wind_Long1+LWND1_L2E
   10 0.6Dead+Wind_Long1+LWND1_R2E
   11 Dead+Collateral+Snow/2+F1PAT_SL_3
   12 Dead+Collateral+Snow/2+F1PAT_SL_4
   13 Dead+Collateral+Snow/2+F1PAT_SL_5
   14 0.6Dead+Wind_Left2+Wind_Suction
   15 0.6Dead+Wind_Pressure+Wind_Long1
   16 0.6Dead+Wind_Right2+Wind_Suction
   17 Dead+Collateral+0.75Snow+0.75Wind_Left2+0.75Wind_Suction+0.75Side_Snow+0.75Floor_Live

BUILDING BRACING REACTIONS

Wall Loc	Wall Line	Col Line	± Reactions (k) Wind Horz	Wind Vert	Seismic Horz	Seismic Vert	Panel_Shear (lb/ft) Wind	Panel_Shear Seis	Note
L_EW	1								(h)
F_SW	F	6,7	6.0	7.8	1.3	1.6			
		10,11	6.0	7.8	1.3	1.6			
R_EW	13	D,C	4.5	6.7	0.3	0.4			
B_SW	A	11,10	5.7	6.4	1.3	1.4			
		7,6	5.7	6.4	1.3	1.4			

(h)Rigid frame at endwall

ANCHOR BOLT SUMMARY

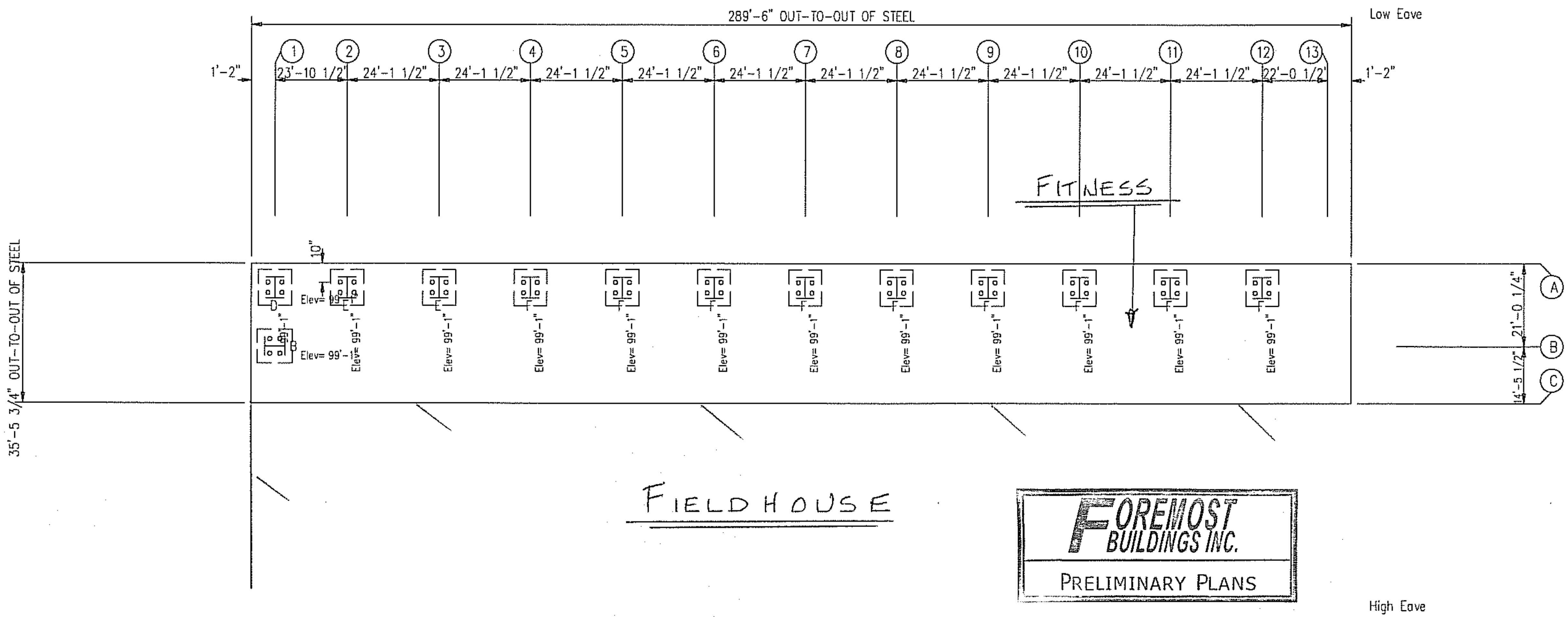
Qty	Locate	Dia (in)	Type	Proj (in)
28	Endwall	5/8"	A307	3.00
8	Endwall	1"		
4	Endwall	3/4"	A307	3.00
4	Frame	5/8"	A307	3.00
4	Frame	1"	A307	3.00
88	Frame	3/4"	A307	3.00

FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	MAIN	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT ADDRESS	JEFFERSON, WI	DATE: 6/23/15	SHEET: [illegible] OF 1[illegible]	
		DO NOT SCALE DRAWING	ISSUE:	

FOREMOST BUILDINGS INC.

PRELIMINARY PLANS

O Dia= 5/8"



ANCHOR BOLT PLAN
NOTE: All Base Plates @ 100'-0" (U.N.)

GENERAL NOTES

1. REVIEW DRAWING 5A FOR ANCHOR BOLT SIZES, LOCATIONS AND PATTERNS
(IE:) CENTERLINE OF A.B. OR CENTERLINE OF PATTERN OR CENTERLINE OF COLUMN.

FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	BLDG 2	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT		DATE: 6/23/15	SHEET: 3 OF 8	
ADDRESS	JEFFERSON, WI	DO NOT SCALE DRAWING	ISSUE:	

GENERAL NOTES

1. FOUNDATION DESIGN AND CONSTRUCTION ARE NOT THE RESPONSIBILITY OF FOREMOST BUILDINGS, INC.
2. THE BUILDING REACTION DATA REPORTS THE LOADS WHICH THIS BUILDING PLACES ON THE FOUNDATION.
3. ANCHOR BOLTS SHALL BE ACCURATELY SET TO A TOLERANCE OF +/- 1/8" IN BOTH ELEVATION AND LOCATION.
4. COLUMN BASE PLATES ARE DESIGNED NOT TO EXCEED A BEARING PRESSURE OF 1125 POUNDS PER SQUARE INCH.
5. ALL COLUMN BASE PLATES ARE TO BE SET AT FINISHED FLOOR ELEVATION OF 100'- 0" UNLESS OTHERWISE NOTED ON THE ANCHOR BOLT SETTING PLAN......
6. SEE REACTION TABLES FOR PROPER BASE PLATE WIDTHS AND LENGTHS.

*** Additional Load Information ***

Snow Drift (Magnitude psf Width ft)
: 60.8 psf and 23.27 ft

Ground Snow:

Crane 1
Capacity (Tons) : GR000
Wheel Load (Kips) : GR006
Wheel Base (Feet) : GR007
Service Class : GR001

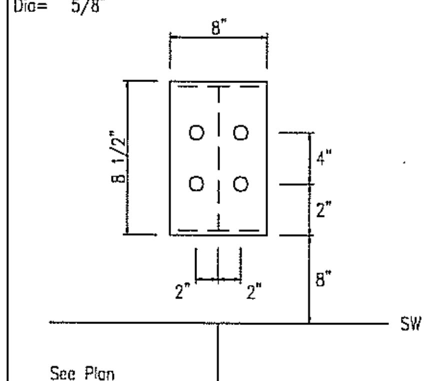
Crane 2
Capacity (Tons) : GR016
Wheel Load (Kips) : GR022
Wheel Base (Feet) : GR023
Service Class : GR017

BUILDING BRACING REACTIONS

Wall Loc	Wall Line	Col Line	± Reactions (k) Wind Horz	Wind Vert	Seismic Horz	Seismic Vert	Panel_Shear (lb/ft) Wind	Seis	Note
L_EW	1								(h)
F_SW	C								(f)
R_EW	13								(h)
B_SW	A	11,10	1.9	0.9	0.5	0.2			
		7,6	1.9	0.9	0.5	0.2			

