Structural Engineers

Robinson Meier Juilly & Associates

RN

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



10-Series Unit

Structural Calculations For Seismic Anchorage

Prepared for:

Crenlo April 06, 2016 Updated June 25, 2018 RMJ Job No. 14273 & 18183 Valid Thru December 31, 2019



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

RMJ



10-Series Units

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10-Series Unit Anchorage Nationwide RMJ Job# 14273

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 concrete strength. See table below for allow cabinet + content weight.

Allowable Values

	LO	W & MODE	RATE SEISMIC	7	HIGH SEISMIC				
MAX CABINET	GROUND		GROUND UPPER		GROU	UND UPPER		ER	
WT. WITH									
CONTENTS	ON FLOOR	RAISED	ON FLOOR	RAISED	ON FLOOR	RAISED	ON FLOOR	RAISED	
SINGLE UNIT	1,500	1,500	1,500	1,500	800	SS^1	800	SS^1	
GANGED UNIT	1,500	1,200	1,300	1,300	1,200	SS^1	1,100	SS^1	

SS¹- Site Specific Calculations Required

Anchor Capacities

Please see the table below for a quick review of our results.

Bolt Alignment	Max Tension (lbf.)	Max Shear (lbf.)	% Capacity
Ground Level	1,275	1,490	99
50% Bld. Ht.	1,275	1,490	99

I have included the Hilti output files along with my hand calculations 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 2012 International Building Code along with the 2013 California Building Code.

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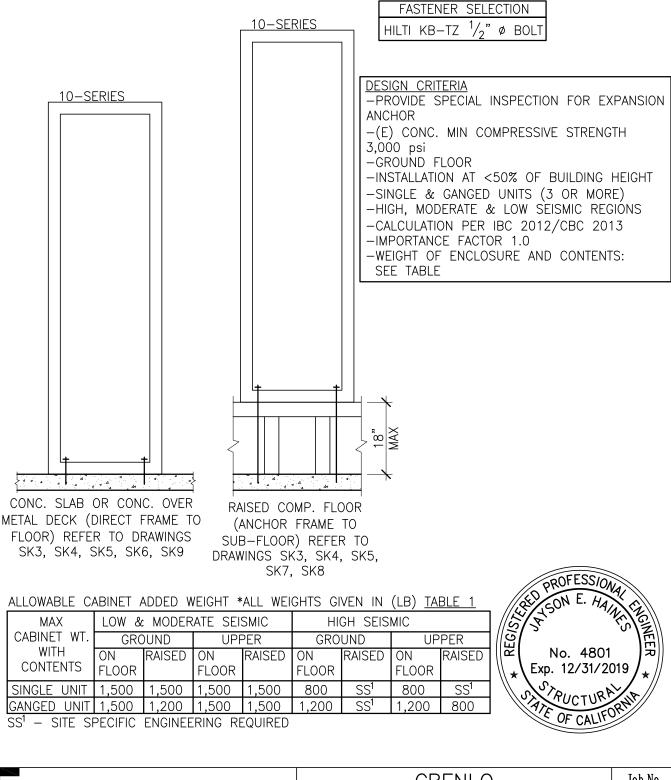
10-Series Units by Cenlo Scope, Assumptions, and Limitations RMJ Job #14273 April 4, 2015

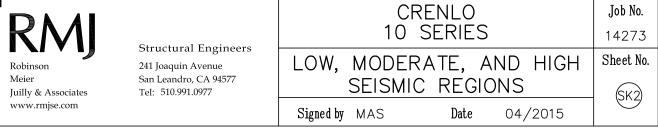
Special Note:

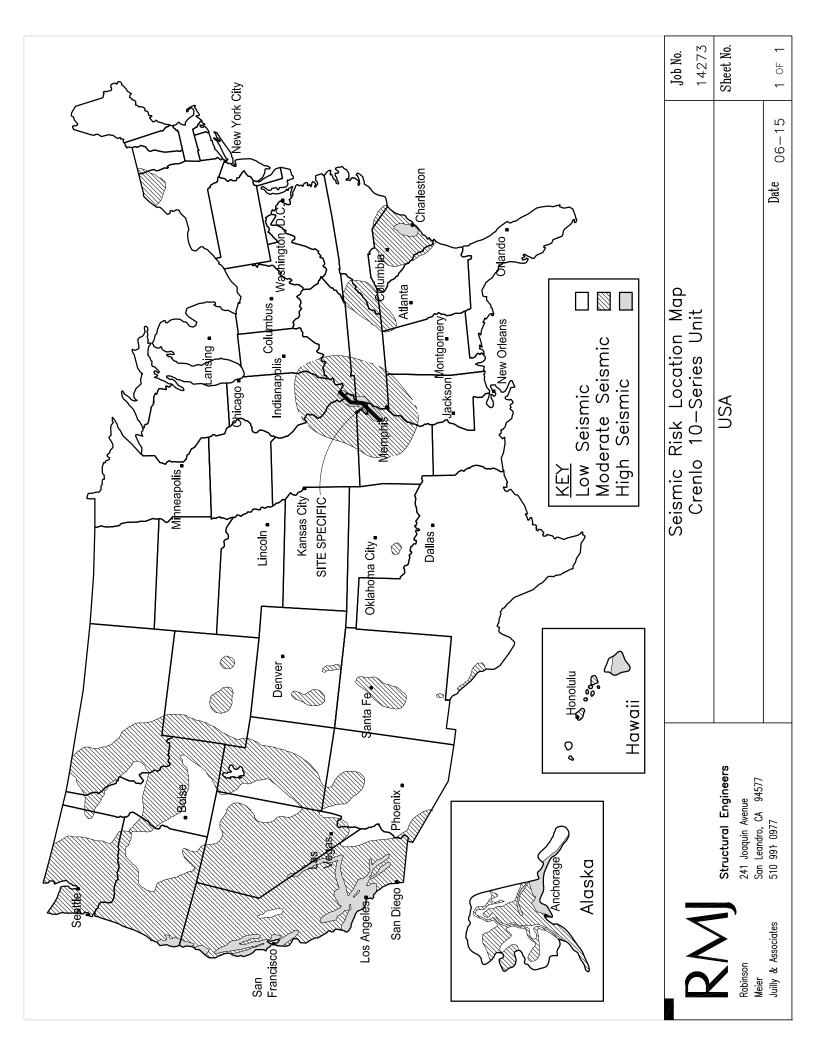
Server rack anchorage calculations are valid under the 2012 International Building Code thru date noted on cover sheet. After valid thru date, contact Crenlo for updates.

- > 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 2012 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 3 Units</u>.
- Calculations are for Crenlo 10-Series units.

DESIGN SCENARIOS AND CONDITIONS







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Low & Moderate Seismic

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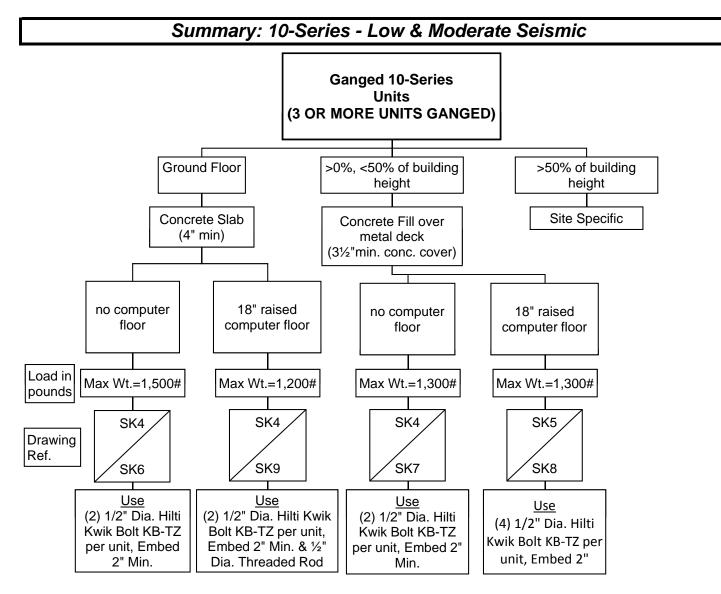
Summary: 10-Series - Low & Moderate Seismic Single **10-Series** Unit Ground Floor >0%, <50% of >50% of building building height height Concrete Slab Site Specific Concrete Fill over (4" min) metal deck (31/2" min. conc. Cover) no computer 18" raised 18" raised no computer floor computer floor floor computer floor Max Wt.=1,500# Max Wt.=1,500# Max Wt.=1,500# Max Wt.=1,500# SK3 SK3 SK3 SK3 Drawing Ref. SK6 SK9 SK7 SK8 U<u>se</u> <u>Use</u> Use Use (4) 1/28" Dia. Hilti (4) 1/2" Dia. Hilti Kwik (4) 1/2" Dia. Hilti (4) 1/2" Dia. Hilti Kwik Bolt KB-TZ, Embed 2" Kwik Bolt KB-TZ, Kwik Bolt KB-TZ Bolt KB-TZ, Embed 2" Embed 2" Min. Min. & 1/2" Dia. per unit, Embed 2" Min. & 1/2" Dia.

Min.

