Structural Engineers

Robinson Meier Juilly & Associates

RM

Principals Peter Robinson, S.E. Jayson E. Haines, S.E.



DEFR Guardian Unit

Structural Calculations For Seismic Anchorage

Prepared for:

Crenlo June 29, 2018 RMJ Job No. 18183 Valid Thru December 31, 2019



241 Joaquin Avenue San Leandro, CA 94577 (510) 991-0977

RMJ



DEFR Guardian Units

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RMJ

DEFR Guardian Unit Anchorage Nationwide RMJ Job# 14273 & 18183

Project Description:

This project involves providing server anchorage support for units located throughout the United States. Calculations have been assembled according to two distinct seismic regions low & moderate, and high. A map has been created based on Figures 3.3-1 & 3.3-2 of ASCE 7-10 to define the two different seismic regions. Please note our seismic map shows three distinct regions low, moderate, and high, but for simplicity of our calculations low and moderate were combined into one region. The map also shows a solid line near the New Madrid Fault where the value of S_s exceeds 2.75. In this area of extreme seismic potential, all anchorage is site specific. The other seismic regions have been determined according to the table included below:

Seismic Design Data								
Seismic design region	Short period spectral response acceleration S_s	Short-period site coefficient F _a	Design spectral response acceleration at short periods $S_{\mbox{\scriptsize DS}}$					
Low	0.4	1.5	0.4					
Moderate	1.5	1.0	1.0					
High	2.75	1.0	2.0					

Anchorage

Calculations are based ¹/₂" diameter Hilti Kwik Bolt KB-TZ Carbon Steel expansion bolts, with the assumptions that anchors are not located within any boundary edges, 4" thick concrete minimum thickness, 2" minimum embedment, and 3,000 psi regular weight concrete strength. See table below for allowable cabinet + content weight.

Allowable Values

	LO	LOW & MODERATE SEISMIC HIGH SEISM					ISMIC	
MAX CABINET	GROUND	FLOOR	UPPER FLOOR G		GROUND FLOOR		UPPER FLOOR	
WT. WITH CONTENTS	ON FLOOR	RAISED	ON FLOOR	RAISED	ON FLOOR	RAISED	ON FLOOR	RAISED
SINGLE UNIT (4 bolts)	1,600	1,000	1,000	1,000	700	400	600	400
GANGED UNIT (2 bolts/unit)	2,000	2,000	1,200	1,200	2,000	1,000	1,000	1,000

SS¹- Site Specific Calculations Required

Anchor Capacities

Bolt Force (tension and shear) summary table.

Bolt Alignment	Max Tension (lbf.)	Max Shear (lbf.)	% Tens. Capacity	% Shear Capacty	
Ground Level (Slab on Grade)	1,199	825	94%	76%	
50% Bld. Ht. (Conc. filled deck)	1,110	733	87%	68%	

Hilti output files along with and calculations are in the appendix section of this calculation packet. Site specific engineering is required where S_S is greater than 2.75. Design is in accordance with the 2015 International Building Code along with the 2016 California Building Code.

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Principals Peter Robinson, S.E. Jayson E. Haines, S.E.

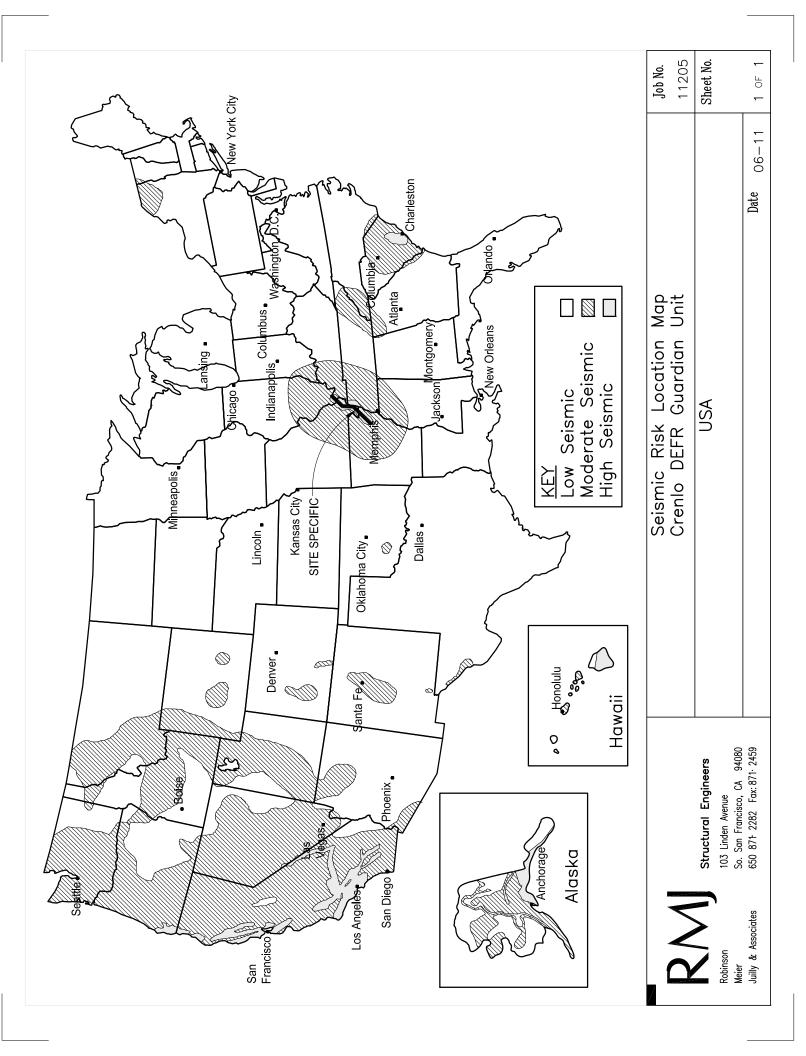
Robinson Meier Juilly & Associates

DEFR Guardian Units by Crenlo Scope, Assumptions, and Limitations RMJ Job #14273 November 11, 2015 Revised June 28, 2018

Special Note:

Server rack anchorage calculations are valid under the 2015 International Building Code thru date noted on cover sheet. After valid thru date, contact Crenlo for updates.

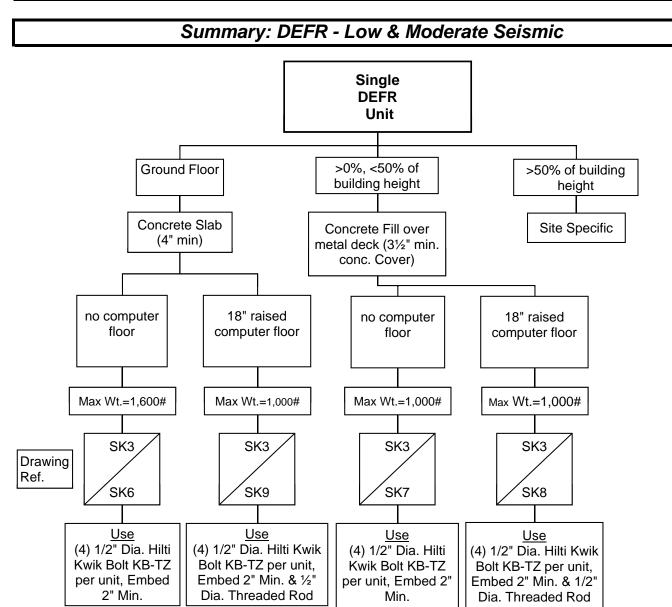
- > Special Inspection shall be provided for expansion bolt installation.
- Existing concrete shall have a minimum compressive strength of 3,000 psi.
- ▶ Importance factor is assumed to be 1.0.
- Raised Units not to exceed 18".
- Soil class is assumed to be D.
- > Calculations and anchorage are done in accordance with the 2015 IBC and ASCE7-10.
- Maximum S_s value is 2.75. Where value of S_s exceeds 2.75, site specific calculations are required for all anchorages. S_s values can exceed 2.75 near the New Madrid fault.
- > The minimum slab on grade thickness is assumed to be 4".
- > The minimum concrete fill over metal deck thickness is $3\frac{1}{2}$ " (with $1\frac{1}{2}$ " metal deck).
- Enclosure is assumed to stay rigid during seismic loading (design by others).
- Computer access floor shall have strength to support compression and lateral loads.
- Floor slab and concrete filled metal deck shall have strength to resist uplift caused by overturning moment of cabinets.
- Any installation located in a high seismic region above the upper half of building shall be site specific. The second floor of a 2 story building is not considered the upper half of the building.
- ➢ Ganged Units based on a <u>Minimum of 2 Units</u>.
- > Calculations are for DEFR Guardian units.



Crenlo

Low & Moderate Seismic

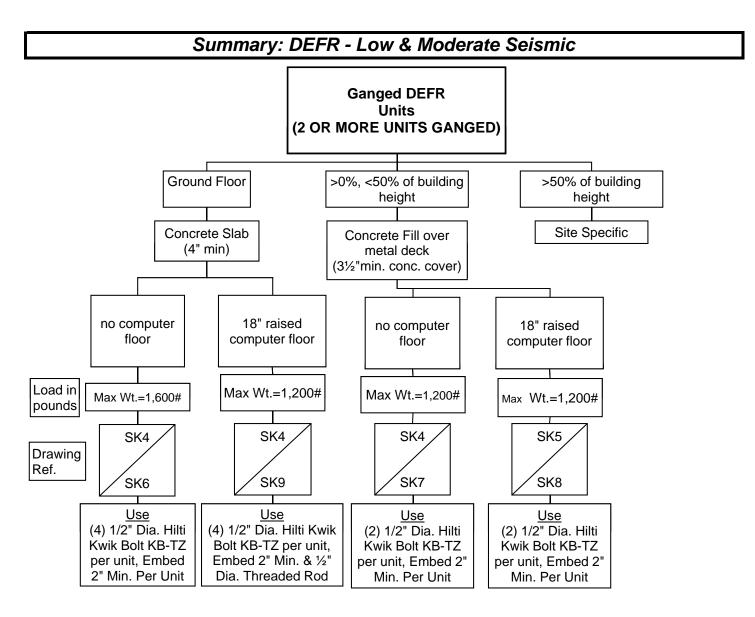
Job No. : 14273 By: MAS Date: 11/12/15 Page: 7



Crenlo

Low & Moderate Seismic

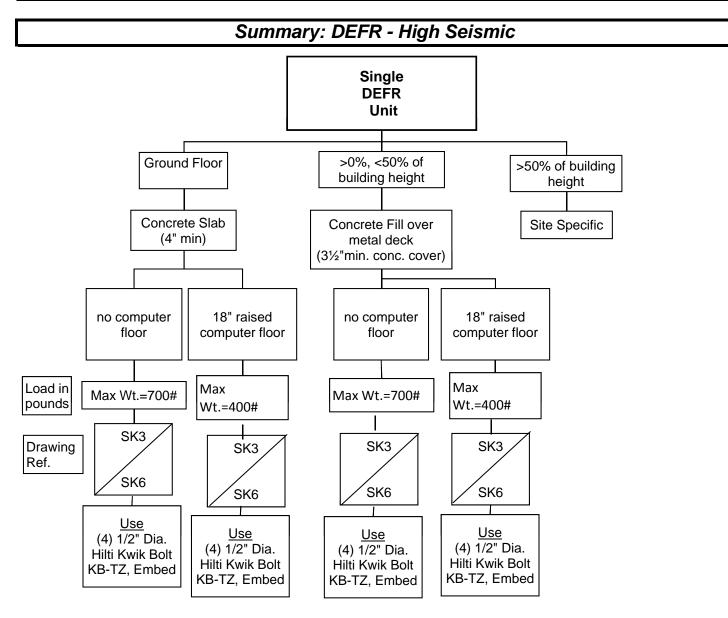
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Crenlo