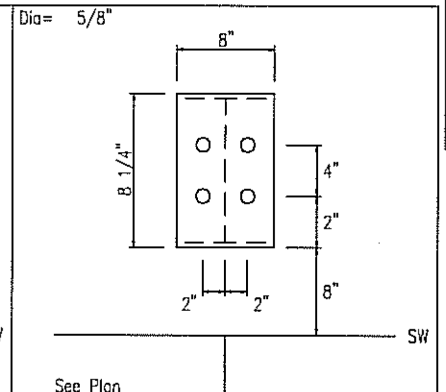
(f)Bracing loads are applied to adjacent building
(h)Rigid frame at endwall

Dia= 5/8"



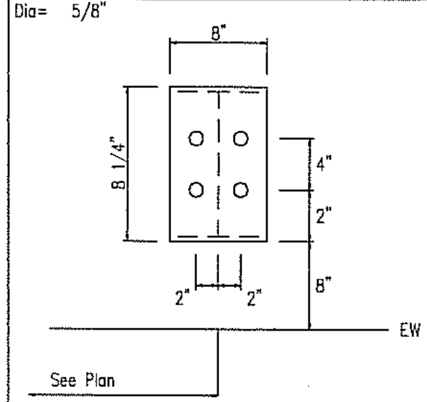
DETAIL E Base EL. 99'-1"

Dia= 5/8"



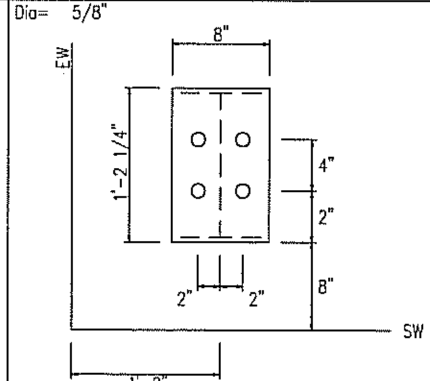
DETAIL F Base EL. 99'-1"

Dia= 5/8"



DETAIL B Base EL. 99'-1"

Dia= 5/8"



DETAIL D Base EL. 99'-1"

~~RIGID FRAME:~~ MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
13	A	5	0.6	7.2	9	-0.5	-1.4	4	0.625	8.000	8.250	0.375	-11
		3	0.3	11.4	8	-0.3	-2.2						
13	B	11	0.0	-2.7	11	0.0	-2.7	4	0.625	8.000	8.250	0.375	0.0
		3	0.0	14.9									

ENDWALL COLUMN: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc. Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
~~1~~	~~A~~	~~13~~	~~0.6~~	~~0.1~~	~~14~~	~~-0.5~~	~~0.1~~	~~4~~	~~0.625~~	~~8.000~~	~~8.250~~	~~0.375~~	~~-11~~
		~~12~~	~~0.0~~	~~0.1~~									
1	B *	15	1.5	-3.4	16	-1.3	-3.4						
		2	0.0	22.2	15	1.5	-3.4						
1	C	13	0.6	0.1	14	-0.5	0.1	4	0.625	8.000	8.250	0.375	-11
		12	0.0	0.1									
~~13~~	~~B *~~	~~13~~	~~2.1~~	~~-3.4~~	~~16~~	~~-1.9~~	~~-3.0~~						
		~~5~~	~~0.0~~	~~15.5~~	~~13~~	~~2.1~~	~~-3.4~~						

*See Rigid Frame Interior Column Reactions

NOTES FOR REACTIONS

1. All loading conditions are examined and only maximum/minimum H or V and the corresponding H or V are reported.
2. Positive reactions are as shown in the sketch. Foundation loads are in opposite directions.
3. Bracing reactions are in the plane of the brace with the H pointing away from the braced bay. The vertical reaction is downward.
4. Building reactions are based on the following building data:

Width (ft)	= 35.5
Length (ft)	= 269.5
Eave Height (ft)	= 12.7/ 14.1
Roof Slope (rise/12)	= 0.5
Dead Load (psf)	= 3.0
Collateral Load (psf)	= 5.0
Live Load (psf)	= 20.0
Snow Load (psf)	= 24.0
Wind Speed (mph)	= 90.0
Wind Code	= WBC 11 (IBC 09)
Exposure	= C
Closed/Open	= C
Importance Wind	= 1.00
Importance Seismic	= 1.00
Seismic Design Category	= B
Seismic Coeff (Fa*Ss)	= 0.12

5. Loading conditions are:

1 Dead+Collateral+Snow
2 Dead+Collateral+Snow+Snow_Drift
3 Dead+Collateral+Snow+Slide_Snow
4 Dead+Collateral+0.75Snow+0.75Wind_Right1+0.75Snow_Drift+0.75Floor_Live
5 Dead+Collateral+0.75Snow+0.75Wind_Right1+0.75Slide_Snow+0.75Floor_Live
6 Dead+Collateral+0.75Snow+0.75Wind_Left2+0.75Snow_Drift+0.75Floor_Live
7 Dead+Collateral+0.75Snow+0.75Wind_Left2+0.75Slide_Snow+0.75Floor_Live
8 0.6Dead+Wind_Left1
9 0.6Dead+Wind_Left2
10 0.6Dead+Wind_Long1+LWIND1_L2E
11 0.6Dead+Wind_Long1+LWIND1_R2E
12 1.01Dead+1.01Collateral+0.52Seismic_Right+0.75Floor_Live
13 0.6Dead+Wind_Right2+Wind_Suction
14 0.6Dead+Wind_Pressure+Wind_Long2
15 0.6Dead+Wind_Left2+Wind_Suction
16 0.6Dead+Wind_Pressure+Wind_Long1

ANCHOR BOLT SUMMARY

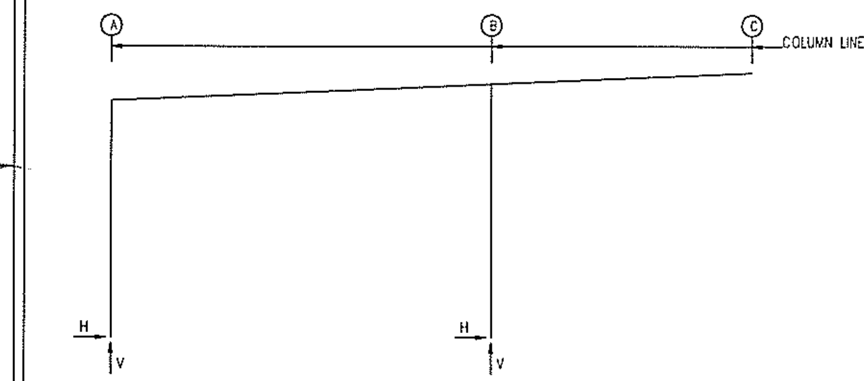
	Qty	Locate	Dia (in)	Type	Proj (in)
O	16	Endwall	5/8"	A307	3.00
O	52	Frame	5/8"	A307	3.00

FITNESS

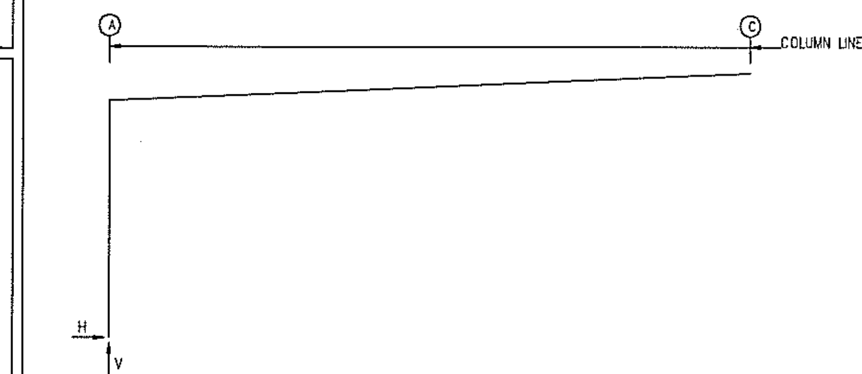
FOREMOST BUILDINGS INC.