Threaded Rod

Threaded Rod

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Low & Moderate SeismicSan Leandro, CA 94577Job No. : 14273
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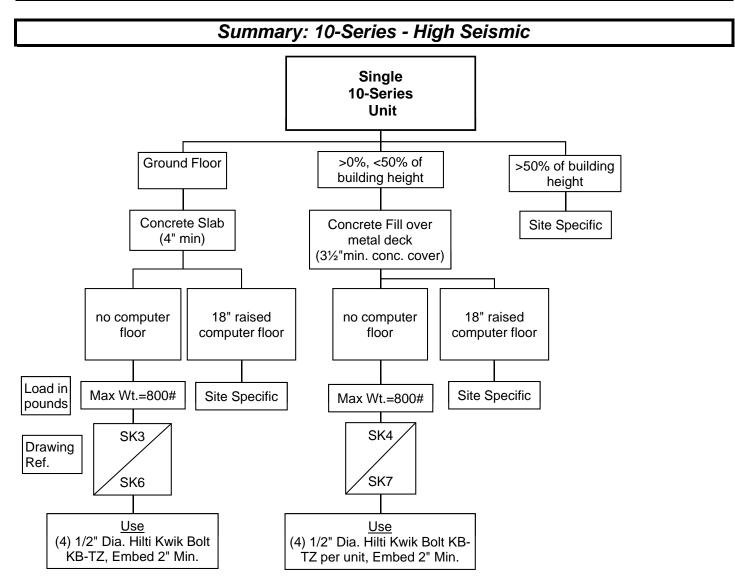


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High Seismic

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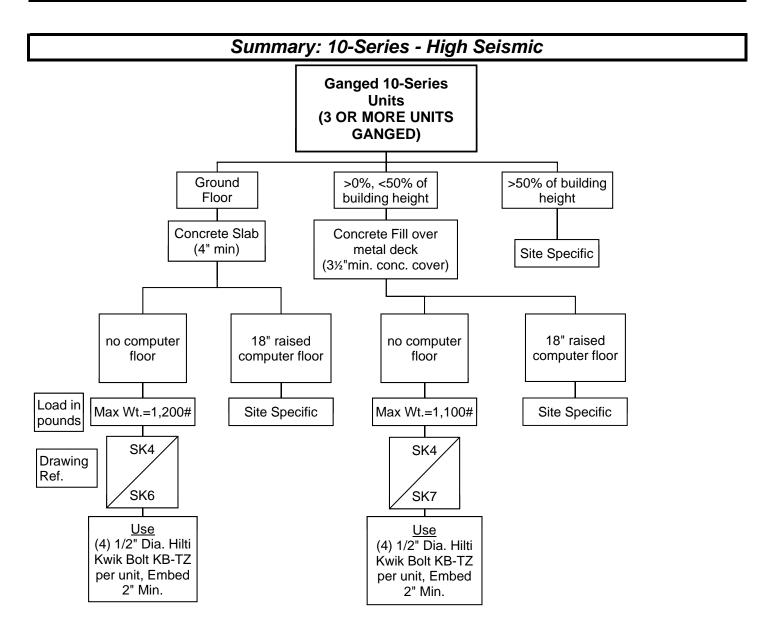


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Low Seismic Calculations

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Low & Moderate Seismic

Job No. : 14273 Date: 04/06/15 By: MAS Page: 12

Find the Seismic Design Category (SDC)

Unit: 10-Series

Project Location:Low & Moderate SeismicLatitude:VariesLongitude: Varies

Soil Classification: DTable 1613.5.2 & Section 1613.5.2Occupancy Category: IITable 1604.5

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

S _S =	1.500	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} =	1.50	g	(Equation 16-37)
S _{M1} =	1.61	g	(Equation 16-38)
S _{DS} =	1.000	g	(Equation 16-39)
S _{D1} =	1.070	g	(Equation 16-40)
$F_{a} = F_{v} = S_{MS} = S_{M1} = S_{DS} = S_{$	1.000 1.500 1.50 1.61 1.000	g g g	Table 1613.5.3(2 (Equation 16-37) (Equation 16-38) (Equation 16-39)

Seismic Design Category (SDC):

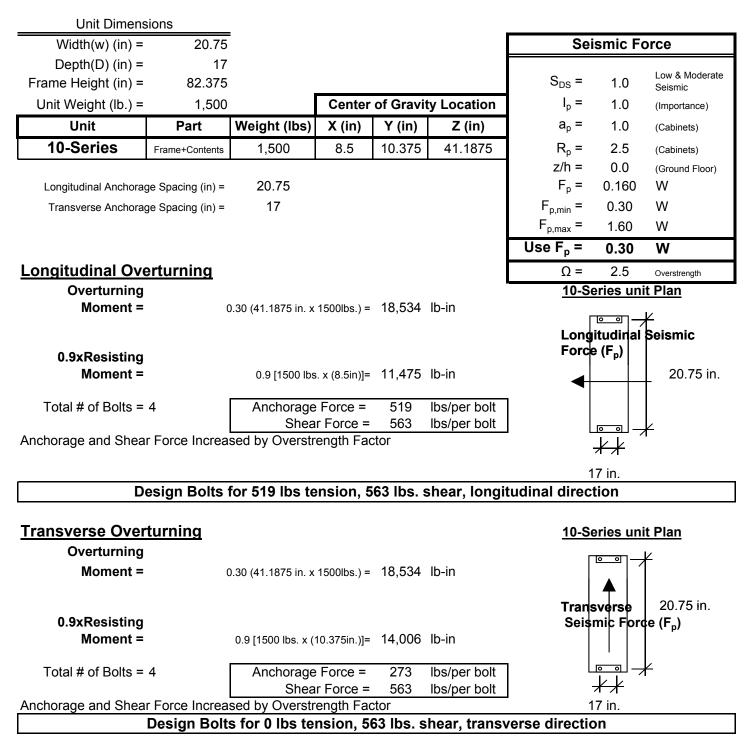
Varies

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Low & Moderate Seismic

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Load Case: Single Unit (Ground floor)



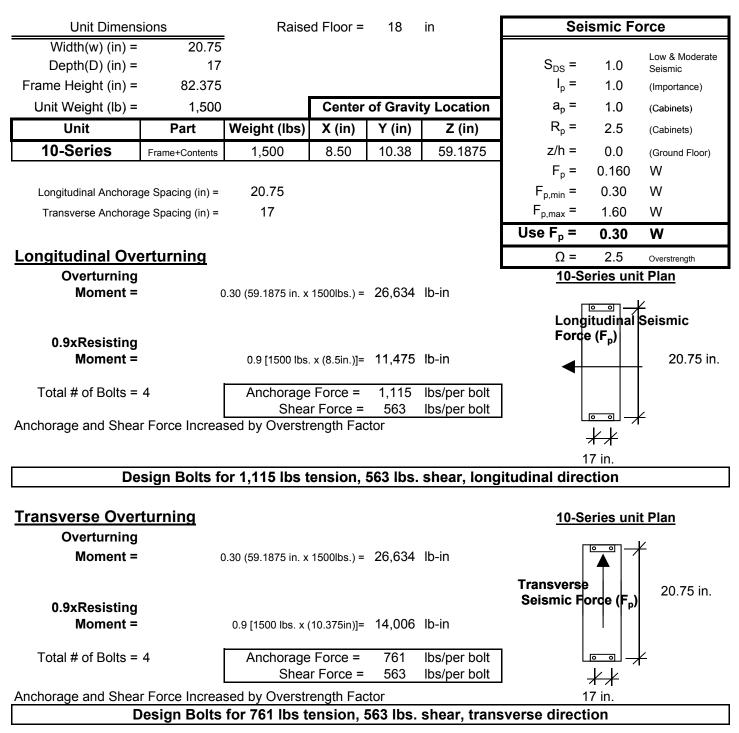
Drawing Reference See: SK3 & SK6

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Low & Moderate Seismic

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



Drawing Reference See: SK3 & SK9

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San Leandro, CA 94577	Job No. : 14273	Date: 04/06/15
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Load Case: Ganged Unit (Ground floor)

of Units ganged (min.)= 3

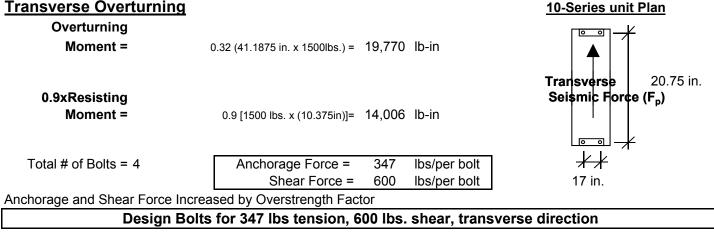
Single Unit Dim	nension					Sei	ismic Fo	orce
Width(w) (in) =	20.75							
Depth(D) (in) =	17					S _{DS} =	1.0	Low & Moderate Seismic
Frame Height (in) =	82.375					$I_p =$	1.0	(Importance)
Frame Weight (lb.) =	1,500		Center	of Gravi	ty Location	a _p =	1.0	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	R _p =	2.5	(Cabinets)
3 - 10-Series	Frame+Contents	4,500	28.5	10.375	41.19	z/h =	0.0	(Ground Floor)
						F _p =	0.160	W
Longitudinal Anchorag	ge Spacing (in) =	62.25				F _{p,min} =	0.30	W
Transverse Anchorag	ge Spacing (in) =	20.75				F _{p,max} =	1.60	W
						Use F _p =	0.30	W
_ongitudinal Ove	erturning					Ω =	2.5	Overstrength
Overturning								
Moment =	().30 (41.1875 in. x	4500lbs.) =	55,603	lb-in		eries uni	
						Longitudinal	Seismic Fo	orce
								<u> </u>
0.9xResisting Moment =		0.9 (4500 lbs	v29 5 in)-	115 / 25	lh in			<u> </u>
Woment -		0.9 (4500 lbs	. x20.5 III.)-	115,425		0		
		Anchorage		0	lbs		3 ganged	
	_		r Force =	-	lbs/per bolt	Total # of b	olts/Unit	= 2
Anchorage and Shear								
Ľ	Design Bolts	for 0 lbs ten	ision, 1,1	125 lbs.	shear, trans	verse direct	ion	
<u>Fransverse Over</u> Overturning	turning					Gangad	10 Sorios	s unit Plan
Moment =).30 (41.1875 in. x	4500lba) -	55 603	lh in		rse Sejsm	
Moment -	().30 (41.1675 III. X	4500lbs.) =	55,005				
0.9xResisting							<u>ہ</u>	<u> </u>
Moment =		0.9 (4500 lbs x1	0.375 in.) =	42,019	lb-in			
		,	,			0		0
		Anchorage	e Force =	546	lbs/per bolt	3	3 ganged	units
		Shoo	r Force =	1,125	lbs/per bolt	Total # of b	olts/Unit	= 2
				,				
nchorage and Shear			ength Fac	ctor			_	