High Seismic

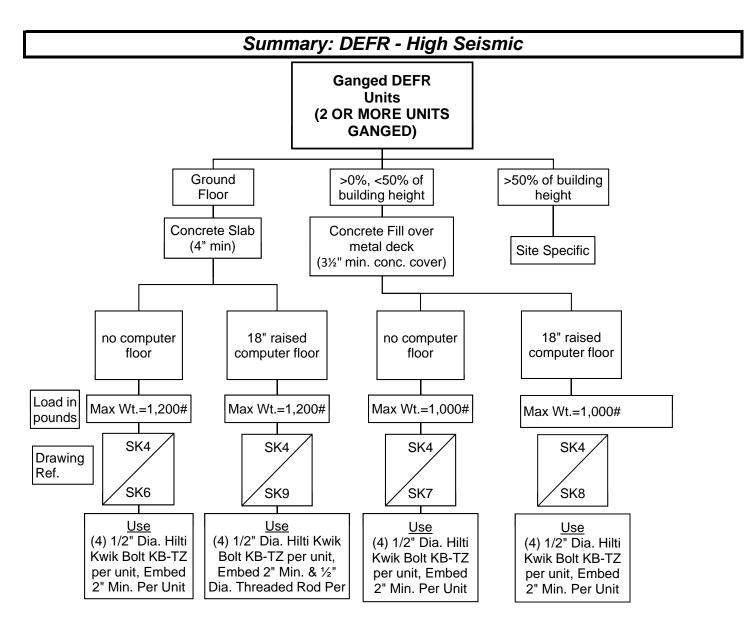
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High Seismic

Job No. : 14273 Date: 11/12/15 By: MAS Page: 10





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Low & Moderate Seismic Calculations

241 Joaquin Avenue San Leandro CA 94577 (510)991-0977

Crenlo

Low & Moderate Seismic

Job No. : 14273 Date: 11/12/15 By: MAS Page: 12

Find the Seismic Design Category (SDC)

Unit : **DEFR**

Project Location: Latitude: Val

Varies

Low & Moderate Seismic Longitude: Varies

Soil Classification: D Occupancy Category: II Table 1613.5.2 & Section 1613.5.2 Table 1604.5

Information from U.S. Geological Survey Website http://earthquake.usgs.gov/research/hazmaps/

1.500	g	
1.070	g	
1.000		Table 1613.5.3(1)
1.500		Table 1613.5.3(2)
1.50	g	(Equation 16-37)
1.61	g	(Equation 16-38)
1.000	g	(Equation 16-39)
1.070	g	(Equation 16-40)
	1.070 1.000 1.500 1.50 1.61 1.000	1.070 g 1.000 1.500 1.50 g 1.61 g 1.000 g

Seismic Design Category (SDC):

Varies

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241 Joaquin Ave.	Low & Moderate Seismic		
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510.991.0977	By: JH		Page: 13
Load Case: Single Unit (Ground Cabinet Dimensions	nd floor)		
Depth (D) (in) = 40		Seisr	nic Force
Width (W) (in) = 24.00			Law 8 Madarata
Height (H) (in) = 82.750		S _{DS} =	1.0 Low & Moderate Seismic

X (in)

12.000

0.30 (41.375 in. x 1600lbs.) = 19,860 lb-in

0.9 [1600 lbs. x (12in)]= 17,280 lb-in

Anchorage Force =

Shear Force =

Center of Gravity Location

Z (in)

41.375

Ibs/per bolt Ibs/per bolt

Y (in)

20

 $I_p =$

a_p =

R_p =

z/h =

 $F_{p} =$

Ω=

 $F_{p,min} =$

 $F_{p,max} =$

Use F_p =

1.0

1.0

2.5

0.0

0.160

0.30

1.60

0.30

2.5

DEFR unit Plan

Longitudinal Seismic

Force (F_p)

(Importance)

(Cabinets)

(Cabinets)

W

W

W

W

Overstrength

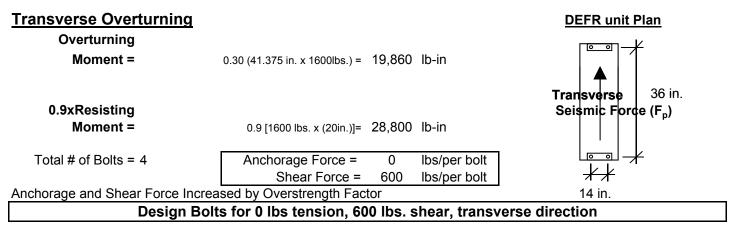
36 in.

(Ground Floor)

	14 in.
Design Bolts for 230 lbs tension, 600 lbs. shear,	longitudinal direction

230

600



Drawing Reference See: <u>SK3 & SK6</u>

Unit Weight (lb.) =

Unit

DEFR

1,600

Anchorage and Shear Force Increased by Overstrength Factor

Weight (lbs)

1,600

36.00

14

Part

Frame+Contents

Transverse Anchorage Spacing (in) =

Longitudinal Anchorage Spacing (in) =

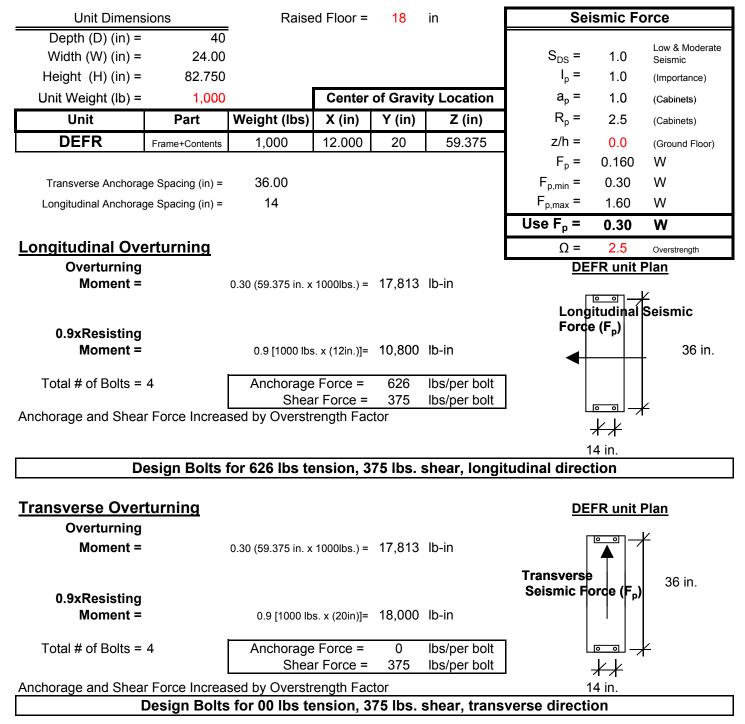
Longitudinal Overturning

Overturning Moment =

0.9xResisting Moment =

Total # of Bolts = 4

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Drawing Reference See: SK3 & SK9

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	San Leandro, CA 94577				Job No. :	14273	Date: 06/29/18		
510.991.0977					By:	JH	Page	: 15	
Load Case: <u>Ganged Unit (Ground floor)</u> # of Units ganged (min.)= 2									
Single Unit Din		:				Se	eismic Force		
Depth (D) (in) = Width (W) (in) =	40 24.00					S _{DS} =	1.0	Low & Moderate Seismic	
Height (H) (in) =	82.750					I _p =	1.0	(Importance)	
Frame Weight (lb.) =	1,600		Center	of Gravit	y Location	a _p =	1.0	(Cabinets)	
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	R _p =	2.5	(Cabinets)	
2 - DEFR	Frame+Contents	3,200	24	20	41.375	z/h =	0.0	(Ground Floor)	
						F _p =	0.160	W	
Longitudinal Anchora	ge Spacing (in) =	30.00				F _{p,min} =	0.30	W	
Transverse Anchoraç	ge Spacing (in) =	36.00				F _{p,max} =	1.60	W	
						Use F _p =	0.30	W	

Longitudinal Overturning

Overturning Moment =

0.30 (41.375 in. x 3200lbs.) = 39,720 lb-in

L

lbs

lbs/per bolt

0.9xResisting Moment =

0.9 (3200 lbs. x24 in.)= 69,120 lb-in



Ω=

2 ganged units Total # of bolts/Unit = 2

2.5

DEFR unit Plan

Overstrength

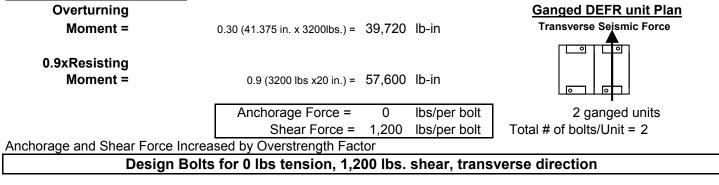
Anchorage and Shear Force Increased by Overstrength Factor

Anchorage Force =

Design Bolts for 0 lbs tension, 1,200 lbs. shear, transverse direction

0

Transverse Overturning



Drawing Reference See: <u>SK4 & SK6</u>

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Load Case: <u>Ganged units on 18in raised computer floor (Ground Floor)</u>

of Units ganged (min.)= 3

Single Unit Dimension		Raise	d Floor =	18	in	Sei	smic Fo	orce
Depth (D) (in) =	40							Low & Moderate
Width (W) (in) =	24.00					S _{DS} =	1.0	Seismic
Height (H) (in) =	82.750					I _p =	1.0	(Importance)
Frame Weight (lb.) =	1,200		Center	of Gravi	ty Location	a _p =	1.0	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	R _p =	2.5	(Cabinets)
3 - DEFR	Frame+Contents	3,600	24	20	59.375	z/h =	0.0	(Ground Floor)
						F _p =	0.160	W
Longitudinal Anchorag	ge Spacing (in) =	30.00				F _{p,min} =	0.30	W
Transverse Anchora	ge Spacing (in) =	36.00				F _{p,max} =	1.60	W
						Use F _p =	0.30	W
Overturning	<u>intarning</u>					32 -	2.0	Overstrength
Moment =		0.3 (59.375 in. x	3600lbs.) =	64.125	lb-in	Gangeo	DEFR I	unit Plan
			,	,		Longitudin		
0.9xResisting								
Moment =		0.9 (3600 lb	s. x24 in.)=	77,760	lb-in			
		Anchorage	Eorco -	0	lbs/per bolt		ganged	unite
			r Force =	900	lbs/per bolt	Total # of be		
Anchorage and Shea	r Force Increa							-
		for 0 lbs ten			hear, longitu	dinal directi	on	
			· · ·					
Transverse Over	turning							
Overturning						Gangeo	DEFR u	unit Plan
Moment =		0.3 (59.375in. x	3600lbs.) =	64,125	lb-in		erse Seisn	
							<u></u>	l
0.9xResisting								
Moment =		0.9 (3600 lb	os x20 in.) =	64,800	lb-in			
		Anchorago	Earoo -	0	lbs/per bolt			unito
		Anchorage Force =0Ibs/per bolt3 ganged unitsShear Force =900Ibs/per boltTotal # of bolts/Unit = 2						
Anchorage and Shea	r Force Increa				120/001 001			-
		s for 0 lbs te			hear, transv	erse directio	on	
<u> </u>	- 0 - 0		- ,		. ,			