PRELIMINARY PLANS

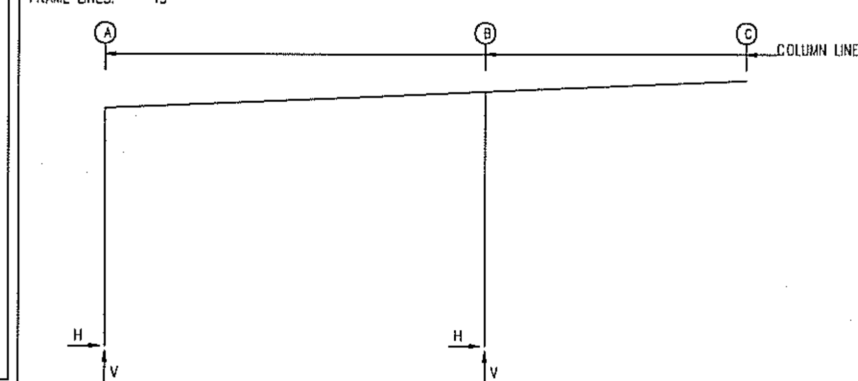
FRAME LINES: 1



FRAME LINES: 2 3 4 5 6 7 8 9 10 11 12



FRAME LINES: 13



RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
1	A	4	1.6	15.6	9	-0.6	-2.5	4	0.625	8.000	14.25	0.375	-11
		2	1.4	23.6	8	-0.5	-4.0						
1	B	11	0.0	-5.1	11	0.0	-5.1	4	0.625	8.000	8.000	0.500	-11
		2	0.0	27.6									

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
2	A	2	5.1	33.5	9	-1.5	-3.5	4	0.625	8.000	8.500	0.375	-11
					8	-1.4	-6.2						

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
3	A	3	4.8	36.5	9	-1.4	-3.9	4	0.625	8.000	8.500	0.375	-11
					8	-1.3	-6.6						

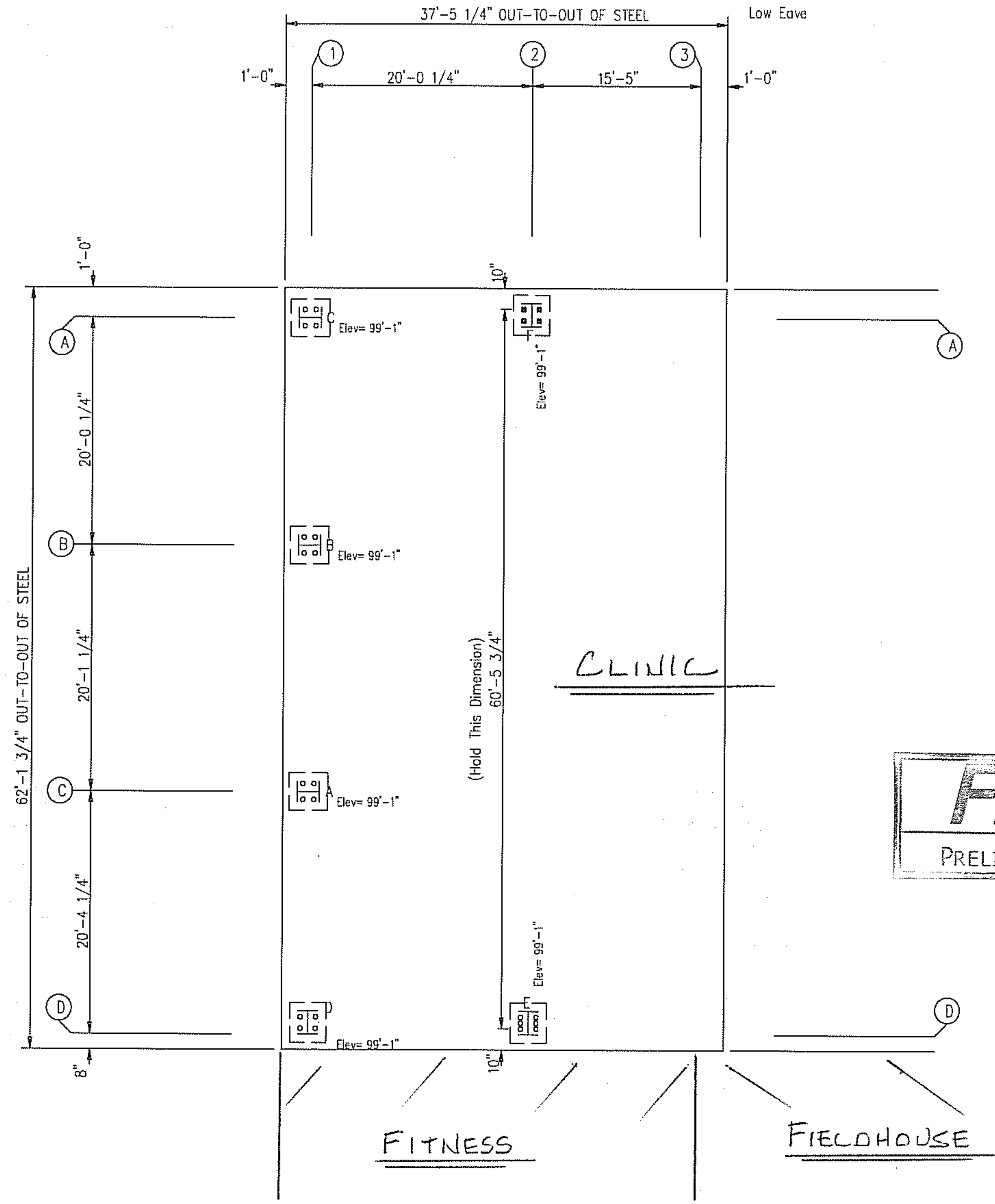
RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
4*	A	3	4.0	29.4	9	-1.5	-4.0	4	0.625	8.000	8.250	0.375	-11
					8	-1.4	-6.7						

4* Frame lines: 4 5 6 7 8 9 10 11 12

O Dia= 5/8"

⊠ Dia= 3/4"



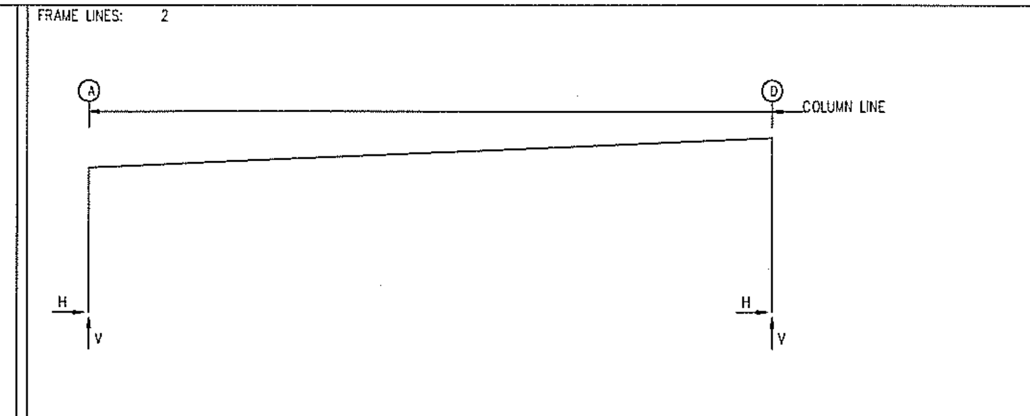
FOREMOST BUILDINGS INC.
PRELIMINARY PLANS

GENERAL NOTES

1. REVIEW DRAWING 5A FOR ANCHOR BOLT SIZES, LOCATIONS AND PATTERNS
   (IE:) CENTERLINE OF A.B. OR CENTERLINE OF PATTERN OR CENTERLINE OF COLUMN.

ANCHOR BOLT PLAN
NOTE: All Base Plates @ 100'-0" (U.N.)

FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	High Eave BLDG 4	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT		DATE: 6/23/15	SHEET: 5 OF 8	
ADDRESS	JEFFERSON, WI	DO NOT SCALE DRAWING		ISSUE:



GENERAL NOTES

1. FOUNDATION DESIGN AND CONSTRUCTION ARE NOT THE RESPONSIBILITY OF FOREMOST BUILDINGS, INC.
2. THE BUILDING REACTION DATA REPORTS THE LOADS WHICH THIS BUILDING PLACES ON THE FOUNDATION.
3. ANCHOR BOLTS SHALL BE ACCURATELY SET TO A TOLERANCE OF +/– 1/8" IN BOTH ELEVATION AND LOCATION.
4. COLUMN BASE PLATES ARE DESIGNED NOT TO EXCEED A BEARING PRESSURE OF 1125 POUNDS PER SQUARE INCH.
5. ALL COLUMN BASE PLATES ARE TO BE SET AT FINISHED FLOOR ELEVATION OF 100'– 0" UNLESS OTHERWISE NOTED ON THE ANCHOR BOLT SETTING PLAN......
6. SEE REACTION TABLES FOR PROPER BASE PLATE WIDTHS AND LENGTHS.

*** Additional Load Information ***

Snow Drift (Magnitude psf Width ft)
: 30.6 psf and 6.631 ft

Ground Snow:

Crane 1
Capacity (Tons) : @R000
Wheel Load (Kips) : @R006
Wheel Base (Feet) : @R007
Service Class : @R001

Crane 2
Capacity (Tons) : @R016
Wheel Load (Kips) : @R022
Wheel Base (Feet) : @R023
Service Class : @R017

BUILDING BRACING REACTIONS

Wall Loc	Wall Line	Col Line	± Reactions (k) Wind Horz	Wind Vert	Seismic Horz	Seismic Vert	Panel_Shear (lb/ft) Wind	Seis
L_EW	1	C,D	2.2	1.5	0.2	0.1		
F_SW	D	Bracing Not Used					0	0
R_EW	3	Bracing Not Used					0	0
B_SW	A	Bracing Not Used					0	0

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
2	A	1	15.9	27.9	2	-7.0	-7.6	4	0.750	10.00	16.50	0.375	-11
2	D	3 1	4.7 -15.9	-3.9 42.5	1 4	-15.9 3.6	42.5 -6.7	6	0.625	8.000	16.00	0.375	-11

ENDWALL COLUMN: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc. Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
1	A	5 1	0.4 0.0	-2.6 11.1	6 5	-0.3 0.4	0.0 -2.6	4	0.625	8.000	8.250	0.375	-11
1	B	7 1	1.1 0.0	-2.9 8.8	6 7	-1.0 1.1	-2.8 -2.9	4	0.625	8.000	10.25	0.375	-11
1	C	7 1	1.5 0.0	-4.4 12.7	6 7	-1.3 1.5	-2.1 -4.4	4	0.625	8.000	8.500	0.375	-11
1	D	8 1	1.0 0.0	-2.2 18.7	6 8	-0.8 1.0	-1.1 -2.2	4	0.625	8.000	8.500	0.375	-11

NOTES FOR REACTIONS

1. All loading conditions are examined and only maximum/minimum H or V and the corresponding H or V are reported.
2. Positive reactions are as shown in the sketch. Foundation loads are in opposite directions.
3. Bracing reactions are in the plane of the brace with the H pointing away from the braced bay. The vertical reaction is downward.
4. Building reactions are based on the following building data:

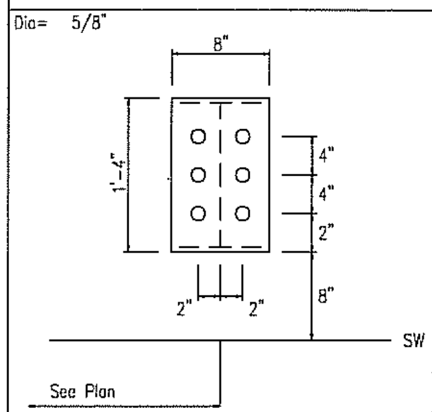
Width (ft)	= 62.1
Length (ft)	= 37.4
Eave Height (ft)	= 12.7/ 15.3
Roof Slope (rise/12)	= 0.5
Dead Load (psf)	= 3.0
Collateral Load (psf)	= 5.0
Live Load (psf)	= 20.0
Snow Load (psf)	= 24.0
Wind Speed (mph)	= 90.0
Wind Code	= WBC 11 (IBC 09)
Exposure	= C
Closed/Open	= C
Importance Wind	= 1.00
Importance Seismic	= 1.00
Seismic Design Category	= B
Seismic Coeff (Fa*Ss)	= 0.12

5. Loading conditions are:
   1 Dead+Collateral+Snow+Snow_Drift
   2 0.6Dead+Wind_Left1
   3 0.6Dead+Wind_Right1
   4 0.6Dead+Wind_Long1+LWIND1_R2E
   5 0.6Dead+Wind_Left1+Wind_Suction
   6 0.6Dead+Wind_Pressure+Wind_Long1
   7 0.6Dead+Wind_Left2+Wind_Suction
   8 0.6Dead+Wind_Right2+Wind_Suction

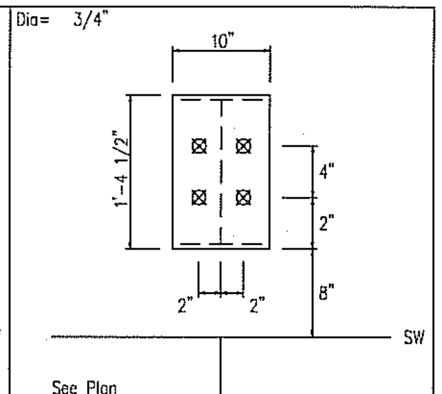
FOREMOST BUILDINGS INC.

PRELIMINARY PLANS

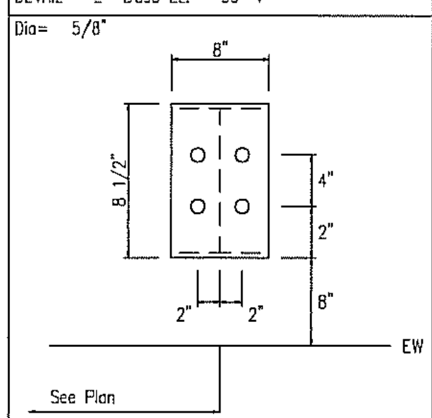
CLINIC (LEFT)



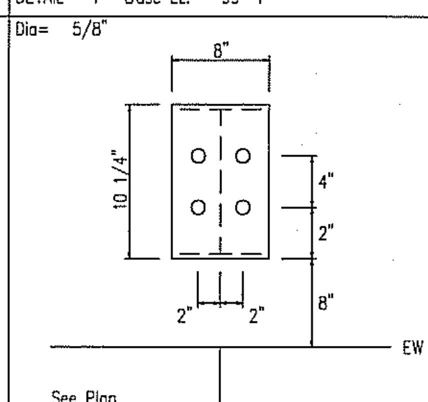
DETAIL E Base EL. 99'-1"



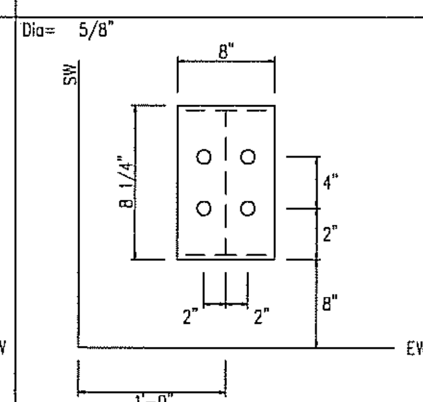
DETAIL F Base EL. 99'-1"