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San Leandro, CA	94577		2011 0.11		Job No. :	14273	Date	: 04/06/15
510.991.0977					By:	MAS	Page	: 16
							<u>U</u>	
Load Case:	<u>Ganged un</u>	its on 18in r	aised co	ompute	r floor (Grou	und Floor)		
# of Units gan	ged (min.)=	3						
Single Unit Din	nension	Raise	d Floor =	18	in	Sei	smic Fo	orce
Width(w) (in) =	20.75	-						Low & Moderate
Depth(D) (in) =	17					S _{DS} =	1.0	Seismic
Frame Height (in) =	82.375					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 - 10-Series	Frame+Contents	3,600	28.5	10.375	59.1875	z/h =	0.0	(Ground Floor)
						F _p =	0.160	W
Longitudinal Anchorag	ge Spacing (in) =	62.25				F _{p,min} =	0.30	W
Transverse Anchorag	ge Spacing (in) =	20.75				F _{p,max} =	1.60	W
						Use F _p =	0.30	W
Longitudinal Ove	erturning					Ω =	2.5	Overstrength
Overturning					•			
Moment =		0.3 (59.1875 in. x	3600lbs.) =	63,923	lb-in			<u>s unit Plan</u>
						Longitudin	al Seismic	Force
0.9xResisting Moment =		0.9 (3600 lbs	x28 5 in)=	92 340	lh-in			
Moment -		0.9 (0000 103	. x20.5 m.)-	52,540	10-111			<u> </u>
						o	0 0	
		Anchorage		0	lbs/per bolt		ganged	
Anchorage and Chas	- Faraa laaraa		r Force =		lbs/per bolt	Total # of bo	olts/Unit :	= 2
Anchorage and Shea		sed by Oversit s for 0 lbs ter			hear Ionaitu	idinal directi	on	
	Jesigii Doita		131011, 30	0 103. 3	ilear, iongitu			
Transverse Over	turnina							
Overturning	tarnig					Ganged 1	0-Series	s unit Plan
Moment =		0.3 (59.1875in. x	3600lbs.) =	63.923	lb-in		erse Seisn	
			· · · · · ,	,		г г-		0
0.9xResisting								
Moment =		0.9 (3600 lbs x1	0.375 in.) =	33,615	lb-in	0		0
		Anchorage	Force =	1,217	lbs/per bolt	3	ganged	units
			r Force =	900	lbs/per bolt	Total # of bo		
Anchorage and Shea			-					
		sed by Overstr for 1,217 lbs	-		. shear, tran	sverse direc	tion	

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

Crenlo 241 Joaquin Ave. Low & Moderate Seismic San Leandro, CA 94577 Job No. : 14273 Date: 04/06/15 510.991.0977 By: MAS Page: 17 Load Case: <u>Single Unit (≤ 50% of Bldg. Ht.)</u> (i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building) Seismic Force Unit Dimensions Width(w)(in) =20.75 Low & Moderate $S_{DS} =$ Depth(D)(in) =17 1.0 Seismic $I_p =$ Frame Height (in) = 82.375 1.0 (Importance) Unit Weight (lb) = 1,500 **Center of Gravity Location** a_p = 1.0 (Cabinets) $R_{p} =$ 2.5 Unit Part Weight (lbs) X (in) Y (in) Z (in) (Cabinets) 10-Series Frame+Contents 1,500 8.5 10.375 41.1875 z/h =0.5 (50% of bldg ht.) $F_{p} =$ 0.320 W $F_{p,min} =$ 0.30 W Longitudinal Anchorage Spacing (in) = 20.75 17 F_{p,max} = 1.60 W Transverse Anchorage Spacing (in) = Use $F_p =$ 0.320 W Longitudinal Overturning Ω= 2.5 Overstrength Overturning **10-Series unit Plan** Moment = 0.32 (41.1875 in. x 1500lbs.) = 19,770 lb-in 0 0 Longitudinal Seismic 0.9xResisting Forde (F_p) Moment = 0.9 [1500 lbs. x (8.5in.)]= 11,475 lb-in 20.75 in. Anchorage Force = Total # of Bolts = 4 610 lbs/per bolt Shear Force = 600 lbs/per bolt +Anchorage and Shear Force Increased by Overstrength Factor 17 in. Design Bolts for 610 lbs tension, 600 lbs. shear, longitudinal direction

Transverse Overturning



Drawing Reference See: SK3 & SK7

RM 241 Joaquin Ave. San Leandro, CA 94577 510.991.0977

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)

		-	-		-					
Unit Dimens		Raise	Raised Floor = 18 in				ismic F	orce		
Width(w) (in) =								Low & Moderate		
Depth(D) (in) =	17					S _{DS} =	1.0	Seismic		
Frame Height (in) =	82.375	-				I _p =	1.0	(Importance)		
Unit Weight (Ib) =	1,500		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)		
10-Series	Frame+Contents	1,500	8.5	10.375	59.1875	z/h =	0.5	(50% of bldg ht.)		
						F _p =	0.320	W		
Longitudinal Anchora	ge Spacing (in) =	20.75				F _{p,min} =	0.30	W		
Transverse Anchora	ge Spacing (in) =	17				F _{p,max} =	1.60	W		
						Use F _p =	0.320	W		
Longitudinal Ove	<u>erturning</u>					Ω =	2.5	Overstrength		
Overturning						<u>10-S</u>	eries un	it Plan		
Moment = 0.9xResisting Moment = Total # of Bolts =	4		. x (8.5in)]= Force = r Force =	11,475 1,245 600			Longitudinal Seismic Force (F _p)			
Anchorage and Shea	r Force Increa	sed by Overstro	ength Fac	tor			★★ ´ 17 in.			
De	sign Bolts fo	or 1,245 lbs t	ension, 6	600 lbs.	shear, long	itudinal dire	ction			
Transverse Over	turning					<u>10-S</u>	eries un	it Plan		
Overturning Moment =	C).32 (59.1875 in. x	1500lbs.) =	28,410	lb-in			4		
0.9xResisting Moment =		0.9 [1500 lbs. x (1	0.375in.)]=	14,006	lb-in		sverse mic Fore	20.75 in. s e (F_p)		
Total # of Bolts =	4	Anchorage	Force =	868	lbs/per bolt] [¥		
			r Force =	600	lbs/per bolt	J	⊀∦			
Anchorage and Shea	r Force Increa	sed by Overstro	ength Fac	tor			17 in.			

Design Bolts for 868 lbs tension, 600 lbs. shear, transverse direction

Drawing Reference See: <u>SK3 & SK8</u>

RMJ	Crenlo	
241 Joaquin Ave.	Low & Moderate Seismic	
San Leandro, CA 94577	Job No. : 14273	Date: 04/06/15
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Load Case: <u>Ganged Unit (≤ 50% of Bldg. Ht.)</u>

of Units ganged (max)= 3

Single Unit Din	nension					Se	ismic Fo	orce
Width(w) (in) = Depth(D) (in) =	20.75 17					S _{DS} =	1.0	Low & Moderate Seismic
Frame Height (in) =	82.375	-				I _p =	1.0	(Importance)
Frame Weight (lb.) =	1,300		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 - 10-Series	Frame+Contents	3,900	28.5	10.375	41.1875	z/h =	0.5	(50% of bldg ht.)
						F _p =	0.320	W
Longitudinal Anchorag	ge Spacing (in) =	62.25				F _{p,min} =	0.30	W
Transverse Anchora	ge Spacing (in) =	20.75				F _{p,max} =	1.60	W
						Use F _p =	0.320	W
Longitudinal Ove	<u>erturning</u>					Ω =	2.5	Overstrength
Overturning	_							
Moment =	0	.32 (82.375/2 in. x 3	3900lbs.) =	51,402	lb-in	<u>Ganged '</u>	0-Series	<u>s unit Plan</u>
						Longitu	dinal Seis	mic Force
0.9xResisting Moment =		0.0 (0000 lb -		100 025	lh in			<u> </u>
Moment -		0.9 (3900 lbs.	x28.5 In.)=	100,035	ID-III			<u> </u>
						•		
		Anchorage	Force =	0	lbs	3	ganged	units
			Force =	,	lbs/per bolt	Total # of b	olts/Unit :	= 2
Anchorage and Shea								
D	esign Bolts	for 0 lbs tens	ion, 1,0	40 lbs. s	shear, longit	udinal direct	tion	
Transverse Over	turning							
Overturning	_			54 400	U		<u>IO-Series</u> erse Seisn	<u>s unit Plan</u>
Moment =	0	.32 (82.375/2 in. x 3	3900lbs.) =	51,402	lb-in	Transv		
0.9xResisting							<u> </u>	
Moment =		0.9 (3900 lbs x10) 375 in) =	36 4 16	lh-in			
momon			5.070	00,110		0		0
							I	
		Anchorage		602	lbs/per bolt		3 ganged	
	- ·		Force =	1,040	lbs/per bolt	Total # of b	olts/Unit :	= 2
Anchorage and Shea					- h		<u> </u>	
De	esign Bolts f	or 602 lbs ter	nsion, 1 _:	, 040 I DS	. snear, tran	sverse airec	tion	

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

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مر 241 Joaquin Ave.								
		Low		loderat	e Seismic			
San Leandro, CA 94577		2011		10001010	Job No. :	14273	Date	: 04/06/15
510.991.0977						MAS	Page	: 20
Load Case: <u>Gangeo</u> # of Units ganged (ma		18in raise	ed co	mpute	<u>r floor (≤50%</u>	<u>% of Bldg. H</u>	' <u>t.)</u>	
Single Unit Dimension		Raised Flo	or =	18	in	Sei	ismic Fo	orce
Width(w) (in) = 2	0.75							
Depth(D) (in) =	17					S _{DS} =	1.0	Low & Moderate Seismic
Frame Height (in) = 82	.375					$I_p =$	1.0	(Importance)
Frame Weight (lb.) = 1	,300	Ce	nter	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 - 10-Series Frame+Con	tents 3,90	0 2	3	10.375	59.1875	z/h =	0.5	(50% of bldg ht.)
						F _p =	0.320	W
Longitudinal Anchorage Spacing ((in) = 45					F _{p,min} =	0.30	W
Transverse Anchorage Spacing ((in) = 20.7	'5				F _{p,max} =	1.60	W
						Use F _p =	0.320	W
Longitudinal Overturnin	g					Ω =	2.5	Overstrength
Overturning Moment = 0.9xResisting Moment =		75 in. x 3900lb 900 lbs. x22.5	·			Longitudi	nal Seismi	<u> </u>
Anchorage and Shear Force In	creased by O	-	ce = n Fac		lbs/per bolt lbs/per bolt	Total # of b	3 ganged olts/Unit :	
Design E	Bolts for 0 lb	os tension	n, 260) Ibs. sl	hear, longitu	idinal directi	on	
<u>Transverse Overturning</u> Overturning Moment = 0.9xResisting Moment =	0.3 (59.18	375in. x 3900lt 0 lbs x10.375	ŗ				erse Seisn	ic Force
Anchorage and Shear Force In		orage Ford Shear Ford verstrength	ce =		lbs/per bolt lbs/per bolt	3 Total # of b		