Drawing Reference See: <u>SK4 & SK9</u>

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241 Joaquin Ave.				/oderat	e Seismic			
San Leandro, CA	94577			noucrui	Job No. :	14273	Date	: 06/29/18
510.991.0977	01011				By:		Page	
					29:	011		
Load Case:	Single Unit	<u>t (≤ 50% of E</u>	Bldg. Ht.)					
	(i.e. 2nd floor	of a 4 story bu	ilding or 4	th floor o	f an 8 story bu	uilding)		
Unit Dimens	sions					So	ismic Fo	orco
Depth (D) (in) =	40	=				56		ЛСЕ
Width (W) (in) =						S _{DS} =	1.0	Low & Moderate Seismic
Height (H) (in) =						US _p =	1.0	(Importance)
Unit Weight (Ib) =			Center	of Gravi	ty Location	a _p =	1.0	(Cabinets)
Unit	Part	Weight (Ibs)	X (in)	Y (in)	Z (in)	R _p =	2.5	(Cabinets)
DEFR			. ,		41.375	z/h =	0.5	. ,
DEFR	Frame+Contents	1,200	12	20	41.375	2/11 = F _p =	0.5	(50% of bldg ht.) W
		36.00				I.	0.320	W
Longitudinal Anchora		14				F _{p,min} = F _{p,max} =	0.30 1.60	W
Transverse Anchora	ge Spacing (in) =	14				-		
	t					Use F _p =	0.320	W
Longitudinal Ove	erturning					<u>Ω</u> =	2.5	Overstrength
Overturning = Moment		0.32 (41.375 in. x	1200lbs) =	15 888	lb-in		FR unit	
		0.02 (11.070 11. X	1200100.)	10,000		Long	itudinal	_ Seismic
0.9xResisting							e (F _p)	
Moment =		0.9 [1200 lbs	s. x (12in.)]=	12,960	lb-in			– 36 in.
								- 30 III.
Total # of Bolts =	4	Anchorage	Force =	261	lbs/per bolt			
		Shear Force = 480 lbs/per bolt			L		Ł	
Anchorage and Shea	r Force Increa	sed by Overstr	ength Fac	tor			オオ I4 in.	
D	esian Bolts	for 261 lbs te	ension 4	80 lbs. 9	shear, longi			
					siloui, ioligi			
Transverse Over	turning					DE	FR unit	<u>Plan</u>
Overturning						Г	<u> </u>	Ł
Moment =		0.32 (41.375 in. x	1200lbs.) =	15,888	lb-in			
						_	T	
0.9xResisting							sverse mic Ford	36 in.
Moment =		0.9 [1200 lb	s. x (20in)]=	21.600	lb-in	Ceia		e (i p)
			(/)	,	-			/
-		A .				L	▣▣ᅴᅴ ╆╆	
Total # of Bolts =	4	Anchorage	e Force =	0 480	lbs/per bolt lbs/per bolt		オオ 14 in.	
Anchorage and Shea	r Force Increa				ווטט ושקיפטו			
-		s for 0 lbs te	-		hear, transv	verse direction	on	
			, • •					

Drawing Reference See: <u>SK3 & SK7</u>

Crenlo

Low & Moderate Seismic

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Load Case: <u>Single Units on 18in Raised Comp. floor (≤50% of Bldg. Ht.)</u>

(i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)

Offic Difference	sions	Raise	d Floor =	18	in	Se	ismic Fo	orce
Depth (D) (in) =	40	1						Laur 9 Madanata
Width (W) (in) =	24.00					S _{DS} =	1.0	Low & Moderate Seismic
Height (H) (in) =	82.750					$I_p =$	1.0	(Importance)
Unit Weight (lb) =	1,000		Center	of Gravi	ty Location	a _p =	1.0	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	R _p =	2.5	(Cabinets)
DEFR	Frame+Contents	1,000	12	20	59.375	z/h =	0.5	(50% of bldg ht.)
						F _p =	0.320	W
Longitudinal Anchora	ge Spacing (in) =	36.00				F _{p,min} =	0.30	W
Transverse Anchorag	ge Spacing (in) =	14				F _{p,max} =	1.60	W
						Use F _p =	0.320	W
Longitudinal Ove	erturning					Ω =	2.5	Overstrength
Overturning						DE	FR unit I	Plan
Moment =		0.32 (59.375 in. x	1000lbs.) =	19,000	lb-in	-		/
0.9xResisting						Lond	itudinal	- Seismic
Moment =		0.9 [1000 lbs	3. x (12in)]=	10,800	lb-in		e (F _p)	
		-						– 36 in.
Tatal # of Dalta -	4	Anghanan	<u> </u>	700	lle e /e e e le e lt			
Total # of Bolts =	4	Anchorage Shea	Force =	732 400	lbs/per bolt lbs/per bolt			
Anchorage and Shea	r Force Increa						▣╝┤ ╆╆	<u>/</u>
		· · · · , · · · · ·	J					
							1 1	
-							14 in.	
-		for 732 lbs te	nsion, 4	00 lbs. :	shear, longit		14 in.	
D	esign Bolts	for 732 lbs te	nsion, 4	00 lbs. s	shear, longit	tudinal direc	14 in. tion	Plan
D Transverse Over	esign Bolts	for 732 lbs te	nsion, 4	00 lbs. :	shear, longit	tudinal direc	14 in.	<u>Plan</u>
D	esign Bolts	for 732 lbs te 0.32 (59.375 in. x				tudinal direc	14 in. tion	<u>Plan</u> ∠
De Transverse Over Overturning	esign Bolts					tudinal direc	14 in. tion	<u>Plan</u> ∠
Dr <u>Transverse Over</u> Overturning Moment = 0.9xResisting	esign Bolts	0.32 (59.375 in. x	1000lbs.) =	19,000	lb-in	tudinal direc DE Tran	14 in. tion FR unit f	∠ 36 in.
Dr <u>Transverse Over</u> Overturning Moment =	esign Bolts		1000lbs.) =	19,000	lb-in	tudinal direc DE Tran	14 in. tion FR unit I	∠ 36 in.
Dr <u>Transverse Over</u> Overturning Moment = 0.9xResisting	esign Bolts	0.32 (59.375 in. x	1000lbs.) =	19,000	lb-in	tudinal direc DE Tran	14 in. tion FR unit f	∠ 36 in.
Dr <u>Transverse Over</u> Overturning Moment = 0.9xResisting	esign Bolts : turning	0.32 (59.375 in. x	1000lbs.) = . x (20in.)]=	19,000	lb-in	tudinal direc DE Tran	14 in. tion FR unit f	∠ 36 in.

Design Bolts for 35 lbs tension, 400 lbs. shear, transverse direction

Drawing Reference See: SK3 & SK8

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241 Joaquin Ave.				/loderate	e Seismic			
San Leandro, CA	94577		Lon a i	nouorut	Job No. :	14273	Date	: 06/29/18
510.991.0977	0-011				By:		Page	
010.001.0011					Cy.	011	i ugo	. 10
Load Case:	Ganged Un	nit (≤ 50% of	Blda. H	t.)				
# of Units gan	aed (max)=	2						
	geu (max)-	2						
Single Unit Din	nension					Se	ismic Fo	orce
Depth (D) (in) =	40	-						Low 9 Madagata
Width (W) (in) =	24.00					S _{DS} =	1.0	Low & Moderate Seismic
Height (H) (in) =	82.750	_				$I_p =$	1.0	(Importance)
Frame Weight (lb.) =	1,200		Center	of Gravit	y Location	a _p =	1.0	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	R _p =	2.5	(Cabinets)
2 - DEFR	Frame+Contents	2,400	24	20	41.375	z/h =	0.5	(50% of bldg ht.)
						F _p =	0.320	W
Longitudinal Anchorag	ge Spacing (in) =	30.00				F _{p,min} =	0.30	W
Transverse Anchorag	ge Spacing (in) =	36.00				F _{p,max} =	1.60	W
						Use F _p =	0.320	W
Longitudinal Ove	erturning					Ω =	2.5	Overstrength
Overturning								

Overturning Moment =

0.32 (82.75/2 in. x 2400lbs.) = 31,776 lb-in

Anchorage Force =

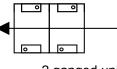
Shear Force =

0.9xResisting Moment =

0.9 (2400 lbs. x24 in.)= 51,840 lb-in

Ganged DEFR unit Plan

Longitudinal Seismic Force



2 ganged units Total # of bolts/Unit = 2

Anchorage and Shear Force Increased by Overstrength Factor

Design Bolts for 0 lbs tension, 960 lbs. shear, longitudinal direction

0

960

lbs

lbs/per bolt

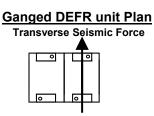
Transverse Overturning

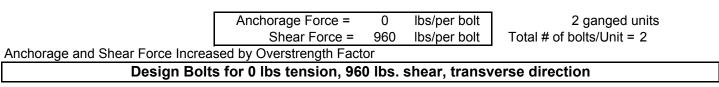
Moment =

Overturning Moment = 0.9xResisting

0.9 (2400 lbs x20 in.) = 43,200 lb-in

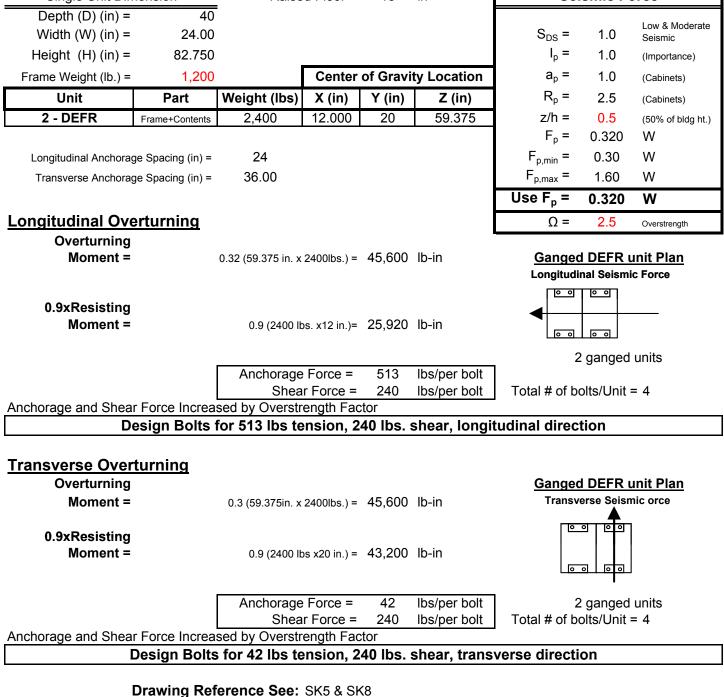
0.32 (82.75/2 in. x 2400lbs.) = 31,776 lb-in





Drawing Reference See: <u>SK4 & SK7</u>

RMJ	Crenlo				
241 Joaquin Ave.	Low & M	oderat	e Seismic		
San Leandro, CA 94577			Job No. :	14273	Date: 06/29/18
510.991.0977			By:	JH	Page: 20
Load Case: <u>Ganged units on 1</u> # of Units ganged (max)= 2	<u>8in raised cor</u>	<u>npute</u>	<u>r floor (≤509</u>		
Single Unit Dimension	Raised Floor =	18	in	Se	ismic Force





RMJ

Robinson Meier Juilly & Associates Principals Peter Robinson, S.E. Jayson E. Haines, S.E.