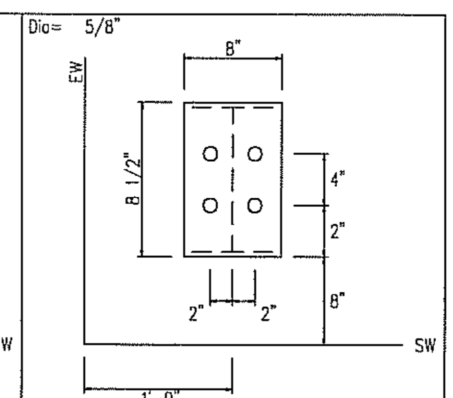
DETAIL A Base EL. 99'-1"



DETAIL B Base EL. 99'-1"



DETAIL C Base EL. 99'-1"

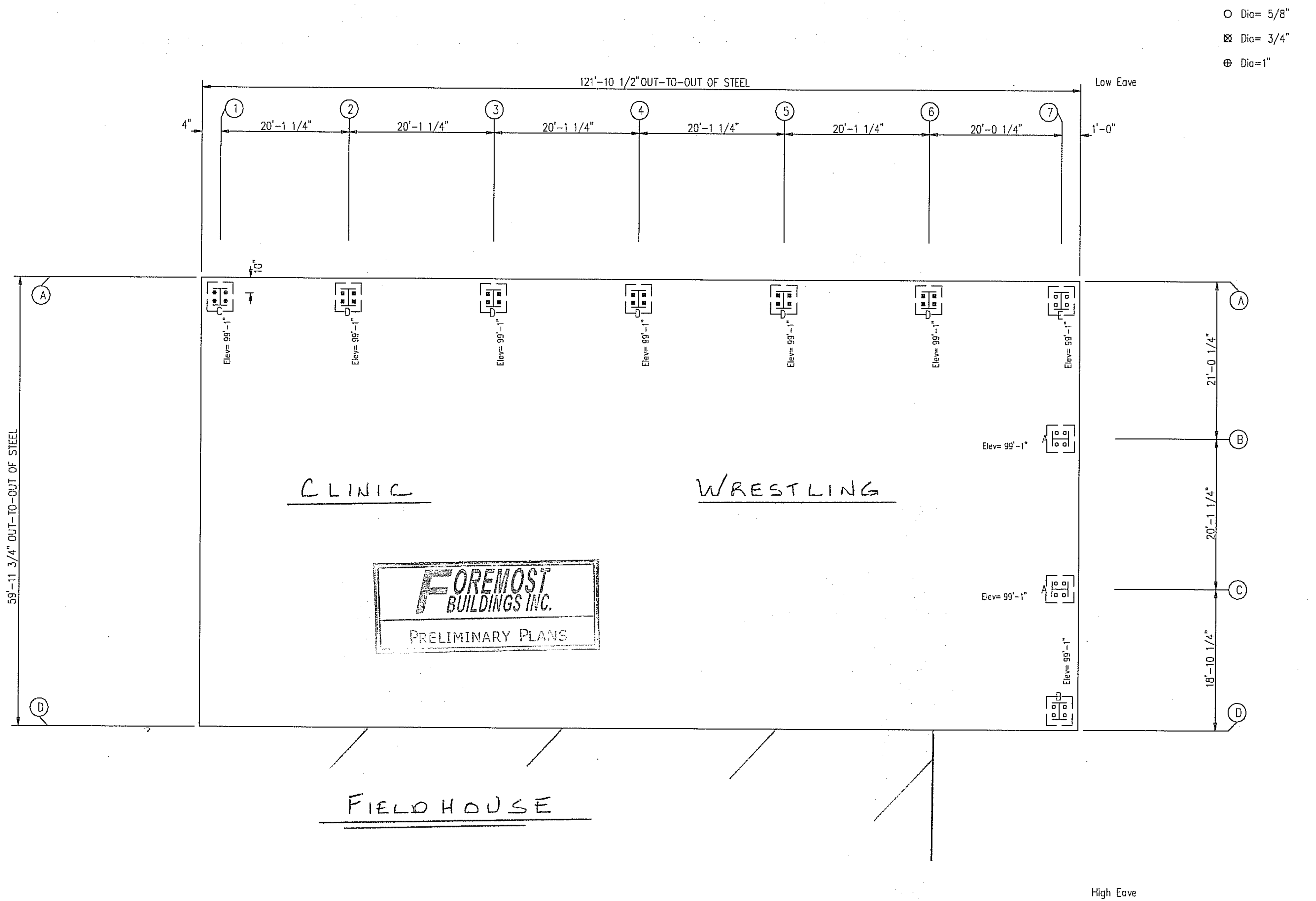


DETAIL D Base EL. 99'-1"

ANCHOR BOLT SUMMARY

Qty	Locate	Dia (in)	Type	Proj (in)
O 16	Endwall	5/8"	A307	3.00
⊠ 4	Frame	3/4"	A307	3.00
O 6	Frame	5/8"	A307	3.00

FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	BLDG 4	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT		DATE: 6/23/15	SHEET: 6 OF 8	
ADDRESS	JEFFERSON, WI	DO NOT SCALE DRAWING		ISSUE:



GENERAL NOTES
1. REVIEW DRAWING 5A FOR ANCHOR BOLT SIZES, LOCATIONS AND PATTERNS (IE:) CENTERLINE OF A.B. OR CENTERLINE OF PATTERN OR CENTERLINE OF COLUMN.

ANCHOR BOLT PLAN
NOTE: All Base Plates @ 100'-0" (U.N.)

FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	BLDG 3	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT		DATE: 6/23/15	SHEET: 7 OF 18	
ADDRESS	JEFFERSON, WI	DO NOT SCALE DRAWING	ISSUE:	

NOTES FOR REACTIONS

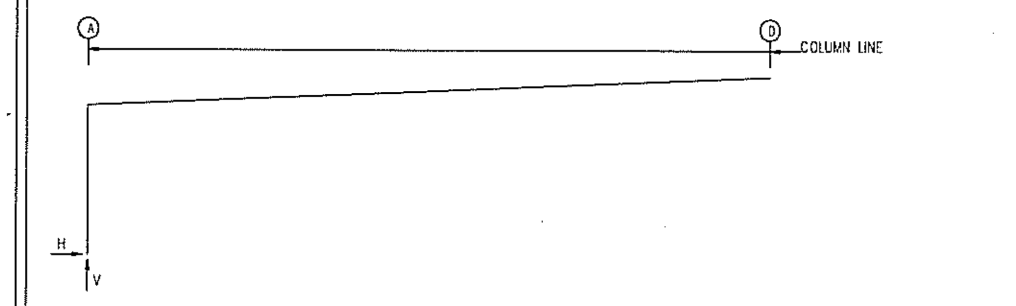
1. All loading conditions are examined and only maximum/minimum H or V and the corresponding H or V are reported.
2. Positive reactions are as shown in the sketch. Foundation loads are in opposite directions.
3. Bracing reactions are in the plane of the brace with the H pointing away from the braced bay. The vertical reaction is downward.
4. Building reactions are based on the following building data:

Width (ft)	= 60.0
Length (ft)	= 121.9
Eave Height (ft)	= 12.7/ 15.2
Roof Slope (rise/12)	= 0.5
Dead Load (psf)	= 3.0
Collateral Load (psf)	= 5.0
Live Load (psf)	= 20.0
Snow Load (psf)	= 24.0
Wind Speed (mph)	= 90.0
Wind Code	= WBC 11 (IBC 09)
Exposure	= C
Closed/Open	= C
Importance Wind	= 1.00
Importance Seismic	= 1.00
Seismic Design Category	= B
Seismic Coeff (Fa*Ss)	= 0.12

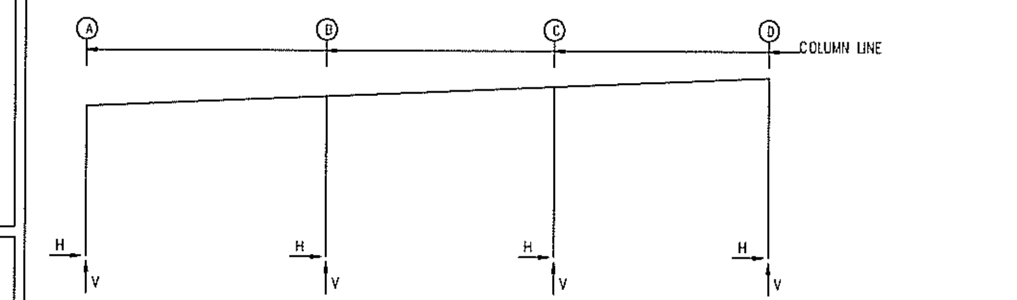
5. Loading conditions are:

1	Dead+Collateral+Snow+Snow_Drift
2	Dead+Collateral+Snow+Slide_Snow
3	Dead+Collateral+0.75Live+0.75Wind_Left1+0.75Floor_Live
4	0.6Dead+Wind_Left1
5	0.6Dead+Wind_Right1
6	0.6Dead+Wind_Left2
7	0.6Dead+Wind_Right2
8	0.6Dead+Wind_Long1+LWIND1_L2E
9	0.6Dead+Wind_Long1+LWIND1_R2E
10	Dead+Collateral+Snow/2+F3PAT_SL_3
11	Dead+Collateral+Snow/2+F3PAT_SL_2
12	Dead+Collateral+Snow+1.0F3PAT_SL_1
13	0.6Dead+Wind_Right2+Wind_Suction
14	0.6Dead+Wind_Pressure+Wind_Long1

FRAME LINES: 1 2 3 4 5 6



FRAME LINES: 7



FOREMOST BUILDINGS INC.

PRELIMINARY PLANS

GENERAL NOTES

1. FOUNDATION DESIGN AND CONSTRUCTION ARE NOT THE RESPONSIBILITY OF FOREMOST BUILDINGS, INC.
2. THE BUILDING REACTION DATA REPORTS THE LOADS WHICH THIS BUILDING PLACES ON THE FOUNDATION.
3. ANCHOR BOLTS SHALL BE ACCURATELY SET TO A TOLERANCE OF +/- 1/8" IN BOTH ELEVATION AND LOCATION.
4. COLUMN BASE PLATES ARE DESIGNED NOT TO EXCEED A BEARING PRESSURE OF 1125 POUNDS PER SQUARE INCH.
5. ALL COLUMN BASE PLATES ARE TO BE SET AT FINISHED FLOOR ELEVATION OF 100'- 0" UNLESS OTHERWISE NOTED ON THE ANCHOR BOLT SETTING PLAN......
6. SEE REACTION TABLES FOR PROPER BASE PLATE WIDTHS AND LENGTHS.

*** Additional Load Information ***

Snow Drift (Magnitude psf Width ft)
:

Ground Snow:

Crane 1
Capacity (Tons) : @R000
Wheel Load (Kips) : @R006
Wheel Base (Feet) : @R007
Service Class : @R001

Crane 2
Capacity (Tons) : @R016
Wheel Load (Kips) : @R022
Wheel Base (Feet) : @R023
Service Class : @R017

ANCHOR BOLT SUMMARY

	Qty	Locate	Dia (in)	Type	Proj (in)
○	8	Endwall	5/8"	A307	3.00
⊕	4	Frame	1"	A307	3.00
⊠	20	Frame	3/4"	A307	3.00
○	8	Frame	5/8"	A307	3.00

BUILDING BRACING REACTIONS

Wall Loc	Wall Line	Col Line	± Reactions (k) Wind Horz	Wind Vert	Seismic Horz	Seismic Vert	Panel_Shear (lb/ft) Wind	Seis	Note
L_EW	1								(h)
F_SW	D						126	21	
R_EW	7								(h)
B_SW	A	7,6	1.2	0.7	0.3	0.2			
		3,2	1.2	0.7	0.3	0.2			

(h)Rigid frame at endwall

CLINIC / WRESTLING

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Column Reactions (k) Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
1	A	2	28.0	47.3	4	-4.6	-7.2	4	1.000	12.00	17.00	0.375	-11

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Column Reactions (k) Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
2*	A	1	20.6	39.7	4	-5.0	-8.5	4	0.750	10.00	16.50	0.375	-11
		2	20.6	39.7	8	-4.4	-8.5						

2* Frame lines: 2 3 4 5 6

RIGID FRAME: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

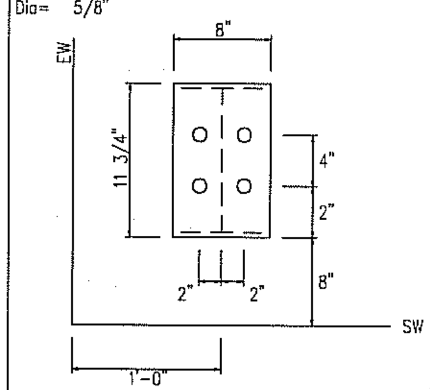
Frm Line	Col Line	Column Reactions (k) Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc._Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
7	A	5	2.4	-1.7	6	-2.6	-3.5	4	0.625	8.000	11.75	0.375	-11
		1	0.5	16.6	4	-1.6	-4.7						
7	D	7	1.8	-0.5	3	-1.6	3.2	4	0.625	8.000	9.750	0.375	-11
		11	-0.6	6.7	9	-0.8	-3.3						
7	B	8	0.0	-5.5	8	0.0	-5.5	4	0.625	8.000	8.000	0.375	-11
		10	0.0	14.8									
7	C	4	0.0	-5.1	4	0.0	-5.1	4	0.625	8.000	8.000	0.375	-11
		12	0.0	14.5									

ENDWALL COLUMN: MAXIMUM REACTIONS, ANCHOR BOLTS, & BASE PLATES

Frm Line	Col Line	Column Reactions (k) Load ID	Hmax H	V Vmax	Load ID	Hmin H	V Vmin	Anc. Bolt Qty	Dia	Base_Plate (in) Width	Length	Thick	Grout (in)
7	C *	13	2.0	-3.6	14	-1.8	-2.4						
		2	0.0	8.0	13	2.0	-3.6						
7	B *	13	1.9	-3.6	14	-1.8	-2.7						
		2	0.0	7.9	13	1.9	-3.6						

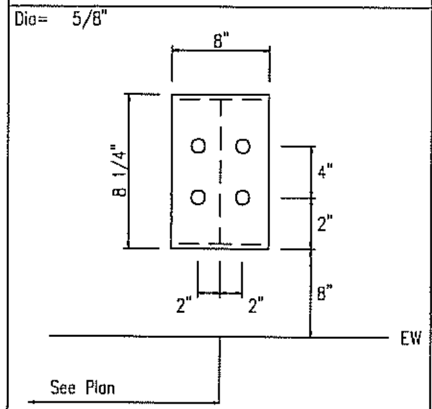
*See Rigid Frame Interior Column Reactions

Dia= 5/8"



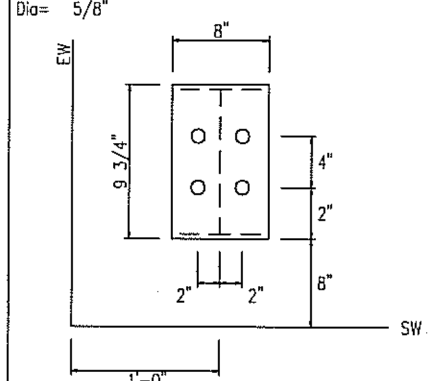
DETAIL E Base EL. 99'-1"

Dia= 5/8"



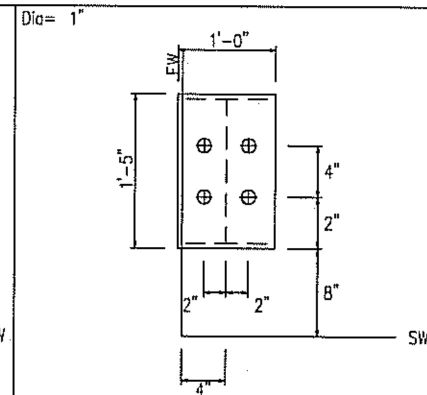
DETAIL A Base EL. 99'-1"

Dia= 5/8"