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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

241 Joaquin Ave. San Leandro, CA 94577 510.991.0977

Crenlo

High Seismic

Job No. : 14273 Date: 04/06/15 By: MAS Page: 22

Find the Seismic Design Category (SDC)

Unit: 10-Series

Project Location: Latitude: Varies

High 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/

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

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High Seismic

Job No. : 14273 Date: 04/06/15 By: MAS Page: 23

Load Case: Single unit (Ground floor)

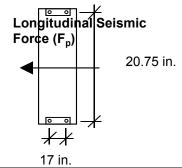
Unit Dimens	sions				
Width(w) (in) =	20.75				
Depth(D) (in) =	17				
Frame Height (in) =	82.375				
Max Weight (lb.) =	800		Center	of Gravit	y Location
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)
Unit 10-Series	Part Frame+Contents	Weight (lbs) 800	X (in) 8.5	Y (in) 10.375	Z (in) 41.1875

Longitudinal Overturning

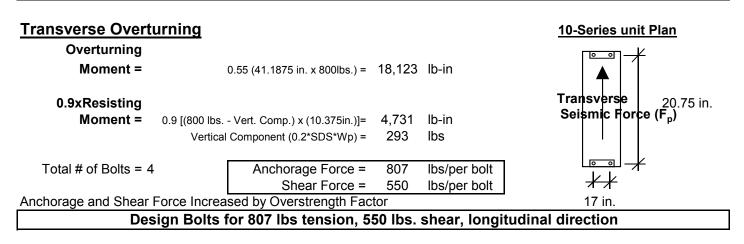
Overturning Moment =	0.55 (41.1875 in. x 800lbs.) =	18,123	lb-in
• •) lbs Vert. Comp.) x 8.5in.]= Component (0.2*SDS*Wp) =	3,876 293	lb-in lbs
Total # of Bolts = 4	Anchorage Force = Shear Force =		lbs/per bolt lbs/per bolt
Anchorage and Shear Force Increa	sed by Overstrength Fac	tor	

Seismic Force $S_{DS} =$ 1.83 High Seismic $I_{p} =$ 1.0 (Importance) a_p = 1.0 (Cabinets) $R_p =$ 2.5 (Cabinets) z/h = 0.0 (Ground Floor) F₀ = 0.293 W $F_{p,min} =$ 0.55 W $F_{p,max} =$ 2.93 W Use F_p = W 0.550 Ω= 2.5 Overstrength

10-Series unit Plan



Design Bolts for 1,048 lbs tension, 550 lbs. shear, longitudinal direction



Drawing Reference See: SK3 & SK6

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Crenlo

High Seismic

Job No. : 14273 Date: 04/06/15 By: MAS Page: 24

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

Unit Dimensior	ns	Raise	d Floor =	18	in	Sei	ismic Fo	orce
Width(w) (in) =	20.75					S _{DS} =	1.83	High Seismic
Depth(D) (in) =	17					I _p =	1.0	(Importance)
Frame Height (in) =	82.375					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	800		Center	of Gravit	ty Location	R _p =	2.5	(Cabinets)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.0	(Ground Floor)
10-Series Fr	rame+Contents	800	8.5	10.375	59.1875	$F_p =$	0.293	W
						F _{p,min} =	0.55	W
Longitudinal Anchorage S	Spacing (in) =	20.75				F _{p,max} =	2.93	W
Transverse Anchorage S	Spacing (in) =	17				Use F _p =	0.550	W
						Ω =	2.5	Overstrength
Longitudinal Overt	turning							
Overturning						<u>10-S</u>	eries uni	<u>t Plan</u>
Moment =		0.55 (59.1875 in.)	(800 lbs) =	26 043	الم : بم			
			(000100.)	20,045	ni-di	_	I	/
			(000100.)	20,043	ID-IN	Long	itudinal	<u>∠</u> Seismic
0.9xResisting			(000150.)	20,043	ID-IN		o jitudinal e (F _p)	∠ Seismic
0.9xResisting Moment =	0.9 [(800	bs Vert. Comp.)		3,876	Ib-in			∠ Seismic - 20.75 in.
•	•••		x (8.5in.)]=					
Moment =	•••	bs Vert. Comp.) Component (0.2*S	x (8.5in.)]= SDS*Wp) =	3,876 293	lb-in lbs			
•	•••	bs Vert. Comp.) Component (0.2*S Anchorage	x (8.5in.)]= SDS*Wp) = e Force =	3,876 293 1,630	lb-in lbs lbs/per bolt	Ford		
Moment =	Vertical	bs Vert. Comp.) Component (0.2*6 Anchorage Shea	x (8.5in.)]= SDS*Wp) = Prorce = r Force =	3,876 293 1,630 550	lb-in lbs	Ford	e (F _p)	

Design Bolts for 1,630 lbs tension, 550 lbs. shear, longitudinal direction

Transverse Overturning

<u> Transverse Overtu</u>	rning			<u>10-Series unit Plan</u>
Overturning				K
Moment =	0.55 (59.1875 in. x 800lbs.) =	26,043	lb-in	
0.9xResisting				Transverse 20.75 in.
Moment =	0.9 [(800 lbs Vert. Comp.) x (10.375in)]=	4,731	lb-in	Seismic Force (F _p)
	Vertical Component (0.2*SDS*Wp) =	293	lbs	
Total # of Bolts = 4	Anchorage Force =	1,284	lbs/per bolt	
	Shear Force =	550	lbs/per bolt	
Anchorage and Shear F	orce Increased by Overstrength Fac	tor		17 in.

Design Bolts for 1,284 lbs tension, 550 lbs. shear, longitudinal direction



RMI			Crenlo					
241 Joaquin Ave.			High Se	ismic				
San Leandro, CA					Job No. :	14273	Date	: 04/06/15
510.991.0977					By:	MAS	Page	: 25
	_							
Load Case:	Ganged Un	nit (Ground i	<u>floor)</u>					
# of Units gar	nged (min)=	3						
Single Unit Din		:					ismic Fo	
Width(w)(in) =	20.75					S _{DS} =	1.83	High Seismic
Depth(D) (in) =	17					I _p =	1.0	(Importance)
Frame Height (in) =			O and		4. J. a 4'	a _p =	1.0	(Cabinets)
Max Weight (lb.) =	1,200	Mainht /lbs)			ty Location	R _p = z/h =	2.5 0.0	(Cabinets)
3 - 10-Series	Part	Weight (lbs) 3,600	X (in) 29	Y (in) 10.375	Z (in) 41.1875		0.0 0.293	(Ground Floor) W
3 - TU-Series	Frame+Contents	3,000	29	10.375	41.1075	F _p =	0.295	
						F _{p,min} = F _{p,max} =	0.55 2.93	W
	o . (1)	45				Use F _p =	0.550	W
Longitudinal Anchora		45						
Transverse Anchoraç	ge Spacing (in) =	20.75				Ω =	2.5	Overstrength
Longitudinal Ov	erturning							
Overturning								
Moment =	0	.55 (41.1875 in. x	3600lbs.) =	81,551	lb-in			<u>unit Plan</u>
0.9xResisting							udinal Seis	
Moment =	0.9 [(3600	lbs Vert. Comp.) x28.5 in.]=	58,482	lb-in			0
		Component (0.2*		1,320	lbs			
		- · ·						
		Anchorag	e ⊢orce = ar Force =	320 825	lbs/per bolt	: Total # of b	3 ganged	
Anchorage and Shea	r Force Increa				lbs/per bolt			+
					shear, longi	itudinal direc	tion	
Transverse Over	turning					0		
Overturning	~	EE / 44 4075	260016-	Q1 EE1	lh in	Ganged 10-S	eries un erse Seisn	
Moment =	0	.55 (41.1875 in. x	36001DS.) =	01,551	ID-III			
0.9xResisting						0	<u> </u>	0 0
Moment =	0.9 [(3600 lbs	- Vert. Comp.) x1	10.375 in.] =	21,290	lb-in			
	Vertical	Component (0.2*	SDS*Wp) =	1,320	lbs			
		Anchorag		1,210	lbs/per bolt	: Total # of b	3 ganged	
			ar Force =	825	lbs/per bolt		ono/Ornt ·	- - 7
Anchorage and Shea	r Force Increa					4		
De	esign Bolts f	or 1,210 lbs	tension,	825 lbs	s. shear, trai	nsverse dire	ction	