High Seismic Calculations

241 Joaquin Avenue San Leandro CA 94577 (510)991-0977

RMJ 241 Joaquin Ave. San Leandro, CA 94577 510.991.0977		Crenl High	o Seismic Job No. : 14273 By: MAS	Date: 11/12/15 Page: 22
Find the Seismic Design Cate	egory (SI	<u>)))</u>	Unit : DEFR	
Project Location: H Latitude: Varies	ligh Seisr		ongitude: Varies	
Soil Classification: D Occupancy Category: II			e 1613.5.2 & Section 1613.5.2 e 1604.5	
Information from U.S. Geologic http://earthquake.usgs.gov/research/h	•	Websi	te	
S _S =	2.750	g		
S ₁ =	1.070	g		
F _a =	1.000		Table 1613.5.3(1)	
F _v =	1.500		Table 1613.5.3(2)	
S _{MS} =	2.75	g	(Equation 16-37)	
S _{M1} =	1.61	g	(Equation 16-38)	
S _{DS} =	1.833	g	(Equation 16-39)	
S _{D1} =	1.070	g	(Equation 16-40)	
Seismic Design Category	/ (SDC):	:	Varies	

Crenlo

High Seismic

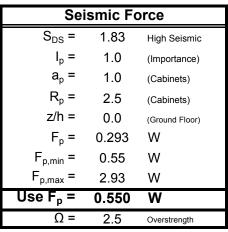
Job No. : 14273 Date: 11/12/15 By: MAS Page: 23

Load Case: Single unit (Ground floor)

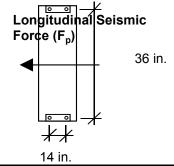
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Longitudinal Overturning

Overturning Moment =	0.55 (41.375 in. x 700lbs.) =	15,929	lb-in
EX	700 lbs Vert. Comp.) x 12in.]= cal Component (0.2*SDS*Wp) =	4,788 257	lb-in lbs
Total # of Bolts = 4	Anchorage Force =	995	lbs/per bolt
	Shear Force =	481	lbs/per bolt
Anchorage and Shear Force Incre	eased by Overstrength Fac	tor	



DEFR unit Plan



Design Bolts for 995 lbs tension, 481 lbs. shear, longitudinal direction

Transverse Overturning **DEFR unit Plan** Overturning Moment = 0.55 (41.375 in. x 700lbs.) = 15,929 lb-in Transverse Transverse 36 in. Seismic Force (F_p) 0.9xResisting Moment = 0.9 [(700 lbs. - Vert. Comp.) x (20in.)]= 7,980 lb-in Vertical Component (0.2*SDS*Wp) = 257 lbs Anchorage Force = 276 Total # of Bolts = 4 lbs/per bolt +Shear Force = 481 lbs/per bolt Anchorage and Shear Force Increased by Overstrength Factor 14 in. Design Bolts for 276 lbs tension, 481 lbs. shear, longitudinal direction

Drawing Reference See: SK3 & SK6

Crenlo

High Seismic

Job No. : 14273 Date: 06/29/18 Page: 24 By: MAS

Load Case: Single units on 18in raised computer floor (Ground floor)

Unit Dimens	ions	Raise	d Floor =	18	in	Se	ismic Fo	orce
Depth (D) (in) =	40					S _{DS} =	1.83	High Seismic
Width (W) (in) =	24.00					I _p =	1.0	(Importance)
Frame Height (in) =	82.750					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	400		Center	of Gravi	ty Location	R _p =	2.5	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.0	(Ground Floor)
DEFR	Frame+Contents	400	12.000	20	59.375	F _p =	0.293	W
						$F_{p,min} =$	0.55	W
Transverse Anchorage	e Spacing (in) =	36.00				$F_{p,max} =$	2.93	W
Longitudinal Anchorage	e Spacing (in) =	14				Use F _p =	0.550	W
						Ω=	2.5	Overstrength
<u>_ongitudinal Ove</u>	erturning							
Overturning						DE	FR unit F	<u>Plan</u>
Moment =		0.55 (59.375 in. :	x 400lbs.) =	13,063	lb-in	_		,
						Lond	itudinal	<u>^</u> Seismic
0.0xPosisting						-	e (F _p)	
0.9xResisting Moment =	0 9 [(400	lbs Vert. Comp.) x (12in)]=	2.736	lb-in		、μ.	_ 36 in.
Moment		Component (0.2*		147	lbs			_ 00
				922	lbs/per bolt			
Total # of Bolts =	4	Anchorage	= Force =	922				/
Total # of Bolts =	4		r Force =	922 275	lbs./per bolt	L	ᆔᆛ	<u> </u>
Total # of Bolts = -	-	Shea	r Force =	275			▣==1 → ★★ 14 in.	<u> </u>

Design Bolts for 922 lbs tension, 275 lbs. shear, longitudinal direction

Transverse Overturning

Transverse Overturn	ning			DEFR unit Plan
Overturning				
Moment =	0.55 (59.375 in. x 400lbs.) =	13,063	lb-in	
0.9xResisting				Transverse 36 in.
Moment =	0.9 [(400 lbs Vert. Comp.) x (20in)]=	4,560	lb-in	Seismic Force (F _p)
	Vertical Component (0.2*SDS*Wp) =	147	lbs	
Total # of Bolts = 4	Anchorage Force =	295	lbs/per bolt	
	Shear Force =	481	lbs/per bolt	
Anchorage and Shear For	ce Increased by Overstrength Fac	tor		14 in.

Design Bolts for 295 lbs tension, 481 lbs. shear, longitudinal direction



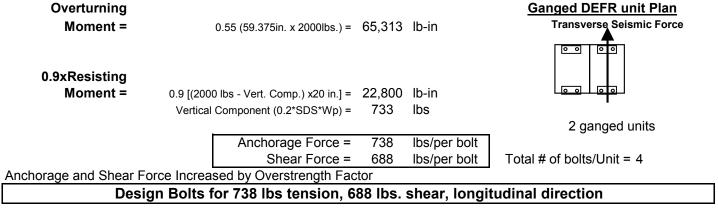
RMJ 241 Joaquin Ave. San Leandro, CA 510.991.0977			Crenlo High Se	eismic	Job No. : By:	14273 JH	Date Page	: 06/29/18 : 25
Load Case:	Ganged Un	nit (Ground t	floor)					
# of Units gar	iged (min)=	2						
Single Unit Din	nension					Se	ismic Fo	orce
Width (W) (in) =	40	:				S _{DS} =	1.83	High Seismic
Depth (D) (in) =	24.00					I _p =	1.0	(Importance)
Frame Height (in) =	82.750					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	2,000		Center	of Gravi	ty Location	R _p =	2.5	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.0	(Ground Floor)
2 - DEFR	Frame+Contents	4,000	24	20	41.375	F _p =	0.293	W
	Traine Contents	1,000	- 1	20	11.070	F _{p,min} =	0.55	W
						F _{p,max} =	2.93	W
		24.00				Use F _p =	0.550	W
Longitudinal Anchorag		24.00				$\Omega = \Omega$		
Transverse Anchorag	je Spacing (in) =	36.00				Ω=	2.5	Overstrength
Longitudinal Ove Overturning Moment =		0.55 (41.375 in. x	4000lbs.) =	91.025	lb-in	Gange	d DEFR ເ	ınit Plan
		,	,	,			udinal Seis	
0.9xResisting						0 0	• •	
Moment =	•••	0 lbs Vert. Com	• • •		lb-in			
	ventical	Component (0.2*	SDS*vvp) =	1,467	lbs	0 0	0 0	
		Anchorage	e Force =	945	lbs/per bolt] 2	2 ganged	units
		Shea	r Force =	1,375	lbs/per bolt	Total # of b	olts/Unit :	= 4
Anchorage and Shea								
Des	sign Bolts fo	or 945 lbs tei	nsion, 1,	375 lbs.	shear, long	gitudinal dire	ction	
Transverse Over	turning					_		
Overturning				0/ 075		Ganged DEF	<u>R unit Pl</u> erse Seisn	
Moment =		0.55 (41.375 in. x	4000lbs.) =	91,025	id-in	Transv	erse Seisn	nc Force
0.9xResisting							9 0 9	
Moment =	0.9 [(400	0 lbs - Vert. Comp	o.) x20 in.1 =	45.600	lb-in			
		Component (0.2*			lbs	0	<u> </u>	
							2 ganged	
		Anchorage		789	lbs/per bolt	Total # of b	olts/Unit :	= 4
Apphorana and Ob	r Force lasses		r Force =		lbs/per bolt	J		
Anchorage and Shea			-		choor tro	nsverse dire	otion	
De	Sign Doits I		131011, 1	,515105	. Silear, udi	ISVEISE UIIE		

Drawing Reference See: SK5 & SK6

RMI			Crenlo					
241 Joaquin Ave.			High Se	ismic				
San Leandro, CA			r light oc		Job No. :	14273	Date	: 06/29/18
510.991.0977	01011					MAS	Page	
					_ <u>_ </u>			
Load Case:	<u>Ganged un</u>	<u>its on 18in i</u>	raised c	ompute	er floor (Gro	<u>und floor)</u>		
# of Units gar	iged (min)=	2						
Single Unit Din	nension	Raise	d Floor =	18	in	Se	ismic Fo	orce
Width (W) (in) =	40					S _{DS} =	1.83	High Seismic
Depth (D) (in) =	24.00					I _p =	1.0	(Importance)
Frame Height (in) =	82.750					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	1,000		Center	of Gravi	ty Location	R _p =	2.5	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.0	(Ground Floor)
2 - DEFR	Frame+Contents	2,000	24	20	59.375	F _p =	0.293	W
						F _{p,min} =	0.55	W
Longitudinal Anchorag	je Spacing (in) =	24				F _{p,max} =	2.93	W
Transverse Anchorag	ge Spacing (in) =	36.00				Use F _p =	0.550	W
						Ω=	2.5	Overstrength
Longitudinal Ove	<u>erturning</u>							
Overturning				05 0 4 0		•		
Moment =		0.55 (59.375 in. x	2000lbs.) =	65,313	lb-in	-	d DEFR ι	
						Longitudin	al Seismic ㅣ ৹ ৹ ㅣ	Force
0.9xResisting								
Moment =	•••	0 lbs Vert. Com	-		lb-in			
	Vertical	Component (0.2*	SDS*Wp) =	733	lbs			
		Anchorage	- Force -	988	lbs/per bolt	2	2 ganged	units
		•	r Force =	988 688	lbs/per bolt	Total # of b	olts/Unit :	= 4
Anchorage and Shea	r Force Increa	sed by Overstr	ength Fac	ctor				

Design Bolts for 988 lbs tension, 688 lbs. shear, longitudinal direction

Transverse Overturning



Drawing Reference See: <u>SK5 & SK9</u>

RMJ			Crenlo					
241 Joaquin Ave.			High Se	eismic				
San Leandro, CA	94577		-		Job No. :	14273	Date	: 06/29/18
510.991.0977					By:	MAS	Page	: 27
Load Case:	Single Unit	t (< 50% of I	Rida Ht)				
		of a 4 story bu		_	an 8 story bu	ilding)		
	(i.e. 2nd floor			_	an 8 story bu	0,	ismic Fo	orce
	(i.e. 2nd floor	of a 4 story bu		_	an 8 story bu	0,	ismic Fo 1.83	D TCE High Seismic
Unit Dimens	(i.e. 2nd floor sions	of a 4 story bu		_	an 8 story bu	Sei		
Unit Dimens Depth (D) (in) =	(i.e. 2nd floor sions 40	of a 4 story bu		_	an 8 story bu	Sei S _{DS} =	1.83	High Seismic
Unit Dimens Depth (D) (in) = Width (W) (in) =	(i.e. 2nd floor sions 40 24.00	of a 4 story bu	ilding or 4	th floor of	an 8 story bu y Location	Sei S _{DS} = I _p =	1.83 1.0	High Seismic (Importance)
Unit Dimens Depth (D) (in) = Width (W) (in) = Frame Height (in) =	(i.e. 2nd floor sions 40 24.00 82.750 600	of a 4 story bu	ilding or 4 Center	th floor of	-	Sp S _{DS} = I _p = a _p =	1.83 1.0 1.0	High Seismic (Importance) (Cabinets)

14.00 Longitudinal Anchorage Spacing (in) = Transverse Anchorage Spacing (in) = 36

Longitudinal Overturning

Overturning				DEFR unit Plan
Moment =	0.59 (41.375 in. x 600lbs.) =	14,564	lb-in	
0.9xResisting				Longitudinal Seismic
Moment =	0.9 [(600 lbs Vert. Comp.) x (12in.)]=	4,104	lb-in	Force (F _p)
	Vertical Component (0.2*SDS*Wp) =	220	lbs	3 6 in.
Total # of Bolts = 4	Anchorage Force =	363	lbs/per bolt	
	Shear Force =	440	lbs/per bolt	
Anchorage and Shear For	ce Increased by Overstrength Fac	tor		11

 $F_{p,min} =$

F_{p,max} =

Ω=

Use F_p =

0.55

2.93

0.587

2.5

14 in.