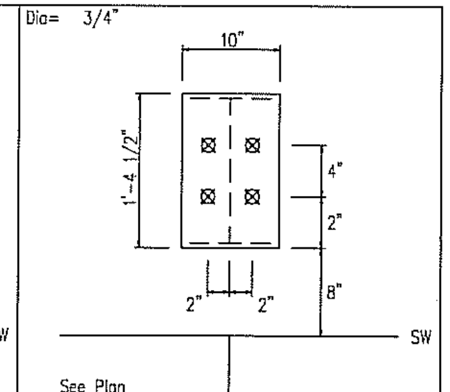
DETAIL B Base EL. 99'-1"

Dia= 1"



DETAIL C Base EL. 99'-1"

Dia= 3/4"



DETAIL D Base EL. 99'-1"

FOREMOST BUILDINGS, INC.		XCEL		
PROJECT	BLDG 3	ANCHOR BOLT PLAN		
ID		DESIGN:	DRAFT:	CHECK:
PROJECT		DATE: 6/23/15	SHEET: 5A OF 1[illegible]	
ADDRESS	JEFFERSON, WI	DO NOT SCALE DRAWING		ISSUE:

Xcel Sports Complex
Jefferson, WI

Appendix B
Specifications -
SECTION 030013 - CONCRETE

SECTION 030013 - CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete.
   2. Concrete accessories.
   3. Formwork, shoring, bracing, and anchorage.
   4. Concrete reinforcement.
   5. Underslab vapor retarder.
   6. Concrete Sealer.

B. Related Sections:
   1. 003152 - Testing and Inspection Services: Owner paid testing and inspections.
   2. 079200 - Joint Sealants: Expansion joint fillers.
   3. 312000 - Earth Moving: Fill under slabs on grade.

C. Drawings, the provisions of the Agreement, the General Conditions, and Division 1 specification sections apply to all work of this Section.

D. Substitutions: Substitute products will be considered only under the terms and conditions of Section 016000.

1.2 REFERENCES

A. American Concrete Institute (ACI):
   1. 117 - Standard Specification for Tolerances for Concrete Construction and Materials.
   2. 301-05 - Specifications for Structural Concrete.
   3. 315 - Details and Detailing of Concrete Reinforcement.

B. American Society for Testing and Materials (ASTM):
   1. A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
   2. C33 - Specifications for Concrete Aggregates.
   3. C94 - Specifications for Ready Mixed Concrete.
   4. C132 - Test for Slump of Portland Cement Concrete.
   5. C150 - Specification for Portland Cement.
   6. C156 - Test Method for Water Retention by Concrete Curing Materials.
   7. C171 - Specification for Sheet Materials for Curing Concrete.
   8. C260 - Specifications for Air-Entraining Admixtures for Concrete.
   9. C309 - Specification for Liquid Membrane Forming Compounds for Curing Compounds.
   10. C494 - Specifications for Chemical Admixtures for Concrete.
   11. C618 - Specification for Fly Ash and Raw or Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   12. C939 - Test Method for Flow of Grout for Preplaced-Aggregate Concrete
   13. C1107 - Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
   14. C1315 - Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
   15. D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
   16. E1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the "F Number" System.

1.3 SUBMITTALS

A. Make submittals in accordance with Section 013300.

B. Product Data: Submit data for each accessory, admixture, and curing material proposed for the work.

C. Shop Drawings:
   1. Reinforcing:
      a. Detail reinforcing in accordance with ACI 315. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing, bending and cutting schedules, splicing, and supporting and spacing devices.
      b. Indicate embedded items.
   2. Slab Layouts: Dimension locations of control, expansion, and construction joints. Relate to building grid lines.

D. Quality Control Submittals:
   1. Mix Designs: Prior to concrete work, submit mix designs for approval.
   2. Test Results: Submit test results per ASTM C311 performed less than 6 months prior to use for approval by Architect.
   3. Certifications: Submit mill certificates for cement, aggregates, and reinforcing.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.

B. Concrete work is subject to special testing and inspection as specified in 014500. Notify Architect at least 48 hours before concrete is poured.

C. Pre-Installation Conference:
   1. At least 35 days prior to start of concrete work the Contractor shall hold, in accordance with Section 013119, a meeting to review the detailed requirements of the concrete design mixes and to determine the procedures for producing proper concrete construction.
   2. Required in attendance:
      a. Contractor's superintendent.
      b. Testing Laboratory representative.
      c. Concrete subcontractor.
      d. Ready-mix producer.
      e. Admixtures manufacturer's representative.
      f. Architect/Engineer
      g. All subcontractors with work to be installed in, or affected by concrete work.
   3. Notify Architect 10 days prior to the scheduled date of the meeting.
   4. Agenda: Include the following.
      a. Installation scheduling and coordination; scheduling of mock-up construction and review.
      b. Classes of concrete required; mix designs; applicable references.
      c. Formwork.
      d. Reinforcement and placement.
      e. Climatic conditions; hot and/or cold weather concreting procedures (as appropriate); unusual placing conditions.
      f. Substrate preparation; placement methods; construction joints.
      g. Flatwork; flatness and levelness requirements; finishing; criteria for acceptance; remedies.
      h. Curing and protection procedures
      i. Site quality control; inspection and testing requirements.
      j. Sealers; locations and coverage rates

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Unless specified otherwise, conform to ACI 301.

B. Plywood:
   1. APA rated High Density Overlay or Medium Density Overlay, Plyform Class 1. EXT.

C. Form Ties: Snap-off metal; metal washer ends.

2.2 REINFORCING

A. Reinforcing Steel: Types as indicated on the structural drawings.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.

2.3 CONCRETE MATERIALS

A. Cement: ASTM C150, normal - Type 1 Portland, grey color.

B. Fly Ash: ASTM C618, Class C or F; loss on ignition (LOI) not to exceed 1 percent. Use fly ash from one single source for the whole Project.

C. Normal Weight Fine and Coarse Aggregates: ASTM C33; severe weather exposure.

D. Water: ASTM C94, para. 5.1.3

2.4 ADMIXTURES

A. Air-Entrainment: ASTM C 260; Master Builders Inc. "Micro-Air" or "MBVR", Euclid Chemical Co. "Air Mix," or approved.

B. Water Reducer Normal: ASTM C 494, Type A; Master Builders Inc. "Pozzolith/Polyheed," Euclid Chemical Co. "Eucon WR 75," or approved.

C. High Range Water Reducer (Superplasticizer): ASTM C 494, Type F or G and shall be of the second or third generation type. Shall be batch plant added, extend plasticity time, reduce water 20 to 30 percent. Master Builders Inc. "Rheobuild," Euclid Chemical "Eucon 37," or approved.

D. Accelerator: ASTM C 494, Type C or E, non-corrosive, non-chloride; Master Builders "Pozzutech 20," Euclid Chemical Co. "Accelgard 90," or approved.

E. Set Retarder: ASTM C494, Type B.

2.5 ACCESSORIES

A. Bonding Agent: Acrylic type; Sonneborn "Sonnocrete", W.R. Grace "Duraweld C", Euclid Chemical Co. "Flex-con", or approved.

B. Non-Shrink Grouts: ASTM C1107, Grade B; non-shrink non-catalyzed natural aggregate grout; minimum compressive strength of 7000 PSI at 28 days; 25 to 30 second flow when tested in accordance with ASTM C939 at 45 to 90 degrees F; cement gray in color; Master Builders Inc. "Masterflow 928," Euclid Chemical Co. "HiFlow Grout," or approved.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces when applied to forms or form liners.

D. Curing Materials:
   1. Waterproof Sheet Material: Waterproof paper in accordance with ASTM C171; reinforced waterproof kraft paper; white color at exterior applications; Burke Kraft Curing Paper Type I-SK-30, or approved.
   2. Mats and Burlap: Fabric covering composed of quilted polyethylene sheeting laminated to outer covering of burlap, cotton, or other approved fabric; outer covering shall weigh not less than 6 ounces per square yard.
   3. Curing Compound: ASTM C309; clear or translucent with fugitive dye; moisture loss not more than 0.055 gr./sq.cm. when tested in accordance with ASTM C156 and applied in a single coat at the manufacturers recommended rate. Euclid Chemical Co. "SuperFloor Coat" or "Floorcoat," or approved.
   4. Curing/Sealing Compound: ASTM C309; water based curing compound; Euclid Chemical Company "Aqua-Cure," Sonneborn "Kur-N-Seal WB," Burke by Edoco "Spartan-Cote WB II," or approved.

E. Underslab Vapor Retarder: ASTM E1745, Class A; one of the following:

1. "Stego Wrap 15 Mil Vapor Barrier" by Stego Industries, LLC (877-464-7834).
2. "Vapor Block 15" by Raven Industries (800-635-3456).
3. "Griffolyn 15 Mil Green" by Reef Industries, Inc. (800-231-6074).
4. “Perminator 15 Mil” by WR Meadows, Inc. (847-214-2100)
5. “Florprufe 120” by WR Grace (866-333-3726).

F. Prefabricated Slab Construction Joints: Burke by Edoco "Keyed Kold Joint," with splice plates, stakes, and driving accessories, or approved; depth 1/2 inch less than slab thickness, galvanized sheet metal tongue and groove joint form, with knockouts for passing reinforcing bars through.

G. Preformed Joint Fillers:
1. Non-extruding type; ASTM D1751; Sonneborn "Expansion Joint Filler,” WR Meadows “Sealtight Fiber”, " Burke by Edoco "Fiber expansion Joint,” or approved.
2. Joint Cap: Strippable plastic type; W.R. Meadows "SealTight Snap-Cap", Burke by Edoco "Joint Cap", or approved; width to match expansion joint filler material.

H. Finishing Aid: Evaporation retardant for preventing rapid drying during hot windy weather, Master Builders "Confilm."

2.6 CONCRETE MIX

A. Mix concrete in accordance with ASTM C94, and in accordance with the requirements indicated on the structural drawings.

B. Concrete at slabs on grade shall have a maximum water/cement ration of 0.45.

C. Admixtures:
1. All concrete shall contain the specified water reducing or high range water reducing admixture, except concrete with a required water/cement ratio of 0.45 or lower shall contain a high range water reducing admixture.
2. All concrete required to be air entrained shall contain air entraining admixture to produce 4% to 6% air.
3. All concrete placed in ambient temperatures from 40 degrees F to 20 degrees F, and all slab concrete placed in ambient temperatures below 50 degrees F, shall contain an accelerator at the manufacturer's required dosage.
4. All concrete placed in ambient temperatures of 90 degrees F or above, shall contain a set retarder at the manufacturer's required dosage.

D. Provide 28 day compressive strengths as indicated on the Structural Drawings. Where not indicated on the Structural Drawings, provide minimum 3000 psi compressive strength unless indicated otherwise.

E. Maximum amount of fly ash is indicated on the Structural Drawings.

2.7 REINFORCEMENT FABRICATION

A. Fabricate as indicated and in accordance with ACI 315.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.

B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.2 FORMWORK ERECTION

A. Verify lines, levels, and measurement before proceeding with formwork. Align form joints.

B. Use plywood forms, unless other systems are approved by the Architect.

C. Use form coating on forms in accordance with the manufacturer's recommendations. Verify that form coatings will not affect the bond of subsequent concrete surface treatments.

D. Coordinate with work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

E. Tolerances: Comply with ACI 117.

F. Where earth forms are used, hand trim sides and bottoms of earth forms. Remove loose dirt.

3.3 REINFORCEMENT

A. Place, support, and secure reinforcement against displacement.

B. Locate reinforcing splices not indicated on the drawings at points of minimum stress.

C. Provide laps and concrete cover as indicated in the Drawings.

3.4 UNDERSLAB VAPOR RETARDER

A. Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions under all interior slabs-on-grade.

B. Lap and seal all seams a minimum of 6 inches, seal around all penetrations, lap and seal against foundation walls and footings with manufacturer’s recommended sealing tape or mastic.

3.5 PLACING CONCRETE

A. In accordance with ACI 301.

B. Bonding Agent: Mix thoroughly and apply strictly in accord with the manufacturer's instructions; do not use when ambient temperature is below 45 degrees F. Place concrete in contact immediately while bonding agent is still tacky.

3.6 SUBSEQUENT TREATMENT FOR FORMED SURFACES

A. Provide smooth form finish for concrete to remain exposed in the finished work; rough form finish for concrete to remain concealed in the finished work.

3.7 SLABS

A. Expansion Joints for Slabs on Grade:
   1. Place expansion joints at locations indicated and where exterior slabs abut concrete walls, the building perimeter, and other fixed objects abutting or within the slab area. At exterior sidewalks, place expansion joints at maximum 20 foot intervals unless otherwise indicated.
   2. Form joints 1/2 inch wide x full depth of slab.
   3. Form expansion joints with preformed joint filler. Install strippable joint at joints to receive sealant specified in Section 079200.
   4. Tool expansion joints to 1/4 inch radius.
   5. Discontinue reinforcing at the expansion joint.
   6. Place perpendicular to longitudinal axis of wall and curbs. Where possible, make joints of curbs coincide with joints in walks.

B. Control Joints for Slabs on Grade:
   1. Make joints straight; perpendicular or parallel to building lines and slab edges, as appropriate.
   2. Control joints shall be saw cut or tooled, unless indicated otherwise.
   3. Radius tooled control joints to match expansion joints.
   4. Control joints shall penetrate the slab a minimum of 1/4 the thickness of the slab and shall be 3/16 inch in width minimum; 1/4 inch width in sidewalks.
   5. Space control joints at the locations indicated, except when not indicated locate in at 32 times the slab thickness. At exterior sidewalks, place control joints at maximum 5 foot intervals .
   6. Align joints with column lines when ever possible. Joints shall form rectangular panels with the long side less than 1-1/2 times the length of the short side. Provide circular or diamond shaped

joint lines around columns. Locate control joints at reentrant corners. Coordinate with placement of joints in tile surfaces.

C. Construction Joints: Place at either expansion or control joint locations for slab on grade construction.

D. Curing:
1. Moisture cure all concrete for a minimum of 7 days, unless approved or specified otherwise.
2. Use curing/sealing compound on concrete slabs scheduled to receive sealer.
3. A curing compound may be used on all exterior slabs, sidewalks, and curbs.
4. Use waterproof sheet material, mats or burlap at surfaces to receive subsequent bonded finish materials, including concrete stain and sealing compound. A curing compound may be used on surfaces to receive subsequent bonded finish materials, provided the curing compound is approved in writing by the manufacturer of the adhesive or the bonding finish material. Curing compound may also be used on surfaces to receive subsequent bonded finish materials, provided the curing compound is removed with shot blasting or other approved method prior to installation of bonded materials.
5. Apply curing compounds and curing/sealing compounds in accordance with the manufacturer's recommendations.
6. Maintain concrete temperatures above 50 degrees F.

E. Finishes:
1. Full Trowel finish interior floor slab surfaces, unless specified otherwise.
2. Light steel trowel finish interior floor slab surfaces scheduled to receive tile, carpet, or other similar bonded materials.
3. Broom finish exterior slabs, sidewalks, and curbs.

F. Curing/Sealing Compound: Apply a second coat of curing/sealing compound to concrete slabs scheduled to receive sealer. Clean floor and apply just prior to substantial completion. Apply in accordance with the manufacturer's recommendations.

G. Tolerance: Provide Random Traffic floor tolerances as follows, when measured in accordance with ASTM E1155, including those floors to receive subsequent finishes.
1. Slab on Grade at exposed slab conditions: F_F 45, F_L 35, over test area; F_F 30, F_L 24, minimum local value.
2. Slabs on Grade to receive thinset flooring and resilient floor covering : F_F 35, F_L 25, over test area; F_F 24, F_L 17, minimum local value.
3. Slabs on Grade to receive carpet: F_F 25, F_L 20, over test area; F_F 17, F_L 15, minimum local value.

END OF SECTION