Drawing Reference See: SK5 & SK6

RMI			Crenlo						
241 Joaquin Ave.			High Se	ismic					
San Leandro, CA			r light OC		Job No. :	14273	Date	: 04/06/15	
510.991.0977	34377					MAS	Page		
010.001.0011					Dy.		i ugo	. 20	
Load Case: <u>Ganged units on 18in raised computer floor (Ground floor)</u>									
# of Units gar	nged (min)=	3							
Single Unit Dim	nension	Raise	ed Floor =	18	in	Sei	ismic Fo	orce	
Width(w) (in) =	20.75					S _{DS} =	1.83	High Seismic	
Depth(D) (in) =	17					I _p =	1.0	(Importance)	
Frame Height (in) =	82.375					a _p =	1.0	(Cabinets)	
Max Weight (lb.) =	800		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)	
3 - 10-Series	Frame+Contents	2,400	29	10.375	59.1875	F _p =	0.293	W	
			I		•	F _{p,min} =	0.55	W	
Longitudinal Anchorag	je Spacing (in) =	45				F _{p,max} =	2.93	W	
Transverse Anchorag		20.75				Use F _p =	0.550	W	
						Ω =	2.5	Overstrength	
Longitudinal Ove	erturning								
Overturning						_			
Moment =	0	.55 (59.1875 in. x	2400lbs.) =	78,128	lb-in	Ganged 10-Series unit Plan			
						Longitudinal Seismic Force			
0.9xResisting									
Moment =	0.9 [(2400	bs Vert. Comp.)) x28.5 in.]=	38,988	lb-in		0 0 0	0	
	Vertical	Component (0.2*	SDS*Wp) =	880	lbs				
		Anchorage	- Eoroo -	544	lbs/per bolt	3	3 ganged	units	
		•	r Force =	544 550	lbs/per bolt	Total # of b	olts/Unit :	= 4	
Anchorage and Shea	r Force Increa							•	
		or 544 lbs te			shear, longi	tudinal dired	ction		
Transverse Over	turning								
Overturning								<u>unit Plan</u>	
Moment =	().55 (59.1875in. x	2400lbs.) =	78,128	lb-in	Tran	isverse Sei	smic Force	
						le_	• • •	0 0	
0.9xResisting									
Moment =	0.9 [(2400 lbs	- Vert. Comp.) x1	0.375 in.1 =	14,193	lb-in	0	• • •	0 0	
		Component (0.2*	-	880	lbs		I		
						3	3 ganged	units	
		Anchorage		1,284	lbs/per bolt	T-1-1 // / /	- 14 - /1		
Anchorage and Shea	r Force Increa		r Force =	550	lbs/per bolt	Total # of b	oits/Unit :	= 4	
		or 1,284 lbs t	-		shear long	itudinal dire	ction		
De		// 1,204 IDS L	ension,	000 105.	silear, iong				

Site Specific Engineering Required

RMJ 241 Joaquin Ave. San Leandro, CA 510.991.0977			Crenlo High Se	eismic	Job No. : By:	14273 MAS	Date Page	: 04/06/15 : 27
Load Case: <u>Single Unit (≤ 50% of Bldg. Ht.)</u> (i.e. 2nd floor of a 4 story building or 4th floor of an 8 story building)								
Unit Dimens	sions					Sei	smic Fo	orce
Width(w) (in) =	20.75					S _{DS} =	1.83	High Seismic
Depth(D) (in) =	17					I _p =	1.0	(Importance)
Frame Height (in) =	82.375					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	800		Center	of Gravit	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.)
10-Series	Frame+Contents	800	8.5	10.375	41.1875	F _p =	0.587	W
						F _{p,min} =	0.55	W
Longitudinal Anchorag	ge Spacing (in) =	20.75				F _{p,max} =	2.93	W
Transverse Anchorag	e Spacing (in) =	17				Use F _p =	0.587	W
$\frac{\text{Longitudinal Overturning}}{\text{Moment = } 0.59 (41.1875 \text{ in. x 800lbs.}) = 19,331 \text{ lb-in}}{0.9 \text{x} \text{Resisting}} = 0.9 [(800 \text{ lbs Vert. Comp.}) \times (8.5 \text{in.})] = 3,876 \text{ lb-in}}{\text{Vertical Component (} 0.2^* \text{SDS*Wp)} = 293 \text{ lbs}} = 293 \text{ lbs}}$								
Total # of Bolts = 4 Anchorage Force = 1,136 lbs/per bolt Shear Force = 587 lbs/per bolt Image: Comparison of the second sec								
Des Transverse Over	•	or 1,136 lbs t	ension,	587 lbs.	shear, long		ction eries uni	t Plan

Overturning Moment = 0.59 (41.1875 in. x 800lbs.) = 19,331 lb-in 0.9xResisting Transverse 20.75 in. Seismic Force (F_p) Moment = 0.9 [(800 lbs. - Vert. Comp.) x (10.375in)]= 4,731 lb-in Vertical Component (0.2*SDS*Wp) = 293 lb-in \mathbf{X} Total # of Bolts = 4 Anchorage Force = 880 lbs/per bolt Shear Force = 587 lbs/per bolt 17 in. Anchorage and Shear Force Increased by Overstrength Factor Design Bolts for 880 lbs tension, 587 lbs. shear, longitudinal direction

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

RMJ 241 Joaquin Ave. San Leandro, CA 94577 510.991.0977

Crenlo

High Seismic

Job No. : 14273 Date: 04/06/15 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 Dimens	iono					Sai	ismic F	orco
	20.75	Deise	d Eleer -	10	in			
Width(w)(in) =		Raise	d Floor =	18	in	S _{DS} =	1.83	High Seismic
Depth(D) (in) =	17					I _p =	1.0	(Importance)
Frame Height (in) =	82.375					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	800				ty Location	R _p =	2.5	(Cabinets)
Unit 40 Corrigo	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	z/h =	0.5	(50% of bldg ht.)
10-Series	Frame+Contents	800	8.5	10.375	59.1875	F _p =	0.587	W
	e	00.75				F _{p,min} =	0.55	W
Longitudinal Anchorag		20.75				F _{p,max} =	2.93	W
Transverse Anchorag	e Spacing (in) =	17				Use F _p =	0.587	W
						Ω =	2.5	Overstrength
Longitudinal Ove	erturning					<u>10-S</u>	eries un	<u>it Plan</u>
Overturning Moment =		0.59 (59.1875 in.)	(800lbs) =	27 779	lh-in	F	<u>।</u>	V
Woment -		0.59 (59.1075 11.)	(000105.) –	21,113				T
0.9xResisting								Seismic
Moment =		lbs Vert. Comp.	· · · -	3,876	lb-in	Forc	e (F _p)	
	Vertical	Component (0.2*S	SDS*Wp) =	293	lbs			20.75 in.
Total # of Bolts =	4	Anchorage	e Force =	1,758	lbs/per bolt	1 ^L	<u></u>	Ł
			r Force =	587	lbs/per bolt		\mathbf{x}	
Anchorage and Shear	r Force Increa	sed by Overstr	ength Fac	ctor		1	17 in.	
Doc	aign Bolto fr	x 1 759 lbc t	oncion	597 lbo	aboar long	uitudinal dira	otion	
Des	SIGH DOILS IC	or 1,758 lbs t	ension,	507 105.	Silear, long		ction	
Transverse Over	turning					10 8		it Blon
Overturning	turning					10-30	eries un	
Moment =		0.59 (59.1875 in.)	(800lbs) -	27 770	lh_in	Γ		ŕ
Woment -		0.59 (59.1875 11.5	(000105.) –	21,119				
0.9xResisting						Tran	sverse	20.75 in.
Moment =	0.9 [(800 lbs.	- Vert. Comp.) x (1	0.375in.)]=	4,731	lb-in	Seis	mic For	ce (F _p)
	Vertical Compone	ent (0.2*SDS*Wp*	10.375in) =	293	lb-in			
							<u> </u>	Ł
Total # of Bolts =	4	Anchorage	Eorce =	1,388	lbs/per bolt] .	+	•
		•	r Force =	587	lbs/per bolt	1	17 in.	
Anchorage and Shear						4		
Des	sign Bolts fo	or 1,388 lbs t	ension,	587 lbs.	shear, long	jitudinal dire	ction	

Site Specific Engineering Required

RMJ			Crenlo					
241 Joaquin Ave.			High Se	eismic				
San Leandro, CA	94577		-		Job No. :	14273	Date	e: 04/06/15
510.991.0977					By:	MAS	Page	e: 29
Load Case:	<u>Ganged Ur</u>	<u>nit (≤ 50% of</u>	Bldg. H	<u>lt.)</u>				
# of Units gan	and (min)-	3						
# Or Onits gan	geu (mm)-	5				Se	ismic F	orce
Single Unit Dim	ension					S _{DS} =	1.83	High Seismic
		=				005	1.05	righ Seismic
Width(w) (in) =	20.75					I _p =	1.0	(Importance)
Depth(D) (in) =	17					a _p =	1.0	(Cabinets)
Frame Height (in) =	82.375					R _p =	2.5	(Cabinets)
Max Weight (lb.) =	1,100		Center	of Gravit	y Location	z/h =	0.5	(50% of bldg ht.)
Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)	F _p =	0.587	W

29

0.59 (41.1875 in. x 3300lbs.) = 79,739 lb-in

10.375

41.1875

Longitudinal Anchorage Spacing (in) = 45 Transverse Anchorage Spacing (in) = 20.75

Frame+Contents

Longitudinal Overturning

3 - 10-Series

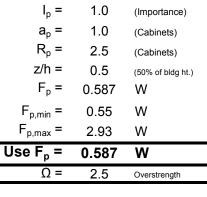
Overturning Moment =

0.9xResisting Moment = 0.9 [(3300 lbs. - Vert. Comp.) x28.5 in.]= 53,609 lb-in Vertical Component (0.2*SDS*Wp) = 1,210 lbs

Anchorage Force =

Shear Force =

3,300



Longitudinal Seismic Force

Ganged 10-Series unit Plan

3 ganged units

Total # of bolts/Unit = 4

Anchorage and Shear Force Increased by Overstrength Factor

Design Bolts for 363 lbs tension, 807 lbs. shear, longitudinal direction

363

807

lbs

lbs/per bolt

Transverse Overturning

Overturning					Ganged 10-Series unit Plan				
Moment =	0	.59 (41.1875 in. x 3300lbs.) =	79,739	lb-in	Transverse Seismic Force				
0.9xResisting Moment =		- Vert. Comp.) x10.375 in.] = Component (0.2*SDS*Wp) =		lb-in lbs					
					3 ganged units				
		Anchorage Force =	1,209	lbs/per bolt	Total # of bolts/Unit = 4				
		Shear Force =	807	lbs/per bolt					
Anchorage and Shear	Force Increa	sed by Overstrength Fac	tor						
Desi	Design Bolts for 1,209 lbs tension, 807 lbs. shear, longitudinal direction								