W

W

W

Overstrength

Design Bolts for 363 lbs tension, 440 lbs. shear, longitudinal direction

Transverse Overturning

Transverse Overturr	ning		DEFR unit Plan			
Overturning						
Moment =	0.59 (41.375 in. x 600lbs.) =	14,564	lb-in			
0.9xResisting				Transverse 36 in.		
Moment =	0.9 [(600 lbs Vert. Comp.) x (20in)]=	6,840	lb-in	Seismic Force (F _p)		
	Vertical Component (0.2*SDS*Wp) =	220	lb-in			
Total # of Bolts = 4	Anchorage Force =	690	lbs/per bolt	+		
	Shear Force =	440	lbs/per bolt	14 in.		
Anchorage and Shear For	ce Increased by Overstrength Fac	tor	•			
Desigi	n Bolts for 690 lbs tension, 4	40 lbs.	shear, longitu	dinal direction		
v	•		· •			

Site Specific Engineering Required

Total # of Bolts = 4

Crenlo

High Seismic

Job No. : 14273 Date: 06/29/18 By: MAS Page: 28

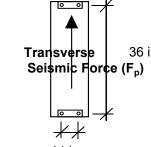
Load Case: <u>Single unit on 18in raised computer floor (≤ 50% of Bldg. Ht.)</u>

(i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)

Unit Dimensions						Se	ismic Fo	orce	
Depth (D) (in) =	40	Raise	d Floor =	18	in	S _{DS} =	1.83	High Seismic	
Width (W) (in) =	24.00					I _p =	1.0	(Importance)	
Frame Height (in) =	82.750					a _p =	1.0	(Cabinets)	
Max Weight (lb.) =	400		Center	of Gravi	ity Location	R _p =	2.5	(Cabinets)	
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.5	(50% of bldg ht.)	
DEFR	Frame+Contents	400	12.000	20	59.375	F _p =	0.587	W	
						F _{p,min} =	0.55	W	
Transverse Anchorag	e Spacing (in) =	36				F _{p,max} =	2.93	W	
Longitudinal Anchorag	e Spacing (in) =	14.00				Use F _p =	0.587	W	
						Ω =	2.5	Overstrength	
Longitudinal Overturning							DEFR unit Plan		
Overturning									
Moment =		0.59 (59.375 in. >	k 400lbs.) =	13,933	lb-in		▫▫┌	Z	
0.9xResisting						Lon	gitudinal	Seismic	
Moment =	0.9 [(400) lbs Vert. Comp.	.) x (12in)]=	2,736	lb-in	For	се (F _p)		
	Vertical	Component (0.2*S	SDS*Wp) =	147	lbs	•		- 36 in.	
Total # of Bolts =	4	Anchorage	- Force =	389	lbs/per bol	· 1		4	
	•	•	r Force =	293	lbs/per bol		++		
Anchorage and Shear	[.] Force Increa	sed by Overstr	ength Fac	tor			14 in.		
				00.11					
De	sign Bolts 1	or 389 lbs te	ension, 2	93 IDS.	snear, Ion	gitudinal dire	ction		
Transverse Overturning DEFR unit Plan									
Transverse Over	turning								
Transverse Over	turning								
Overturning	turning	0.59 (59.375 in)	(400lbs) =	13 033	lh-in			Z	
	turning	0.59 (59.375 in. >	k 400lbs.) =	13,933	lb-in			2	
<u>Transverse Over</u>	turning								

 Moment =
 0.9 [(400 lbs. - Vert. Comp.) x (20in.)]=
 4,560 lb-in

 Vertical Component (0.2*SDS*Wp*20in) =
 147 lb-in



14 in.

Anchorage and Shear Force Increased by Overstrength Factor

Shear Force =

Anchorage Force =

Design Bolts for 837 lbs tension, 293 lbs. shear, longitudinal direction

837

293

lbs/per bolt

lbs/per bolt

Site Specific Engineering May Result in Higher Loads

Crenlo

High Seismic

Job No. : 14273 Date: 06/29/18 By: MAS Page: 29

Load Case: <u>Ganged Unit (≤ 50% of Bldg. Ht.)</u>

of Units ganged (min)= 2

# of Units gar	J ()					Se	ismic Fo	orce
Single Unit Din	nension	_				S _{DS} =	1.83	High Seismic
Depth (D) (in) =	40	add	0	in	Edge length	I _p =	1.0	(Importance)
Width (W) (in) =	24.00					a _p =	1.0	(Cabinets)
Frame Height (in) =	82.750					R _p =	2.5	(Cabinets)
Max Weight (lb.) =	1,000		Center	of Gravi	ty Location	z/h =	0.5	(50% of bldg ht.)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	F _p =	0.587	W
2 - DEFR	Frame+Contents	2,000	24	20	41.375	F _{p,min} =	0.55	W
					•	F _{p,max} =	2.93	W
Longitudinal Anchorag	e Spacing (in) =	24				Use F _p =	0.587	W
Transverse Anchorag	ge Spacing (in) =	36.00				Ω =	2.5	Overstrength
Overturning Moment = 0.9xResisting		0.59 (41.375 in. x					d DEFR u nal Seismic	
Moment =		0 lbs Vert. Com	, -		lb-in lbs			
	ventical	Component (0.2*	5D3 Wp) =	733	105	0 0	0 0	
							2 ganged	units
		Anchorage		552	lbs			
Anabaraga and Shaa	r Earaa Inaraa		r Force =	733	lbs/per bolt	Total # of b	olts/Unit :	= 4
Anchorage and Shea		for 552 lbs te			shoar longi	tudinal diro	tion	
	Sign Doits i		, , , , , , , , , , , , , , , , , , , ,	55 153.	shear, longi		,	
<u>Transverse Over</u>	turning							
Overturning						<u>Gange</u>	d DEFR ι	init Plan
Moment =		0.59 (41.375 in. x	2000lbs.) =	48,547	lb-in	Transvers	e Seismic∣ ▲	Force
0.9xResisting Moment =		0 lbs - Vert. Comp Component (0.2*		22,800 733	lb-in Ibs	0 0	• •	
			r Force =	447 733	lbs/per bolt lbs/per bolt	2 Total # of b	2 ganged olts/Unit :	
Anchorage and Shear Force Increased by Overstrength Factor Design Bolts for 447 lbs tension, 733 lbs. shear, longitudinal direction								
116	seinn Ruite 1	or 44/ ins to	nsion 7	A A ING	snear iondi	TUMINAL MIRA	מסודי	

Drawing Reference See: <u>SK5 & SK7</u>

RMI			Crenlo					
241 Joaquin Ave.				iomio				
San Leandro, CA			High Se	ISTIIC	Job No. :	14072	Data	e: 06/29/18
510.991.0977	34377					MAS	Page	
010.001.0011					Dy.	WI/ (O	r age	. 00
Load Case:	<u>Ganged un</u>	<u>nit on 18in ra</u>	nised co	mputer	<u>floor (≤ 50%</u>	<u>% of Bldg. H</u>	<u>(t.)</u>	
# of Units gar	nged (min)=	2						
Single Unit Dir	nension	Raise	d Floor =	18	in	Se	ismic F	orce
Depth (D) (in) =	40	=				S _{DS} =	1.83	High Seismic
Width (W) (in) =	24.00					I _p =	1.0	(Importance)
Frame Height (in) =	82.750					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	1,000		Center	of Gravi	ty Location	R _p =	2.5	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.5	(50% of bldg ht.)
2 - DEFR	Frame+Contents	2,000	24	20	59.375	F _p =	0.587	W
						F _{p,min} =	0.55	W
Longitudinal Anchorag	ge Spacing (in) =	24				F _{p,max} =	2.93	W
Transverse Anchora	ge Spacing (in) =	36.00				Use F _p =	0.587	W
						Ω =	2.5	Overstrength
Longitudinal Ov	erturning							
Overturning								
Moment =		0.59 (59.375 in. x	2000lbs.) =	69,667	lb-in			<u>unit Plan</u>
0.9xResisting						Longitudii		c Force
Moment =		0.9 (2000 lb	os. x24 in.)=	27.360	lb-in	0 0		
		Vert. Comp. (0.2	,	733	lbs			
						0 0	00	
		Anakana		1 400	lbo/romball	2	2 ganged	units
		Anchorage	r Force =	1,102 733	lbs/per bolt lbs/per bolt	Total # of b	olte/l Init	= 1
Anchorage and Shea	ar Force Increa				ibs/per bolt		ons/Orm	
		or 1,102 lbs t			shear, long	itudinal dire	ction	
Transverse Over	<u>rturning</u>							
Overturning						<u>Gange</u>	DEFR	unit Plan
Moment =		0.59 (59.375in. x	2000lbs.) =	69,667	lb-in	Transv	verse Seis	mic Force
0 0xDeeleting						•	<u>।</u>	1
0.9xResisting = Moment		0 lbs - Vert. Comp) x20 in 1 –	22 800	lb-in			
	= .	l Component (0.2*	· -	733	lb-in	<u> </u>	0 0 0	
			• /					-
						2	o anned	units

 Anchorage Force =
 814
 lbs/per bolt

 Anchorage Force =
 733
 lbs/per bolt

 Total # of bolts/Unit = 4

 Anchorage and Shear Force Increased by Overstrength Factor

 Design Bolts for 814 lbs tension, 733 lbs. shear, longitudinal direction

Drawing Reference See: <u>SK5 & SK8</u>



RMJ

Robinson Meier Juilly & Associates Principals Peter Robinson, S.E. Jayson E. Haines, S.E.

Drawing Details

241 Joaquin Avenue San Leandro CA 94577 (510)991-0977

GENERAL NOTES

<u>design</u>

Design conforms to the International Building Code, 2012 Edition, & the California Building Code, 2013 Edition.

<u>Typical Details</u>: and notes on these sheets shall apply unless specifically shown or noted otherwise. Construction details not fully shown or noted shall be similar to details for similar conditions. All work and construction shall comply with all applicable building codes, regulations, and safety requirements.

<u>Discrepancies</u>: The Contractor shall inform the Architect in writing, during the bidding period, of any discrepancies or omissions noted on the drawings or in the specifications, or of any variations needed in order to conform to codes, rules, and regulations. Upon receipt of such information, the Architect will send written instructions to all concerned. Any such discrepancy, omission, or variation not reported shall be the responsibility of the Contractor, and work shall be performed in a manner as directed by the Architect.