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

RMJ 241 Joaquin Ave. San Leandro, CA 510.991.0977	94577	it on 40in m	Crenlo High Se			MAS	Page	: 04/06/15 : 30
Load Case:			aised coi	mputer	<u>floor (≤ 50%</u>	<u>% of Blag. H</u>	<u>t.)</u>	
# of Units gar	iged (min)=	3						
Single Unit Din	nension	Raised Floor = 18			in	Seismic Force		
Width(w) (in) =	20.75					S _{DS} =	1.83	High Seismic
Depth(D) (in) =	17					I _p =	1.0	(Importance)
Frame Height (in) =	82.375					a _p =	1.0	(Cabinets)
Max Weight (lb.) =	800		Center	of Gravi	ty Location	R _p =	2.5	(Cabinets)
Unit	Part	Weight (lbs)		Y (in)	Z (in)	z/h =	0.5	(50% of bldg ht.)
3 - 10-Series	Frame+Contents	2,400	29	10.375	59.1875	F _p =	0.587	W
						F _{p,min} =	0.55	W
Longitudinal Anchorag	ge Spacing (in) =	45				F _{p,max} =	2.93	W
Transverse Anchorag	ge Spacing (in) =	20.75				Use F _p =	0.587	W
						Ω =	2.5	Overstrength
Longitudinal Ove	erturning							
Overturning Moment =	0	EQ (EQ 1975 in y	2400lba) -	83 336	lh in	Gangod	10-Sorios	s unit Plan
Woment -	0	.59 (59.1875 in. x	2400IDS.) =	63,330	10-111	Longitudir		
0.9xResisting								<u> </u>
Moment =		0.9 (2400 lbs.						
		Vert. Comp. (0.2	*SDS*Wp)=	880	lbs	0 0	0 0 0	0
						3	3 ganged	units
		Anchorage	e Force =	616	lbs/per bolt		gangea	dinto
			r Force =	587	lbs/per bolt	Total # of b	olts/Unit :	= 4
Anchorage and Shea			<u> </u>			4	41	
De	esign Bolts 1	for 616 lbs te	ension, 5	87 IDS.	snear, longi	tudinal direc	ction	
<u>Transverse Over</u> Overturning Moment =).59 (59.1875in. x	2400lbs.) =	83,336	lb-in	-	10-Series verse Seisi	<u>s unit Plan</u> nic Force
0.9xResisting						0		<u> </u>
Moment =	0.9 [(2400 lbs	- Vert. Comp.) x1	0.375 in.] =		lb-in			
	Vertical	Component (0.2*	SDS*Wp) =	880	lb-in	0	• • •	0 0
						. 3	B ganged	units
		Anchorage		1,388	lbs/per bolt	_ ,		
Anchorage and Shae	r Force Increa		r Force =	587	lbs/per bolt	Total # of b	olts/Unit :	= 4
Anchorage and Shear Force Increased by Overstrength Factor Design Bolts for 1,388 lbs tension, 587 lbs. shear, longitudinal direction								
De		. 1,000 103 1			Silvar, iong		5001	
[oifie From					

Site Specific Engineering Required



RMJ

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

Drawing Details

241 Joaquin Ave. 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.

Design live loads: Importance Factor 1.0 Seismic Design Category (SDC).... VARIES Maximum Value of Ss..... 2.75

<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 members.

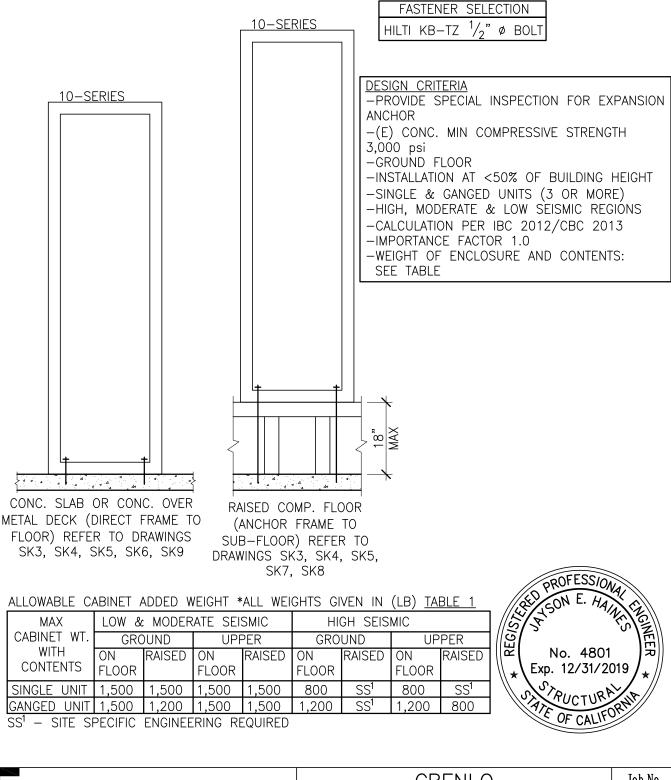
FASTENERS

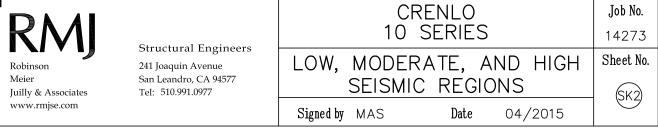
<u>Wedge Anchors</u>: Hilti Kwik Bolt Wedge Anchor, types as indicated per ICBO evaluation report No. 1917 or by manufacture having current ICBO evaluation report with values in shear and tension) equal or greater.



RMJ	Structural Engineero	CRE 10 SI	Job No. 14273		
Robinson Meier Juilly & Associates	Structural Engineers 241 Joaquin Avenue San Leandro, CA 94577 Tel: 510.991.0977	LOW, MODERA SEISMIC	•		Sheet No.
www.rmjse.com		Signed by MAS	Date	04/2015	
					•

DESIGN SCENARIOS AND CONDITIONS





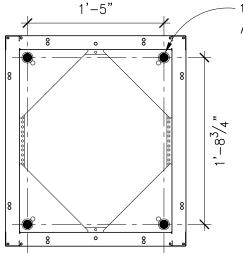
NOTES: *POSITION BOLTS IN OUTER OR UPPER HALF OF SLOTTED BOLT HOLES WHERE APPLICABLE *SEE MANUFACTURE DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF 10-SERIES UNITS

INSTALLATION FOR THE FOLLOWING CONDITIONS:

1. ALL (EXCEPT SUBBASE)

CONDITION SCHEDULE

CONDITION	<u>SEE</u>
CONCRETE SLAB	SK6
CONCRETE FILL OVER METAL DECK	SK7
RAISED COMP. FLOOR CONC. FILL METAL DECK	SK8
RAISED COMP. FLOOR CONC. SLAB	SK9

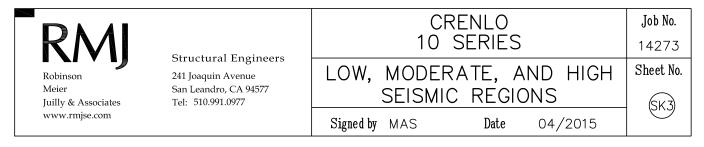


1/2"Ø HILTI KB-TZ EXPANSION ANCHOR, at <u>4</u> LOCATIONS

SINGLE UNIT BOTTOM PLAN VIEW







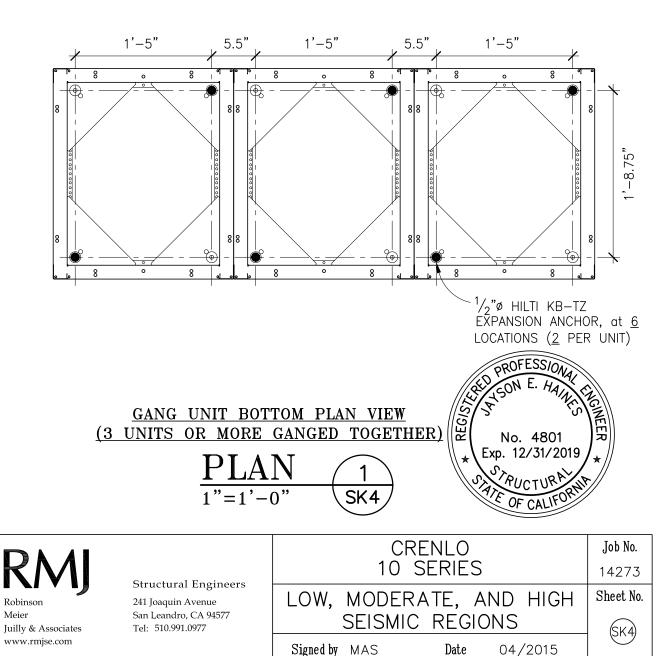
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RAISED COMP. FLOOR CONC. SLAB	SK9



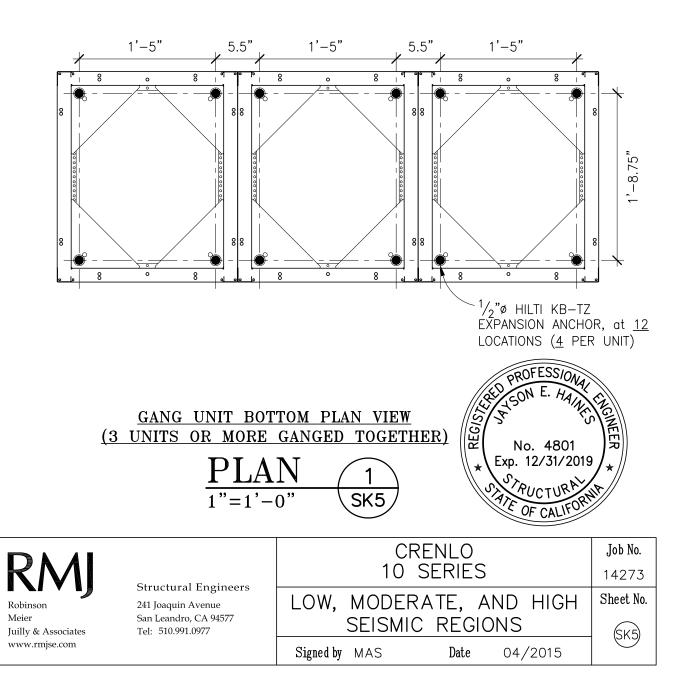
NOTES: *POSITION BOLTS IN OUTER OR UPPER HALF OF SLOTTED BOLT HOLES WHERE APPLICABLE *SEE MANUFACTURE DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF 10-SERIES UNITS

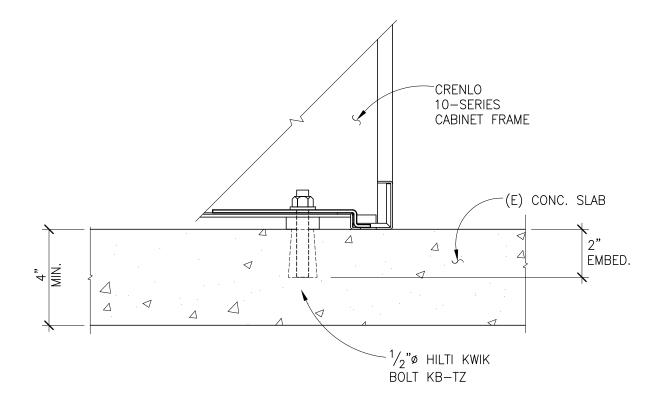
INSTALLATION FOR THE FOLLOWING CONDITIONS:

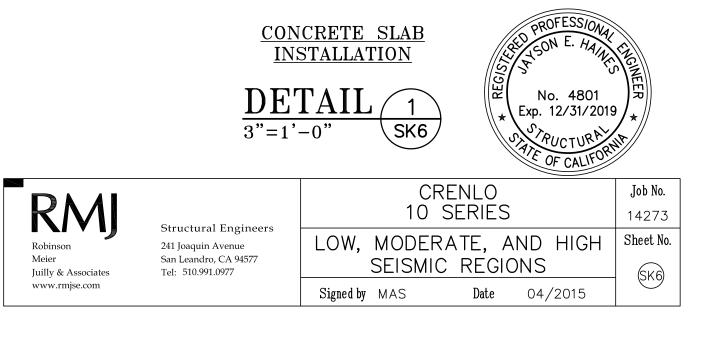
1. ALL (EXCEPT SUBBASE)

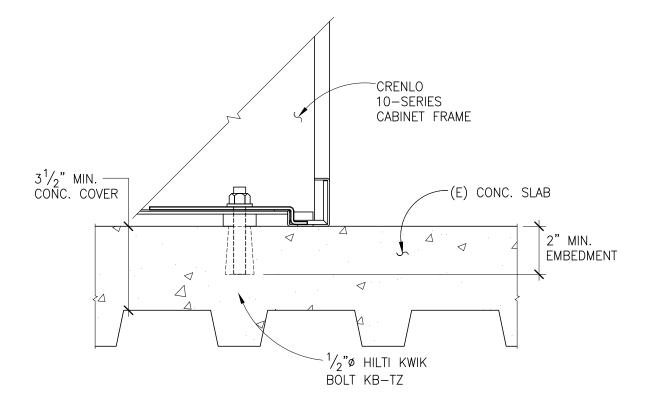
CONDITION SCHEDULE

CONDITION	<u>SEE</u>
CONCRETE SLAB	SK6
CONCRETE FILL OVER METAL DECK	SK7
RAISED COMP. FLOOR CONC. FILL METAL DECK	SK8
RAISED COMP. FLOOR CONC. SLAB	SK9

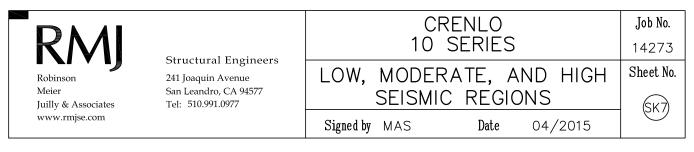


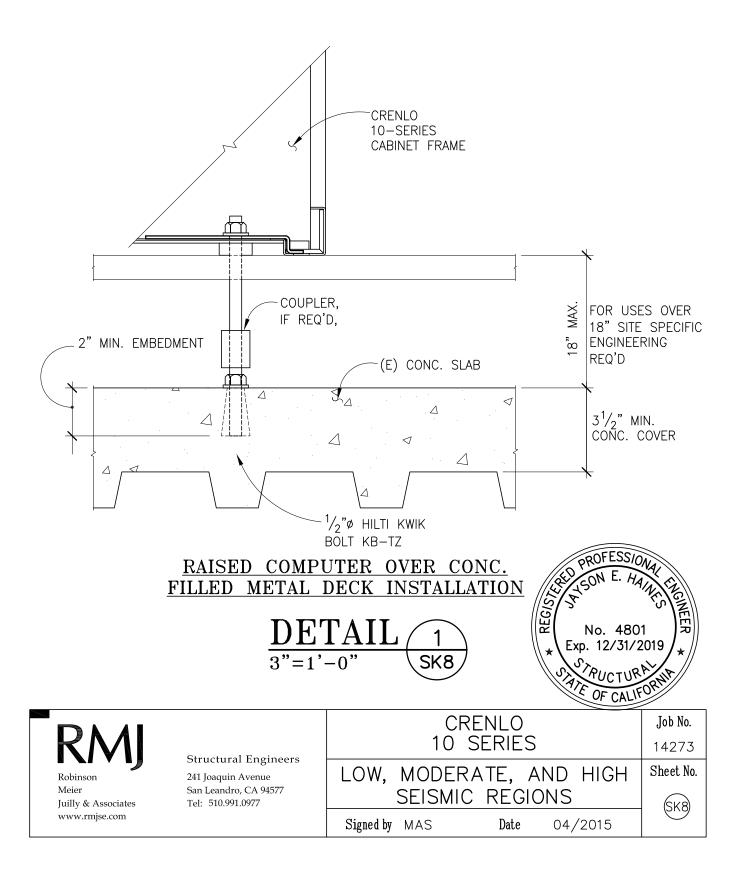


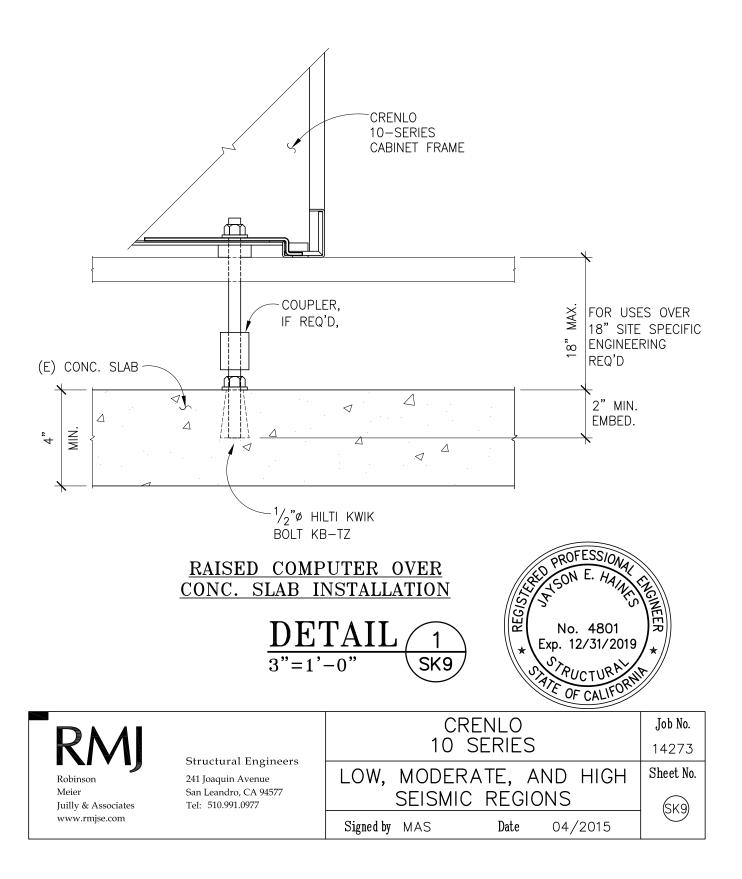














Robinson Meier Juilly & Associates

RMJ

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

Appendix

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Company: Specifier: Address: Phone I Fax: E-Mail:

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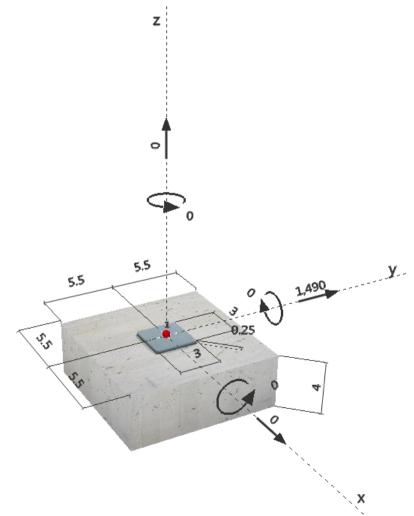
RMJ Mario 241 Joaquin Ave. 510.991.0977 | msigala@rmjse.com Page: Project: Sub-Project I Pos. No.: Date: 1 Creno-10-Series 14273 4/6/2015

Specifier's comments: 10-Series: SINGLE ANCHOR, Maximum Shear 1,490# 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]





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Company:
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2 Creno-10-Series 14273 4/6/2015

2 Load case/Resulting anchor forces Load case: Design loads ĻУ Anchor reactions [lb] Tension force: (+Tension, -Compression) Shear force y Anchor Tension force Shear force Shear force x 1490 0 1490 1 0 max. concrete compressive strain: - [‰] max. concrete compressive stress: - [psi] 0 [lb] resulting tension force in (x/y)=(0.000/0.000): resulting compression force in (x/y)=(0.000/0.000): 0 [lb] **3** Tension load

Load N _{ua} [lb]	Capacity _o N _n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
N/A	N/A	Ň/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
	N/A N/A	N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A