EXISTING CONSTRUCTION

The Contractor shall verify all existing conditions and shall notify the Architect of all exceptions before proceeding with the work. The removal, cutting, drilling, etc. of existing work shall be performed with great care and small tools in order not to jeopardize the structural integrity of the building. If existing structural members, not indicated for removal, interfere with the new work, the Structural Engineer shall be notified immediately, and approval obtained, before removal of the existing

FASTENERS

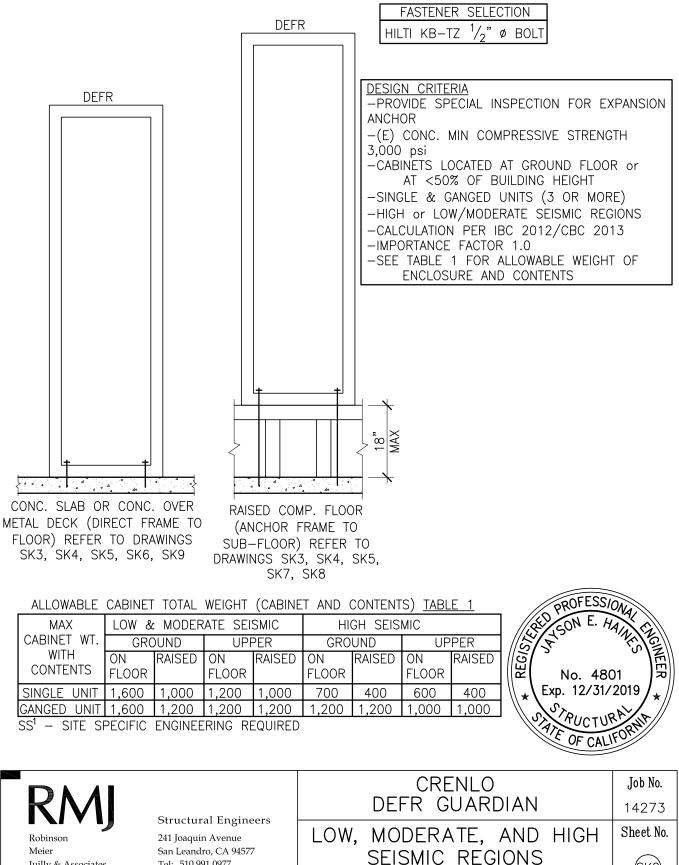
members.

<u>Wedge Anchors</u>: Hilti Kwik Bolt Wedge Anchor, types as indicated per ICBO evaluation report No. 1917 or by manufacture having current ICBO evaluation report with values in shear and tension) equal or greater.



RM		CRENLO DEFR GUARDIAN	Job No. 14273
Robinson Meier Juilly & Associates	Structural Engineers 241 Joaquin Avenue San Leandro, CA 94577 Tel: 510.991.0977	LOW, MODERATE, AND HIGH SEISMIC REGIONS	Sheet No.
www.rmjse.com		Signed by JEH Date 6/29/18	

DESIGN SCENARIOS AND CONDITIONS



Signed by

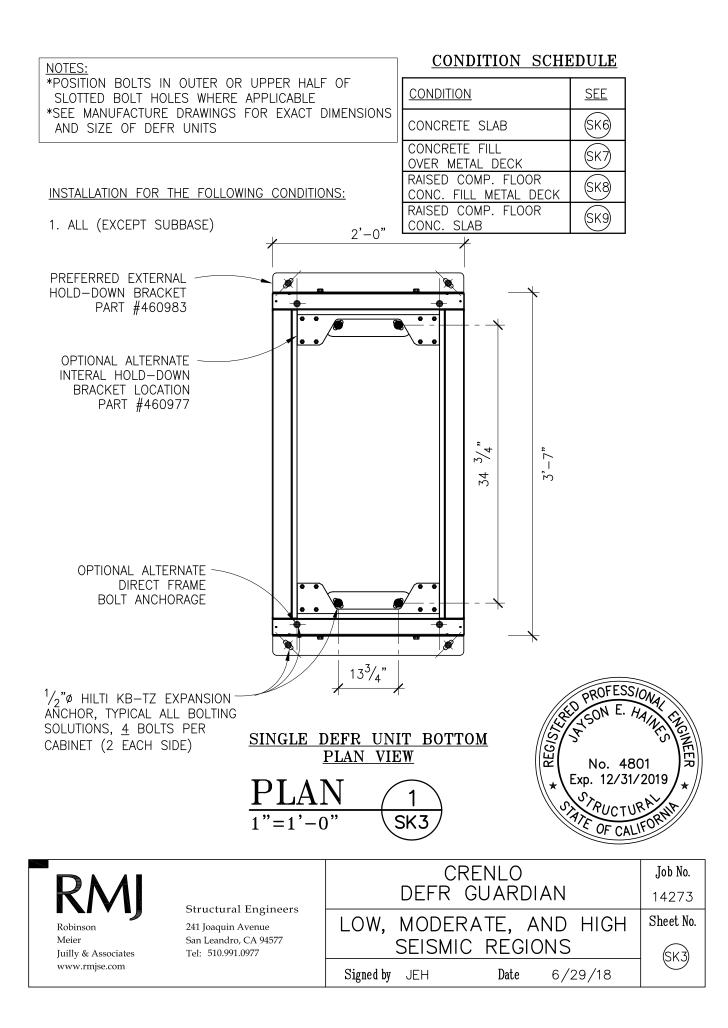
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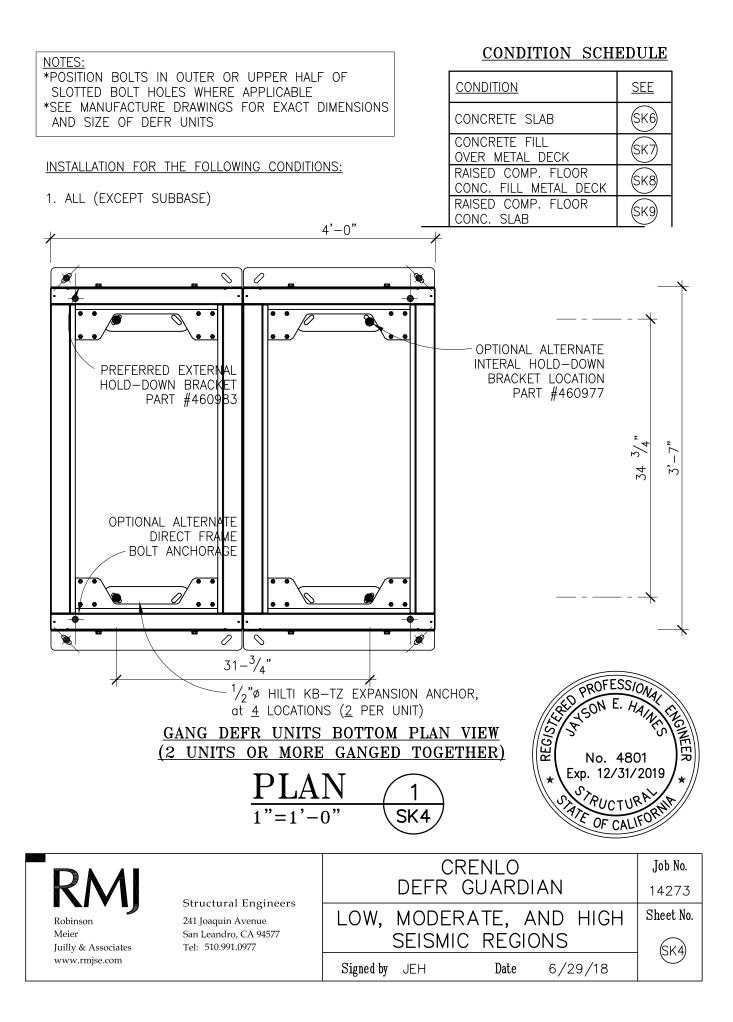
6/29/18

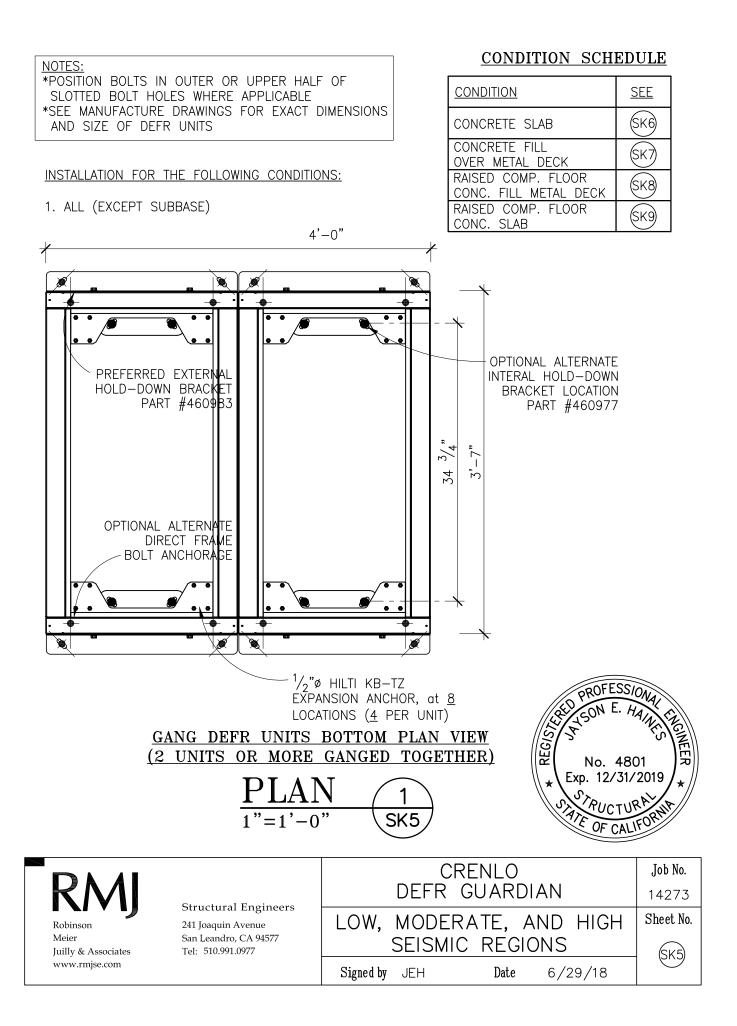
Date

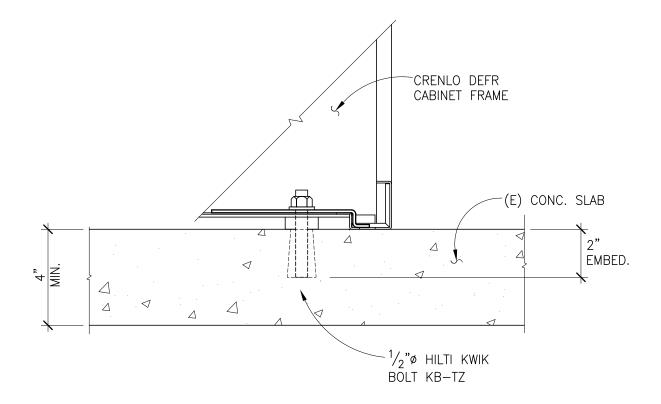
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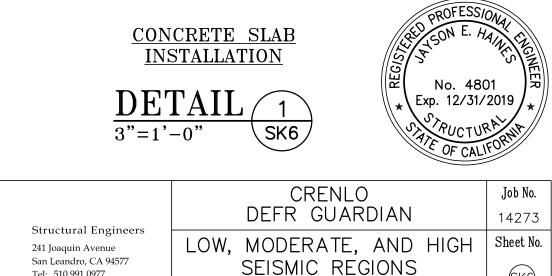
San Leandro, CA 94577 Tel: 510.991.0977











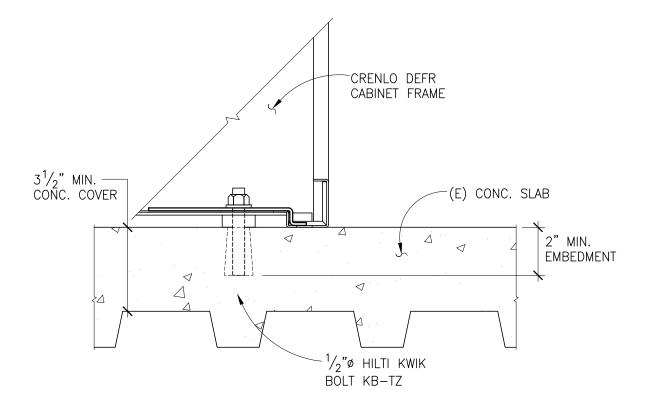
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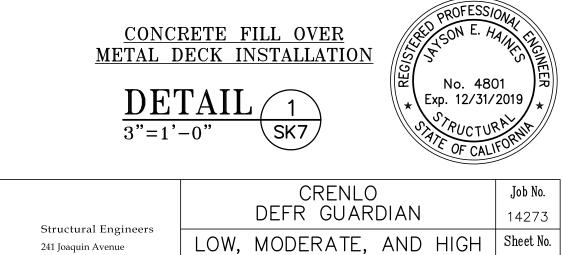
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6/29/18 Date JEH

(SK6)





Signed by

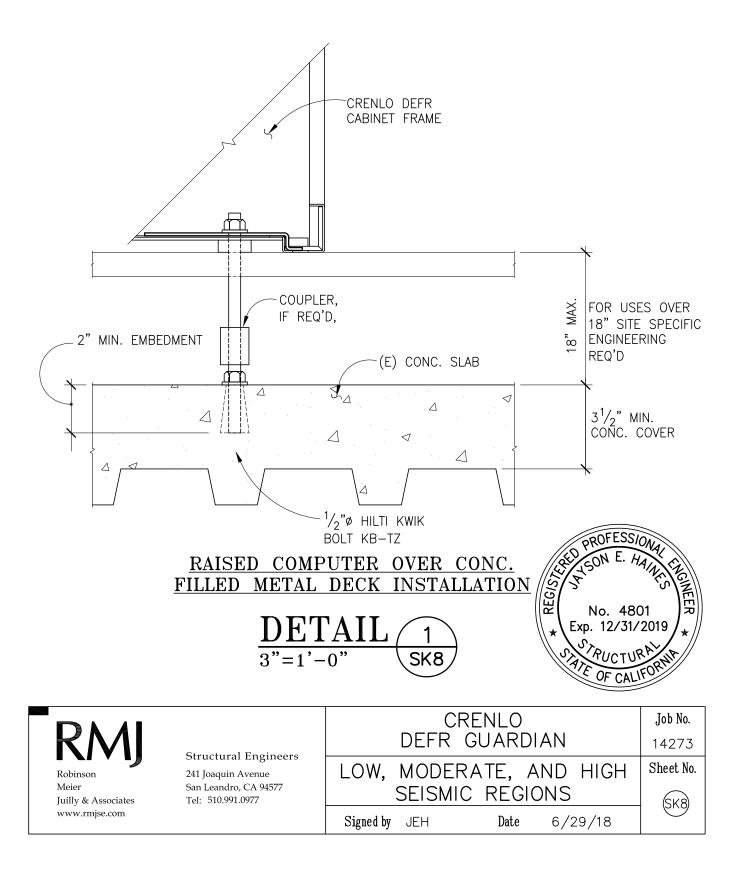
Robinson Meier Juilly & Associates www.rmjse.com

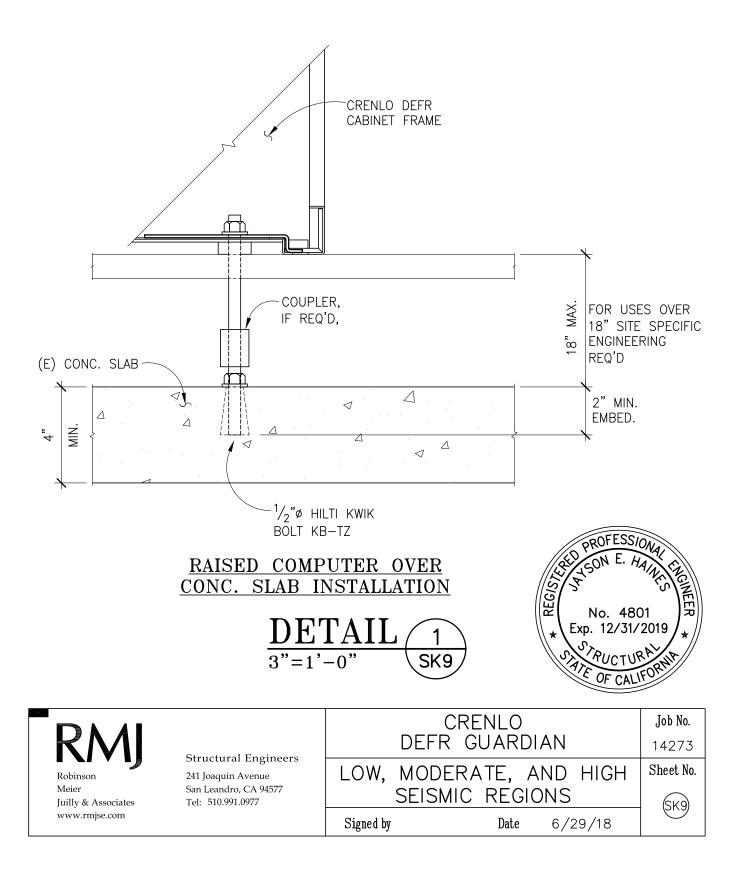
241 Joaquin Avenue San Leandro, CA 94577 Tel: 510.991.0977

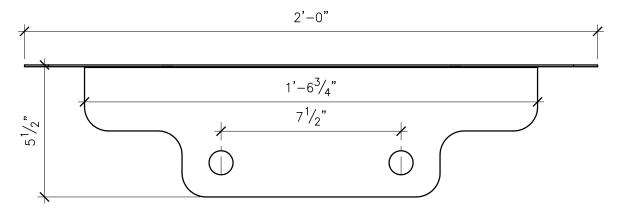
> 6/29/18 Date

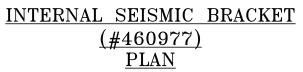
SEISMIC REGIONS

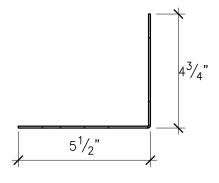
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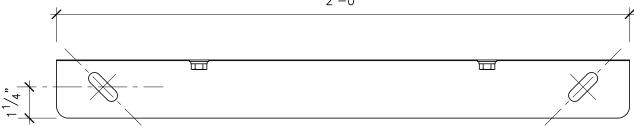




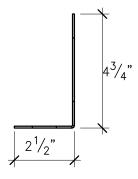




 $\frac{\text{DETAIL}}{3^{"}=1^{'}-0^{"}}$



EXTERNAL SEISMIC BRACKET (#460983) PLAN







<u> DETAI</u>

 $\overline{3"=1'-0"}$



RMJ

Robinson Meier Juilly & Associates Principals Peter Robinson, S.E. Jayson E. Haines, S.E.

Appendix (Hilti Output Files)

241 Joaquin Avenue San Leandro CA 94577 (510)991-0977



www.hilti.us

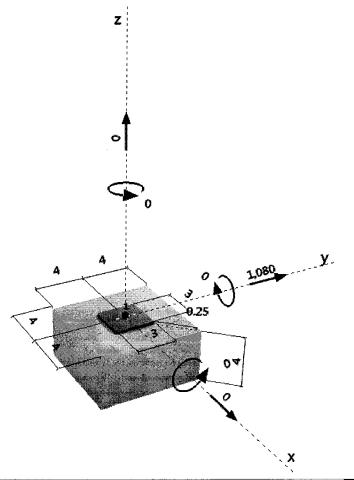
Company: Specifier: Address: Phone I Fax: E-Mail: RMJ Mario 241 Joaquin Ave. 510.991.0977 | msigala@rmjse.com

Creno-DEFRS 14273 4/6/2015

Specifier's comments: DEFRS: SINGLE ANCHOR, Maximum Shear 1,080# 100% Capacity

1 Input data		
Anchor type and diameter:	Kwik Bolt TZ - CS 1/2 (2)	
Effective embedment depth:	h _{ef,act} = 2.000 in., h _{nom} = 2.375 in.	
Material:	Carbon Steel	
Evaluation Service Report:	ESR-1917	
Issued I Valid:	5/1/2013 5/1/2015	
Proof:	Design method ACI 318-11 / Mech.	
Stand-off installation:	$e_b = 0.000$ in. (no stand-off); t = 0.250 in.	
Anchor plate:	l _x x l _y x t = 3.000 in. x 3.000 in. x 0.250 in.; (Recommended plate thickness: not calculated)	
Profile:	no profile	
Base material:	cracked concrete, 3000, f_c ' = 3000 psi; h = 4.000 in.	
Installation:	hammer drilled hole, Installation condition: Dry	
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present	
Seismic loads (cat. C, D, E, or F)	edge reinforcement: none or < No. 4 bar Tension load: yes (D.3.3.4.3 (d))	
	Shear load: yes (D.3.3.5.3 (c))	

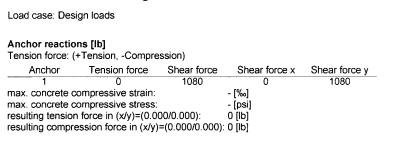
Geometry [in.] & Loading [lb, in.lb]

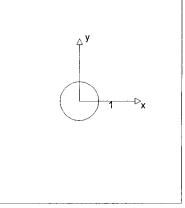




www.hilti.us			Profis Anchor 2.5.1
Company:	RMJ	Page:	2
Specifier:	Mario	Project:	Creno-DEFRS
Address:	241 Joaquin Ave.	Sub-Project I Pos. No.:	14273
Phone Fax:	510.991.0977	Date:	4/6/2015
E-Mail:	msigala@rmjse.com		
			· · · · · · · · · · · · · · · · · · ·

2 Load case/Resulting anchor forces





3 Tension load

	Load N _{ua} [lb]	Capacity _∲ N _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
• and the state of the first set to address the				

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



		Profis Anchor 2.5.1
RMJ	Page:	3
Mario	Project:	Creno-DEFRS
241 Joaquin Ave.	Sub-Project I Pos. No.:	14273
510.991.0977 msigala@rmjse.com	Date:	4/6/2015
	Mario 241 Joaquin Ave. 510.991.0977	MarioProject:241 Joaquin Ave.Sub-Project I Pos. No.:510.991.0977 Date:

4 Shear load

	Capacity _∲ V _n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
1080	3572	31	OK
N/A	N/A	N/A	N/A
1080	1844	59	ОК
1080	1090	100	ОК
	N/A 1080	N/A N/A 1080 1844 1080 1090	N/A N/A N/A 1080 1844 59 1080 1090 100

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

4.1 Steel Strength

V _{sa.eq} = ESR value	refer to ICC-ES ESR-1917
_ϕ V _{steel} ≥ V _{ua}	ACI 318-11 Table D.4.1.1

Variables

n	A _{se,V} [in. ²]	f _{uta} [psi]	
1	0.10	106000	-

Calculations

V_{sa,eq} [lb] 5495

Results

V _{sa,eq} [lb]	Ø steel	_φ V _{sa} [lb]	V _{ua} [lb]
5495	0.650	3572	1080

4.2 Pryout Strength

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_{b} \right]$	ACI 318-11 Eq. (D-40)
_φ V _{cp} ≥ V _{ua} A _{Nc} see ACI 318-11, Part D.5.2.1, Fig. RD.5.2.1(b)	ACI 318-11 Table D.4.1.1
$A_{\rm Nc0} = 9 \ h_{\rm ef}^2$	ACI 318-11 Eq. (D-5)
$\psi_{\text{ec,N}} = \left(\frac{1}{1 + \frac{2 e_{\text{N}}}{3 h_{\text{ef}}}}\right) \le 1.0$	ACI 318-11 Eq. (D-8)
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{C_{a,min}}{1.5h_{ef}} \right) \le 1.0$	ACI 318-11 Eq. (D-10)
$\begin{split} v_{Vcp,N} &= MAX\left(\frac{C_{a,\min}}{C_{ac}}, \frac{1.5h_{ef}}{C_{ac}}\right) \leq 1.0\\ N_{b} &= k_{c} \lambda_{a} \sqrt{f}_{c}^{L} h_{ef}^{1.5} \end{split}$	ACI 318-11 Eq. (D-12)
$N_{b} = k_{c} \lambda_{a} \sqrt{f_{c}} h_{ef}^{1.5}$	ACI 318-11 Eq. (D-6)

Variables

141145100						
k _{cp}	h _{ef} [in.]	e _{c1,N} [in.]	e _{c2,N} [in.]	c _{a,min} [in.]		
1	2.000	0.000	0.000	4.000		
Ψc,N	c _{ac} [in.]	k _c	λa	f _c [psi]		
1.000	5.500	17	1.000	3000		
Calculations						
A _{Nc} [in. ²]	A _{Nc0} [in. ²]	Wec1,N	Wec2,N	Ψed,N	Ψcp,N	N _b [lb]
36.00	36.00	1.000	1.000	1.000	1.000	2634
Results						
V _{cp} [lb]	фсолстеte	фseismic	φnonductile	_φ V _{cp} [lb]	V _{ua} [lb]	
2634	0.700	1.000	1.000	1844	1080	



2.5.1

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Company:	RMJ	Page:	4
Specifier:	Mario	Project:	Creno-DEFRS
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Phone I Fax:	510.991.0977	Date:	4/6/2015
E-Mail:	msigala@rmjse.com		

4.3 Concrete edge failure in direction y+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ed,V} \psi_{c,V} \psi_{h,V} \psi_{parallel,V} V_{b}$	ACI 318-11 Eq. (D-30)
$_{\phi}$ V _{cb} ≥ V _{ua} A _{Vc} see ACI 318-11, Part D.6.2.1, Fig. RD.6.2.1(b)	ACI 318-11 Table D.4.1.1
$A_{Vc0} = 4.5 C_{a1}^{2}$	ACI 318-11 Eq. (D-32)
$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_v}{3c_{a1}}}\right) \le 1.0$	ACI 318-11 Eq. (D-36)
$\psi_{\text{ed},V} = 0.7 + 0.3 \left(\frac{C_{a2}}{1.5 c_{a1}} \right) \le 1.0$	ACI 318-11 Eq. (D-38)
$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \ge 1.0$	ACI 318-11 Eq. (D-39)
$V_{b} = \left(7 \left(\frac{I_{e}}{d_{a}}\right)^{0.2} \sqrt{d_{a}}\right) \lambda_{a} \sqrt{f_{c}} c_{a1}^{1.5}$	ACI 318-11 Eq. (D-33)

Variables

c _{a1} [in.]	c _{a2} [in.]	e _{cv} [in.]	Ψc,V	h _a [in.]	
2.667	4.000	0.000	1.000	4.000	
l _e [in.]	λa	d _a [in.]	ŕ _c [psi]	ΨparaNel,V	
2.000	1.000	0.500	3000	1.000	
Calculations					
A _{Vc} [in. ²]	A _{Vc0} [in. ²]	Wec.V	Ψed,V	Ψh,V	V _b [lb]
32.00	32.00	1.000	1.000	1.000	1558
Results					
V _{cb} [lb]	Ø concrete	Ø seismic	Ønonductile	_ф V _{сь} [lb]	V _{ua} [lb]
1558	0.700	1.000	1.000	1090	1080

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.
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- · Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- · An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-11 Appendix D, Part D.3.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Part D.3.3.4.3 (b), Part D.3.3.4.3 (c), or Part D.3.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Part D.3.3.5.3 (a), Part D.3.3.5.3 (b), or Part D.3.3.5.3 (c).
- Part D.3.3.4.3 (b) / part D.3.3.5.3 (a) requires that the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Part D.3.3.4.3 (c) / part D.3.3.5.3 (b) waives the ductility requirements and requires that the anchors shall be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Part D.3.3.4.3 (d) / part D.3.3.5.3 (c) waives the ductility requirements and requires the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by On
- · Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-11, Part D.9.1

Fastening meets the design criteria!



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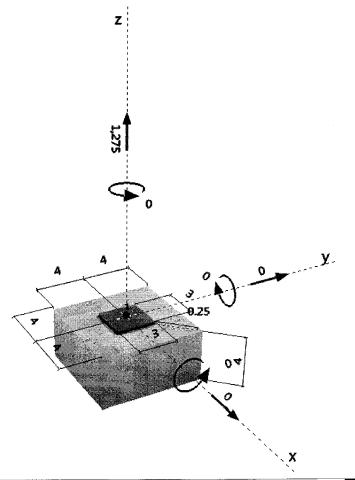
Company: Specifier: Address: Phone I Fax: E-Mail: RMJ Mario 241 Joaquin Ave. 510.991.0977 | msigala@rmjse.com

Creno-DEFRS 14273 4/6/2015

Specifier's comments: DEFRS: SINGLE ANCHOR, Maximum Tension 1,275# 100% Capacity

1 Input data	
Anchor type and diameter:	Kwik Bolt TZ - CS 1/2 (2)
Effective embedment depth:	h _{efact} = 2.000 in., h _{nom} = 2.375 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2013 5/1/2015
Proof:	Design method ACI 318-11 / Mech.
Stand-off installation:	e _b = 0.000 in. (no stand-off); t = 0.250 in.
Anchor plate:	$I_x \times I_y \times t$ = 3.000 in. x 3.000 in. x 0.250 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 3000, f_c = 3000 psi; h = 4.000 in.
Installation:	hammer drilled hole, Installation condition: Dry
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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





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Page: Project:
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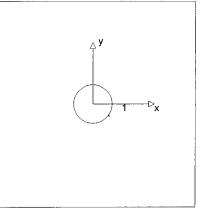
2 Creno-DEFRS 14273 4/6/2015

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	1275	0	0	0	
max. concrete compressive strain: - [%]					
max. concrete compressive stress: - [psi]					
resulting tension force in $(x/y)=(0.000/0.000)$: 1275 [lb]					
resulting compression force in $(x/y) = (0.000/0.000)$: 0 [Ib]					



3 Tension load

	Load N _{ua} [lb]	Capacity _o N _n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1275	8029	16	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	1275	1284	100	ОК
* anchor having the highest loading	**anchor group (anchors in tension)			

3.1 Steel Strength

N _{sa}	= ESR value	refer to ICC-ES ESR-1917
φ N _{ste}	_{el} ≥ N _{ua}	ACI 318-11 Table D.4.1.1

Variables

n 1	A _{se,N} [in. ²] 0.10	f _{uta} [psi] 106000	
Calculations			
N _{sa} [lb] 10705			
Results			
N _{sa} [lb]	Ф steel	_φ N _{sa} [lb]	N _{ua} [lb]
10705	0.750	8029	1275



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0	DMI		
Company:	RMJ	Page:	3
Specifier:	Mario	Project:	Creno-DEFRS
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Phone I Fax:	510.991.0977	Date:	4/6/2015
E-Mail:	msigala@rmjse.com		

3.2 Concrete Breakout Strength

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc}}\right) \psi_{ed,N}$	$ψ_{c,N}$ $ψ_{cp,N}$ N_b		ACI 318-11 Eq. (D-3)	
_φ N _{cb} ≥ N _{ua} A _{Nc} see ACI 318-11	1 Port D 5 2 1 Eig		ACI 318-11 Table D.4	.1.1
$A_{\rm Nc0} = 9 h_{\rm ef}^2$	i, Fait D.J.Z. I, Fig.	ND.5.2.1(D)	ACI 318-11 Eq. (D-5)	
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}}\right)$	≤ 1.0		ACI 318-11 Eq. (D-8)	
$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_a}{1.3}\right)$	<u>.,min</u> 5h _{ef}) ≤ 1.0		ACI 318-11 Eq. (D-10))
$\psi_{cp,N} = MAX \left(\frac{C_{a,min}}{C_{ac}} \right)^{\frac{1}{2}}$	$\left(\frac{1.5h_{ef}}{C_{ac}}\right) \le 1.0$		ACI 318-11 Eq. (D-12)	1
$N_b = k_c \lambda_a \sqrt{f_c} h_{ef}^{1.5}$	40 -		ACI 318-11 Eq. (D-6)	
Variables				
h _{ef} [in.] 2.000	e _{c1,N} [in.] 0.000	e _{c2,N} [in.] 0.000	c _{a,min} [in.] 4.000	Ψc.N 1.000
c_ac [in.] 5.500	k _c 17	λa 1.000	f _c [psi] 3000	

Calculations

A _{Nc} [in. ²]	A _{Nc0} [in. ²]	Wec1,N		Ψed,N	Ψcp,N	N _b [lb]
36.00	36.00	1.000	1.000	1.000	1.000	2634
Results						
N _{cb} [lb]	фconcrete	фseismic	Ønonductile	_φ N _{cb} [lb]	N _{ua} [lb]	
2634	0.650	0.750	1.000	1284	1275	



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Company:	RMJ	Page:	4
Specifier:	Mario	Project:	Creno-DEFRS
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Phone I Fax: E-Mail:	510.991.0977 msigala@rmjse.com	Date:	4/6/2015

4 Shear load

	Load V _{ua} [lb]	Capacity _∲ V _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.
- · Refer to the manufacturer's product literature for cleaning and installation instructions.
- · Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-11 Appendix D, Part D.3.3.4.3 (a) that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, the connection design (tension) shall satisfy the provisions of Part D.3.3.4.3 (b), Part D.3.3.4.3 (c), or Part D.3.3.4.3 (d). The connection design (shear) shall satisfy the provisions of Part D.3.3.5.3 (a), Part D.3.3.5.3 (b), or Part D.3.3.5.3 (c).
- Part D.3.3.4.3 (b) / part D.3.3.5.3 (a) requires that the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Part D.3.3.4.3 (c) / part D.3.3.5.3 (b) waives the ductility requirements and requires that the anchors shall be designed for the maximum tension / shear that can be transmitted to the anchors by a non-yielding attachment. Part D.3.3.4.3 (d) / part D.3.3.5.3 (c) waives the ductility requirements and requires the design strength of the anchors to equal or exceed the maximum tension / shear obtained from design load combinations that include E, with E increased by Ω_0 .
- · Hilti post-installed anchors shall be installed in accordance with the Hilti Manufacturer's Printed Installation Instructions (MPII). Reference ACI 318-11, Part D.9.1

Fastening meets the design criteria!