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



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Company:	RMJ	Page:	3
Specifier:	Mario	Project:	Creno-10-Series
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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*	1490	3572	42	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	1490	1844	81	OK
Concrete edge failure in direction y+**	1490	1499	100	OK
		``````````````````````````````````````		

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

## 4.1 Steel Strength

V _{sa,eq} = ESR value	refer to ICC-ES ESR-1917
_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]	Østeel	_φ V _{sa} [lb]	V _{ua} [lb]
5495	0.650	3572	1490

## 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)
$_{\phi}$ 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
$A_{Nc0} = 9 h_{ef}^2$	ACI 318-11 Eq. (D-5)
$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N}{3 h_{ef}}}\right) \le 1.0$	ACI 318-11 Eq. (D-8)
$\psi_{\text{ed,N}} = 0.7 + 0.3 \left( \frac{\text{c}_{a,\text{min}}}{1.5\text{h}_{\text{ef}}} \right) \le 1.0$	ACI 318-11 Eq. (D-10)
$\begin{split} \psi_{\text{cp,N}} &= \text{MAX}\left(\frac{c_{a,\min}}{c_{ac}}, \frac{1.5h_{\text{ef}}}{c_{ac}}\right) \leq 1.0\\ N_{\text{b}} &= k_{\text{c}} \lambda_{a} \sqrt{f_{\text{c}}} h_{\text{ef}}^{1.5} \end{split}$	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

k _{cp}	h _{ef} [in.]	e _{c1,N} [in.]	e _{c2,N} [in.]	c _{a,min} [in.]		
1	2.000	0.000	0.000	5.500		
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	Ψec2,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]	∳concrete	∮seismic		$_{\phi}$ V _{cp} [lb]	V _{ua} [lb]	
2634	0.700	1.000	1.000	1844	1490	



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#### 4.3 Concrete edge failure in direction y+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vco}}\right) \psi_{ed,V} \psi_{c,V} \psi_{h,V} \psi_{parallel,V} V_{b}$	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)
$\psi_{\text{ec,V}} = \left(\frac{1}{1 + \frac{2e_v}{3c_{a1}}}\right) \le 1.0$	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)
$V_{b} = \left(7 \left(\frac{I_{e}}{d_{a}}\right)^{0.2} \sqrt{d_{a}}\right) \lambda_{a} \sqrt{I_{c}} c_{a1}^{1.5}$	ACI 318-11 Eq. (D-33)

#### Variables

c _{a1} [in.]	c _{a2} [in.]	e _{cV} [in.]	<u>ψc,ν</u>	h _a [in.]	
3.667	5.500	0.000	1.000	4.000	
l _e [in.]	<u>λa</u>	d _a [in.]	f _c [psi]	₩parallel,V	
2.000	1.000	0.500	3000	1.000	
Calculations					
A _{vc} [in. ² ]	A _{Vc0} [in. ² ]	ψ _{ec,V}	Ψed,V	Ψh,v	V _b [lb]
44.00	60.50	1.000	1.000	1.173	2512
Results					
V _{cb} [lb]	¢concrete	¢seismic	φnonductile	_φ V _{cb} [lb]	V _{ua} [lb]
2142		1.000	1.000	1499	1490

## **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 Ω₀.
- 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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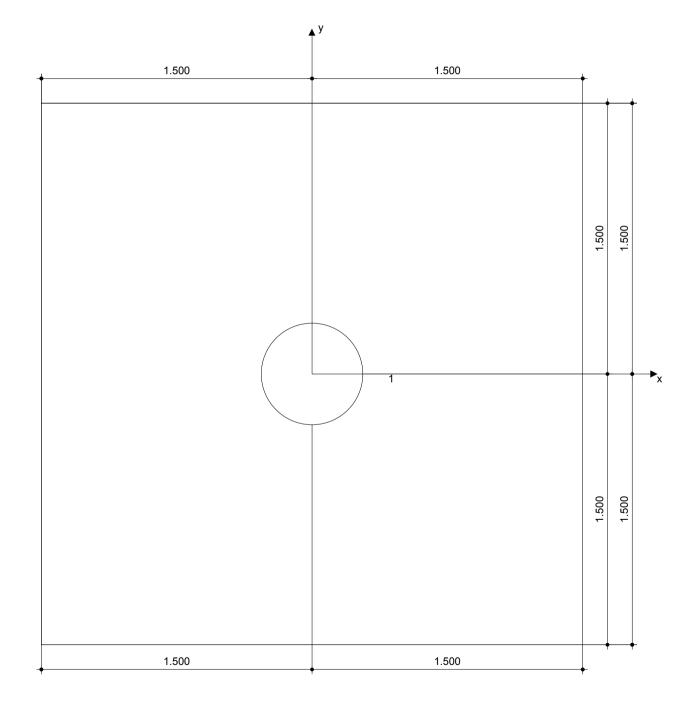
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# 6 Installation data

Anchor plate, steel: -

Profile: no profile; 0.000 x 0.000 x 0.000 in.Installation torHole diameter in the fixture:  $d_f = 0.563$  in.Hole diameterPlate thickness (input): 0.250 in.Hole depth in tRecommended plate thickness: not calculatedMinimum thickCleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ - CS 1/2 (2) Installation torque: 480.001 in.lb Hole diameter in the base material: 0.500 in. Hole depth in the base material: 2.625 in. Minimum thickness of the base material: 4.000 in.



## Coordinates Anchor in.

Anchor	х	У	С _{-х}	C+x	c_y	c _{+y}	
1	0.000	0.000	5.500	5.500	5.500	5.500	

Input data and results must be checked for agreement with the existing conditions and for plausibility! PROFIS Anchor ( c ) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan



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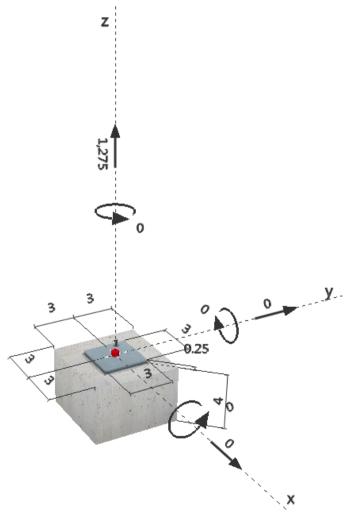
1 Creno-10-Series 14273 4/6/2015

Specifier's comments: 10-Series: 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 _{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:	I _x x I _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
	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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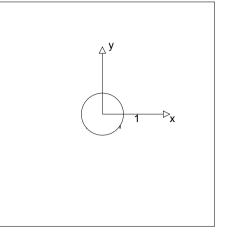
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# 2 Load case/Resulting anchor forces

Load case: Design loads

## Anchor reactions [lb]

Tension force: (-	Tension, -Compre	ssion)		
Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1275	0	0	0
max. concrete c	ompressive strain:		- [‰]	
max. concrete c	ompressive stress:		- [psi]	
resulting tension	force in $(x/y)=(0.00)$	00/0.000):	1275 [lb]	
resulting compre	ession force in (x/y)	=(0.000/0.000)	: 0 [lb]	
<b>o</b> .		· · · ·		



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

#### 3.1 Steel Strength

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

#### Variables

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



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#### 3.2 Concrete Breakout Strength

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_{b}$	ACI 318-11 Eq. (D-3)
$_{\phi}$ N _{cb} ≥ N _{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)
$\begin{split} \psi_{cp,N} &= MAX \left( \frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0\\ N_{b} &= k_{c} \lambda_{a} \sqrt{l_{c}} h_{ef}^{1.5} \end{split}$	ACI 318-11 Eq. (D-12)
$N_{\rm b} = k_{\rm c} \lambda_{\rm a} \sqrt{f_{\rm c}} h_{\rm ef}^{1.5}$	ACI 318-11 Eq. (D-6)
Variables	

### Variables

h _{ef} [in.]	e _{c1,N} [in.]	e _{c2,N} [in.]	c _{a,min} [in.]	Ψc,N		
2.000	0.000	0.000	3.000	1.000		
c _{ac} [in.]	k _c	λa	f _c [psi]			
5.500	17	1.000	3000			
Calculations						
A _{Nc} [in. ² ]	A _{Nc0} [in. ² ]	Wec1,N	Wec2,N	Wed,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	∲nonductile	$_{igoplus}$ N _{cb} [lb]	N _{ua} [lb]
2634	0.650	0.750	1.000	1284	1275



		Profis Anchor 2
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Mario	Project:	Creno-10-Series
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

	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
• enclosed by the state of the	*			

* 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 Oo.
- · 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!



Company: Specifier: Address: Phone I Fax: E-Mail:

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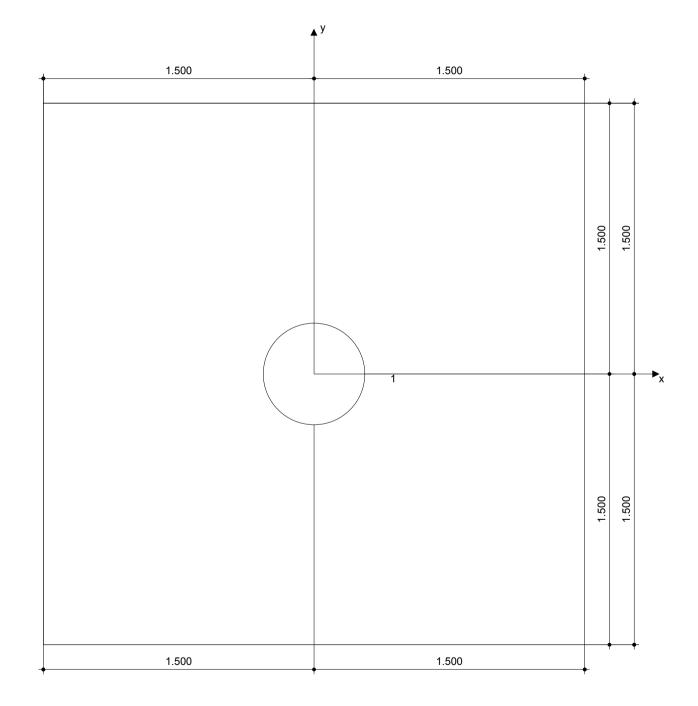
Page: Project: Sub-Project I Pos. No.: Date: 5 Creno-10-Series 14273 4/6/2015

# 6 Installation data

Anchor plate, steel: -

Profile: no profile; 0.000 x 0.000 x 0.000 in.Installation torHole diameter in the fixture:  $d_f = 0.563$  in.Hole diameterPlate thickness (input): 0.250 in.Hole depth in tRecommended plate thickness: not calculatedMinimum thickCleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: Kwik Bolt TZ - CS 1/2 (2) Installation torque: 480.001 in.lb Hole diameter in the base material: 0.500 in. Hole depth in the base material: 2.625 in. Minimum thickness of the base material: 4.000 in.



## Coordinates Anchor in.

Anchor	x	У	С _{-х}	C+x	C_y	c _{+y}	
1	0.000	0.000	3.000	3.000	3.000	3.000	

Input data and results must be checked for agreement with the existing conditions and for plausibility! PROFIS Anchor ( c ) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan